NASA SP-7037(192) October 1985



Aeronautical Engineering A Continuing Bibliography with Indexes

> National Aeronautics and Space Administration

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ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series) N85-27821 - N85-29909

IAA (A-10000 Series)

A85-36853 - A85-39960

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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 192)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in September 1985 in

- Scientific and Technical Aerospace Reports (STAR)
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INTRODUCTION

This issue of Aeronautical Engineering -- A Continuing Bibliography (NASA SP-7037) lists 626 reports, journal articles, and other documents originally announced in September 1985 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA).

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes -- subject, personal author, corporate source, foreign technology, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies of accessions are available at \$8.50 per document. Microfiche⁽¹⁾ of documents announced in *IAA* are available at the rate of \$4.00 per microfiche on demand. Standing order microfiche are available at the rate of \$1.45 per microfiche for *IAA* source documents.

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A11	226-250	20 50	41 00
A12	251-275	22 00	44 00
A13	276-300	23 50	47 00
A14	301-325	25 00	50 00
A15	326-350	26 50	53 00
A16	351-375	28 00	56 00
A17	376-400	29 50	59 00
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TABLE OF CONTENTS

	Page
Category 01 Aeronautics (General)	615
Category 02 Aerodynamics Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.	617
Category 03 Air Transportation and Safety Includes passenger and cargo air transport operations; and aircraft accidents.	638
Category 04 Aircraft Communications and Navigation Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.	642
Category 05 Aircraft Design, Testing and Performance Includes aircraft simulation technology.	645
Category 06 Aircraft Instrumentation Includes cockpit and cabin display devices; and flight instruments.	655
Category 07 Aircraft Propulsion and Power Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.	657
Category 08 Aircraft Stability and Control Includes aircraft handling qualities; piloting; flight controls; and autopilots.	673
Category 09 Research and Support Facilities (Air) Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.	, 681
Category 10 Astronautics Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.	685
Category 11 Chemistry and Materials Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.	686

Category 12 Engineering Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.	692
Category 13 Geosciences Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.	701
Category 14 Life Sciences Includes sciences (general); aerospace medicine; behavioral sciences; man/ system technology and life support; and planetary biology.	N.A .
Category 15 Mathematics and Computer Sciences Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.	703
Category 16 Physics Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.	704
Category 17 Social Sciences Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.	705
Category 18 Space Sciences Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.	N.A.
Category 19 General	N.A .

Subject Index A-1
Personal Author Index B-1
Corporate Source Index C-1
Foreign Technology Index D-1
Contract Number Index E-1
Report Number Index F-1
Accession Number Index

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TYPICAL CITATION AND ABSTRACT FROM STAR

		AVAILABLE ON MICROFICHE
MBER	DEVELOPMENT AND APPLICATIONS OF ALGORITHMS FOR	CORPORATE
	CALCULATING THE TRANSONIC FLOW ABOUT	SOURCE
rLE	HARMONICALLY OSCILLATING WINGS	
	F E EHLERS, W. H WEATHERILL, and E L YIP Oct 1984 ←	<u> </u>
	152 p refs	
ITHORS ————	—— (Contract NAS1-16297)	DATE
	(NASA-CR-172376, NAS 1 26 172376) Avail NTIS HC A08/MF	_
NTRACT	A01 CSCL 01A -	
GRANT	A finite difference method to solve the unsteady transonic flow	SOURCE
GIAN	about harmonically oscillating wings was investigated. The	SOURCE
	procedure is based on separating the velocity potential into steady	
PORT	and unsteady parts and linearizing the resulting unsteady differential	COSAT
MBER	equation for small disturbances. The differential equation for the	CODE
	unsteady velocity potential is linear with spatially varying coefficients	
	and with the time variable eliminated by assuming harmonic motion	
	An alternating direction implicit procedure was investigated, and a	
	pilot program was developed for both two and three dimensional	
	wings This program provides a relatively efficient relaxation solution	
	without previously encountered solution instability problems	
	Pressure distributions for two rectangular wings are calculated	
	Conjugate gradient techniques were developed for the asymmetric,	
	indefinite problem. The conjugate gradient procedure is evaluated	
	for applications to the unsteady transonic problem Different	
	equations for the alternating direction procedure are derived using	
	a coordinate transformation for swept and tapered wing planforms	
	Pressure distributions for swept, untaped wings of vanishing	
	thickness are correlated with linear results for sweep angles up	
	to 45 degrees. EA.K	

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UMBER —	A VORTEX-LATTICE METHOD FOR GENERAL, UNSTEADY	TITLE
	AERODYNAMICS	
r		
UTHORS	NAYFEH, and L. WATSON (Virginia Polytechnic Institute and State -	AUTHOR'S
	University Blacksburg VA) Journal of Aircraft (ISSN 0021-8669)	AFFILIATION
	vol 22 Jan 1985, p 43-49 refs	
TLE OF	(Contract N00014-79-C-0103, NSG-1262)	
ERIODICAL	A general method of calculating unsteady, incompressible	
	inviscid, three-dimensional flows around arbitrary planforms has	DATE
	been developed. The method is an extension of the vortex-lattice	
	technique. It is not limited by aspect ratio, camber, or angle of	
	attack, as long as vortex breakdown does not occur above the	
	surface of the wing and separation occurs only along sharp edges	
	As the wing performs arbitrary maneuvers the position of the	
	wake and the distribution of circulation on the wing and in the	
	wake and the distribution of circulation of the wing and in the	
	the present method is its ability to treat steady lifting flows very	
	efficiently Several examples of steady and unsteady flows are	
	presented These include rectangular wings, with and without flaps,	
	delta, and cropped delta wings Author	

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 192)

OCTOBER 1985

01

AERONAUTICS (GENERAL)

A85-37176

ISRAEL ANNUAL CONFERENCE ON AVIATION AND ASTRONAUTICS, 26TH, HAIFA, ISRAEL, FEBRUARY 8, 9, 1984, COLLECTION OF PAPERS

Conference supported by Technion - Israel Institute of Technology, Tel Aviv University, Ministry of Defence of Israel, et al Haifa, Israel, Technion - Israel Institute of Technology, 1984, 358 p For individual items see A85-37177 to A85-37213.

The experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures is considered along with an unsteady wake model of the aerodynamic behavior of a rotor in forward flight, the influence of fighter aircraft load spectrum variations on fatigue crack initiation and growth, a fatigue life evaluation program for the Kfir aircraft, computer-aided tube routing design in aircraft, and a pursuit evasion game with a limited detection range Attention is given to a crack growth analysis in multiple load path structure, the crack propagation analysis of longitudinal skin cracks in a pressurized cabin, a supersonic panel method based on the triplet singularity, a method to estimate the service life of a case bonded rocket engine, and computational aerodynamics and supercomputers. Other topics explored are related to the concepts and application of aircraft damage tolerance analysis, the influence of initial imperfections on nonlinear free vibration of elastic bars, and wing optimization and fuselage intergration for future generations of supersonic aircraft. GR

A85-37183#

COMPUTER AIDED TUBE ROUTING DESIGN IN AIRCRAFTS

A. MINKOV (Israel Arcraft Industries, Ltd., Tel Aviv, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 41-47.

The routing design process in the case of the tubes and harnesses of an aircraft is different from the design procedures which are followed for mechanical parts and structures. Thus, problems not foreseen in the design stage at the drawing board can arise later, and time-consuming adjustment procedures become necessary. It is, therefore, highly desirable to develop more efficient procedures for tube routing design in aircraft manufacture. The present investigation is concerned with the development of such procedures. The employment of better tools for handling aircraft tubing is discussed, taking into account production tools and design tools. Particularly useful appears to be an approach which is based on the utilization of a computer. Attention is given to the CATS (Computer Aided Tube data storage) software which was developed for the required computer operations.

A85-38236

DEVELOPMENT IN UK ROTOR BLADE TECHNOLOGY

R. W WHITE (Westland Helicopters, Ltd, Yeovil, Somerset, England) Future, Spring 1985, p 31-40. Research supported by the Ministry of Defence.

An account is given of the development history of the British Experimental Rotor Program (BERP), which has been concerned with the production of an aerodynamically innovative composite rotor blade for helicopters of Lynx and W30 type. The BERP rotor is distinguished by a paddle-like tip which furnishes aerodynamic efficiency benefits in the advancing and retreating blade regimes, while decoupling advancing and rotating blade dynamic behavior. The blade also provides more than 30 percent greater thrust than conventional designs, and extends the forward speed potential of the edgewise rotor to more than 200 kts. Attention is given to the development of a glass-carbon fiber hybrid reinforcement for the composite blade, and to its laminate's prepreg layup and molding methodology, which is highly automated O.C.

A85-38301

SCIENTIFIC BALLOONING - IX; PROCEEDINGS OF THE SEVENTH SYMPOSIUM, GRAZ, AUSTRIA, JUNE 25-JULY 7, 1984

W. RIEDLER, ED and K TORKAR, ED. (Oesterreichische Akademie der Wissenschaften, Institut fuer Weltraumforschung, Graz, Austria) Symposium sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol 5, no 1, 1985, 135 p In English and French For individual items see A85-38302 to A85-38326.

Selected topics pertaining to scientific ballooning are discussed. Papers are presented on recent materials problems relating to catastrophic balloon failures, stratospheric flights with large polyethylene balloons from equatorial latitudes, a new reeling technique for very long extension scanning system for X-ray astronomy. Consideration is given to attitude determination in a limb-scanning balloon radiometer, balloon-borne high-altitude gravimetry, solar and cosmic X-ray and gamma-ray studies with long-duration balloon flighs, and the role of scientific ballooning for the exploration of the magnetosphere. M.D.

A85-38353#

MAN-POWERED AIRCRAFT

H. KIMURA and A. NAITO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no 360, 1984, p. 15-22. In Japanese. refs

A historical review on the developments in man-powered aircraft in Japan is presented. The first man-powered aircraft, Linnet I, was developed by Nihon University in 1966, and Storke B of Nihon University achieved a 2093-m straight line flight in 1977. In 1980 the main wing of Ibis also of Nihon University was built with carbon fiber composites and an aluminum alloy. The Gossamer series are analyzed and compared with Milan 82, Ibis, and Storke B of Nihon University. S H

A85-38439

ULTRALIGHTS BREAK THE RULES

I. GOOLD Flight International (ISSN 0015-3710), vol. 127, June 1, 1985, p. 175-177.

In the 1980-1983 period, general aviation aircraft deliveries fell significantly while purchase prices and operating costs increased.

01 AERONAUTICS (GENERAL)

The growth of ultralight aircraft purchases for that period, by contrast, are noted by an FAA report to have been exceptionally high, with 60 manufacturers in the U.S. alone producing a total of 25,000 ultralights to date at the rate of 7000 units/year. While the average price of an ultralight in the U.S. is \$4500-6500, with averge hourly operating costs of about \$4, single piston-engined aircraft sell for \$60,000 and typically cost \$30-60/hr to operate. OC.

A85-38641

METHODS FOR THE ASSEMBLY OF AIRCRAFT STRUCTURES [METODY SBORKI SAMOLETNYKH KONSTRUKTSII]

A. I BABUSHKIN Moscow, Izdatel'stvo Mashinostroenie, 1985, 248 p. In Russian. refs

The book presents a systematic review of the engineering and organizational problems involved in the aircraft assembly process in relation to a specific method of assembly. Attention is given to the analytical evaluation of the accuracy of components for various methods of assembly; the effect of inaccuracies at the different stages of the assembly process on the final dimensions of components; and the correlation of the shapes and dimensions of components in various assembly processes. The discussion also covers approaches to the optimization of the assembly process and a cost-effectiveness analysis of assembly methods. VI

A85-38776

LIGHTER-THAN-AIR SYSTEMS CONFERENCE, 6TH, NORFOLK, VA. JUNE 26-28, 1985, TECHNICAL PAPERS

Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1985, 163 p. For individual items see A85-38777 to A85-38798.

The topics discussed cover the feasibility of airship-borne warning systems, the operation of tethered aerostats in a marine environment, an aerodynamic performance model for hybrid airship heavy lift systems, an experimental investigation of aerodynamic effects on a body of revolution in turning flight, the design and development of the GAC-20 airship, airship certification programs, the use of hydrogen as a lifting gas, and the use of source panel and vortex methods for aerodynamic solutions of airship configurations. Also covered are a wind tunnel investigation of airship configuration-lifting rotor interaction, the development status of the LTA 20-1 airship, thrust-vectored takeoff, landing and ground handling of an airship, the dynamic characteristics of the STARS aerostat, and Skyship-500 control response measurements. O.C.

A85-38797#

THE TETHERED AEROSTAT ANTENNA PROGRAM (TAAP) DEMONSTRATION PHASE

A. S. CARTEN, JR. (USAF, Geophysics Laboratory, Bedford, MA) and T. F. STOMPS (TCOM, Columbia, MD) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 142-152. Research sponsored by the U.S. Defense Communications Agency. refs (AIAA PAPER 85-0883)

The U.S. Air Force's Tethered Aerostat Antenna Program (TAAP) has designed, built, and tested a highly mobile, self-contained and quickly deployable demonstration model configured around the existing, 25,000-cu ft capacity STARS aerostat and mooring system. The TAAP aerostat's 3000-ft tether can be used as the antenna of a VLF transmitter to establish emergency communications with national security forces. Attention is-given_to_the_physical and electrical links between the tether/antenna and transmitter/tuner assembly, as well-as the telemetry subsystem used for monitoring of aerostat 'housekeeping' functions. The impact of corona effects on tether design and aerostat protection measures are noted. O.C.

A85-39068

REPAIRING COMMERCIAL AIRCRAFT JET ENGINE NACELLE COMPOSITE STRUCTURES

L. A HUGHES (Rohr Industries, Inc., Chula Vista, CA) Advances in aerospace propulsion: Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 121-133.

(SAE PAPER 841567)

Composite structures used in jet engine nacelle applications and advantages of this type of construction are briefly reviewed. Composite structures are designed to be durable components having a long service life, but damage from outside sources can occur on a random basis during operational service, necessitating repair or disposition of the damage. Sources of damage, types of damage, and inspection methods used for detecting damage are discussed. Specific repairs and elements of the repair process such as materials, tools and equipment, procedures and techniques are discussed in detail. Author

A85-39201

V/STOL: AN UPDATE AND OVERVIEW: PROCEEDINGS OF THE AEROSPACE CONGRESS AND EXPOSITION, LONG BEACH, CA. OCTOBER 15-18, 1984

Congress and Exposition sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-591), 1984, 114 p. For individual items see A85-39202 to A85-39209

(SAE SP-591)

Among the topics covered are a computer study of a jet flap-equipped Advanced Supersonic Short Takeoff and Vertical Landing aircraft, model test results of the 'split-fan' cross-ducted propulsion system concept for medium-speed V/STOL aircraft, the application of circulation control technology to propulsive high lift systems, and recent developments in the design of ejectors for V/STOL aircraft Also discussed are the estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage, a twin-tilt nacelle V/STOL configuration, the altitude testing of a flight-weight, self-cooled, two-dimensional vectoring exhaust nozzle, and the development of a pneumatic thrust deflector. O.C.

A85-39214#

PILOT PRODUCTION OF SUPERPLASTICALLY FORMED/DIFFUSION BONDED T-38 MAIN LANDING GEAR DOORS

W. LEODOLTER (McDonnell Douglas Corp., Airframe Research and Technology Div., Long Beach, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 568-572 (Contract F33615-80-C-5045)

(AIAA PAPER 84-0933)

This paper discusses the engineering development effort, the preliminary and final airworthiness gualification of a test door, and the manufacture of 30 titanium main landing gear strut doors for the T-38 aircraft using superplastic forming and concurrent diffusion bonding (SPF/DB) as the principal fabrication method. The structural concept of the new door is a variable thickness sandwich panel having an internal core structure with rectangular cells. The tooling concept and fabrication steps, from sheet preparation to final assembly and nondestructive testing, are described, with particular emphasis on those elements that contribute most to the process reliability. Cost analyses indicated that fabrication costs are sensitive to the cost and utilization of the titanium material. Although acquisition costs for the SPF/DB doors are higher than those for the currently used aluminum honeycomb doors, significant life-cycle cost savings can be achieved. The discussion on costs deviates from the standard and highlights the implications from the time lag between front-end investments and later benefit accrual as a potential barrier for technology implementation. Since-1983, the titanium doors have been used on U.S. Air Force aircraft.

Author

A85-39621#

ADVANCED TECHNIQUES FOR HEALTH AND USAGE MONITORING OF HELICOPTER TRANSMISSIONS

D. G. ASTRIDGE (Westland Helicopters, Ltd., Yeovil, Somerset, England) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs (AIAA PAPER-85-1142)

Recent advances in diagnostics and monitoring technology, particularly in quantitative debris monitoring and vibration analysis of helicopter transmissions in service with commercial airlines, are summarized. It is shown that the combination of the techniques with transmission usage monitoring, and health, performance, status, and usage monitoring of engines and rotor systems in a comprehensive on-board analysis system offers significant benefits in improved flight safety and reduced operating costs. The monitoring requirements of development testing and of production quality assurance testing are considered and the relevance of the technology to the emerging propeller-fan engine applications is indicated M.D.

N85-28912*# McLean (F. Edward), Yorktown, Va.

SUPERSONIC CRUISE TECHNOLOGY

F. E. MCLEAN Feb. 1985 194 p refs Original contains color illustrations

(Contract NASW-3531)

(NASA-SP-472; NAS 1.21:472, LC-83-26912) Avail: NTIS HC A09/MF A01; SOD HC \$6.50 as 033-000-00944-5 CSCL 01B

The history and status of supersonic cruise research is covered. The early research efforts of the National Advisory Committee for Aeronautics and efforts during the B-70 and SST phase are included. Technological progress made during the NASA Supersonic Cruise Research and Variable Cycle Engine programs are presented. While emphasis is on NASA's contributions to supersonic cruise research in the U.S., also noted are developments in England, France, and Russia. Written in nontechnical language, this book presents the most critical technology issues and research findings. Author

N85-28913# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

HELICOPTER AERÓMECHANICS

Loughton, England Apr 1985 329 p refs Lectures held in Brunswick, 2-3 May 1985, in Rome, 6-7 May 1985, and in St. Louis, 21-22 May 1985

(AGARD-LS-139; ISBN-92-835-1499-8) Avail: NTIS HC A15/MF A01

A variety of information relevant to helicopters is presented. Topics range from actual aerodynamic studies to computerized simulation as employed in flight simulators

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A85-36996*#

ROTARY-WING AERODYNAMICS. VOLUME 1 - BASIC THEORIES OF ROTOR AERODYNAMICS (WITH APPLICATION TO HELICOPTERS). VOLUME 2 PERFORMANCE PREDICTION OF HELICOPTERS (2ND REVISED AND ENLARGED EDITION) W. Z. STEPNIEWSKI and C. N. KEYS Research supported by the U.S. Army and NASA. New York, Dover Publications, Inc., 1984, 258 p. refs

Basic theories of rotor aerodynamics are presented and applied to the performance prediction of helicopters. The very simple physicomathematical model of the rotor offered by momentum theory is addressed first, followed by the combined blade-element and momentum theory. Vortex theory is discussed, and a rotor blade is modeled by means of a vortex filament or vorticity surface. Considerations of airfoil sections suitable for rotors are examined. Detailed performance techniques for a single-rotor helicopter in hover, vertical ascent, and forward flight are described, and winged and tandem-rotor helicopter performance calculations are presented as extensions and modifications of single-rotor methodology. Computer data based on the vortex theory are compared with approximate results obtained from the simplified momentum theory and the blade element solution. C.D

A85-37049#

INTERACTION OF TWIN TURBULENT CIRCULAR JET

M. YAGITA (Tokyo Institute of Technology, Tokyo, Japan), A. WATANABE (Japan Aircraft Manufacturing Co., Ltd., Yokohama, Japan), K. KAWAMURA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and T. OKAMOTO JSME, Bulletin (ISSN 0021-3764), vol. 28, April 1985, p. 617-622.

An experimental study of the interaction of a twin turbulent circular jet is presented The velocity and the static pressure of the jets were measured by varying the distance between two nozzles. The results of the twin-jet were compared with those of a jet parallel to a plane wall on the basis of the principle of reflected image The main results are as follows: (1) the twin-jet interacts and joins in the form of an ellipse at the downstream distance, becoming close to a circular jet at far downstream distances; (2) the position of maximum velocity of the twin-jet shifts from the axis of nozzle to the mid-point between the jets, (3) the positions of maximum velocity of the twin-jet and the jet parallel to a plane wall are expressed by similar curves for various nozzle distances, and (4) the difference between the characteristics of the twin-jet and those of the jet parallel to a plane wall is due to their different boundary conditions

A85-37178#

A NEW UNSTEADY PRESCRIBED WAKE MODEL OF THE AERODYNAMIC BEHAVIOR OF A ROTOR IN FORWARD FLIGHT

O RAND and A. ROSEN (Technion - Israel Institute of Technology, Haifa, Israel) IN Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 8-21. refs

A derivation of an unsteady prescribed wake model of the aerodynamics of an helicopter rotor in forward flight is presented. At the begining, expressions for the velocity which is induced at the 1st blade by all the wake elements and the bound vortices, is obtained The wake includes the free trailing vortices and shed vortices of all the blades. The bound vortices of the other blades ae modeled as lifting lines while the bound vortices of the 1st blade are described in more detail Chordwise bound vortices are also taken into account By applying the condition of non-penetration through the blade surface, a system of equations in the unknowns is obtained. The unknowns are the harmonics which compose the total circulations at the blade cross sections. In order to simplify the analysis, the velocity which is induced by the wake and the bound vortices of the other blades is calculated at a representative chordwise location. The model which is obtained is very general and contains new features compared with other models which have been reported in the literature. Example of using the model is presented and the theoretical results are compared with existing experimental results. Good agreement is obtained in most of the cases Author

A85-37191#

A SUPERSONIC PANEL METHOD BASED ON THE TRIPLET SINGULARITY

B. L. COLEMAN (Israel Aircraft Industries, Ltd., Tel Aviv, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 109-114 refs

Supersonic panel methods in general use employ sources or vortices to describe body panels. The piecewise nature of such

distributions prevents complete cancellation of internal radiation, and mutual interference occurs between panels on opposite sides of the body In consequence calculated wing pressures show spurous spatial oscillations. The triplet singularity proposed by Woodward and Landrum combines sources and vortices in proportions which greatly reduce the internal leakage. In their treatment the vortices are closed through ring triplets on the body. In this note trailing vortices are used, paralleling standard wing analysis, enabling complex configurations to be modeled. Author

A85-37194#

THE STABILITY OF SYMMETRICAL VORTICES IN THE WAKE OF ELLIPTICAL CYLINDERS IN CONFINED FLOW

A. KAROU and D. WEIHS (Technion - Israel Institute of Technology, Haifa, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 140-145. refs

A theoretical investigation of the stability of symmetrical vortex pairs in the wake of elliptical bodies in confined potential flow is presented. The stability around points of zero induced velocity was analyzed by the small perturbations method. It was found that a symmetrical vortex pair has four natural modes of oscillation. Two are constant amplitude symmetrical harmonic oscillations and two are diverging and converging asymmetrical oscillations, respectively These natural modes are independent of the body shape and wall distance. The frequency of the symmetrical oscillations decreases as the vortex strength increases and it moves downstream from the body. This frequency increases with the widening of the elliptical body and with the reduction in wall distance The rate of divergence of one asymmetrical oscillation is equal to the rate of convergence of the other and both decrease with increasing vortex strength in unconfined flow. In confined flow this rate remains unchanged when the vortices are close to the body, but as they move downstream and closer to the walls it becomes much larger relative to its values in unconfined flow. Author

A85-37197#

NONEQUILIBRIUM SUPERSONIC FLOWS PAST OSCILLATING 2-D LIFTING SURFACES AND THIN ELASTIC BODIES

L. LIBRESCU (Tel Aviv University, Tel Aviv, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 159-164. refs

The present study is concerned with the determination of the 2-D unsteady pressure field on lifting surfaces and thin elastic bodies harmonically oscillating in a non-equilibrium supersonic gas flow. The analysis assumes that a single relaxation process characterizes the flow and that transport phenomena are disregarded. By accounting for the finite-reaction-rate processes, two closed form solutions of the unsteady pressure field are obtained Their classical counterparts (for non-reactive flows) referred to as quasi-static and piston-theory aerodynamics are widely used in flutter analyses. The peculiarities of the obtained results involving qualitative and quantitative differences with respect to their frozen and equilibrium counterparts are pointed out. The work is intended to constitute a basis for a consistent evaluation of aeroelastic phenomena of lifting surfaces and panels placed in a supersonic reactive flow-environment. Author

A85-37200#

LIFT AND DRAG OF AIRFOILS IN NONUNIFORM SUPERSONIC STREAM

A BARSONY-NAGY and M. HANIN (Technion - Israel Institute of Technology, Haifa, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 195-204. refs

A method is developed for calculating the aerodynamic forces on a two-dimensional airfoil set at an angle of attack in a nonuniform parallel supersonic stream whose velocity and temperature vary in the vertical direction. Explicit analytic expressions for the lift and inviscid drag are deduced from linearized equations of flow by using the concept of fundamental solutions. Numerical results are presented, showing the effects of stream nonuniformity on the lift and drag forces of a rhombic airfoil in a sheared stream, a jet stream and a wake stream. Comparisons with computations using the method of characteristics indicate that the fundamental-solution method is efficient and accurate. Author

A85-37203#

THE EVALUATION OF AERODYNAMIC COEFFICIENTS FOR PROJECTILES FIRED FROM A HOVERING HELICOPTER

R ARIELI, A. SIGAL (Technion - Israel Institute of Technology, Haifa, Israel), and D BRUCKER IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p 231-234. refs

An approximate method is presented aiming at the evaluation of the aerodynamic coefficients of a projectile fired from a helicopter in hover. The analysis uses a prescribed downwash field due to the helicopter rotor namely a fixed, a priori known wake model. The aerodynamic coefficients are evaluated assuming that the configuration is slender. The method proposed is an extension of methods used for slender bodies at high angles of attack, to nonuniform flows. It is a hybrid method that uses experimental data, and analytically corrects them for the nonuniform flow field. The theoretical influence of the rotor flow field on the projectile aerodynamics has been examined for a wide range of angles of attack, concluding that the variation of flow properties along the projectile axis significantly affects the aerodynamic force and moment coefficients

A85-37212#

WING OPTIMIZATION AND FUSELAGE INTEGRATION FOR FUTURE GENERATION OF SUPERSONIC AIRCRAFT

A NASTASE (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 318-325. refs

A graphic-analytical method of the author is here presented for the design of fully optimized integrated wings for which the fuselage is located inside the thickness of the wing and the geometrical characteristics of this integrated wing, i.e., camber, twist, thickness and also the shape of the plan projection are simultaneously optimized in order to obtain a minimum drag by cruising Mach number. Author

A85-37330

A SYSTEM OF SHOCK AND RAREFACTION WAVES IN FLOWS PAST BODIES WITH COMPLEX SHAPES [SISTEMA SKACHKOV UPLOTNENIIA I VOLN RAZREZHENIIA PRI OBTEKANII TEL SLOZHNOI FORMY]

G. I. PETROV IN: Hydroaeromechanics and space research . Moscow, Izdatel'stvo Nauka, 1985, p. 32-35. In Russian.

A description of a model and the results of computations of an inhomogeneous supersonic gas flow around an obstruction on a flat surface are presented. A summary of available information is also included for Mach numbers of 2 5, 3, 4, and 6. It is pointed out that the theoretically predicted pressure distribution at the walls is in qualitative agreement with experiments. Computations of the flow around an axisymmetric obstruction confirm that the pressure ratio of two specified regions is independent of the shape of the obstruction. It is concluded that the model presented can yield satisfactory quantitative agreement with experimental data for Mach numbers larger than 2.

A85-37333

A NUMERICAL INVESTIGATION OF A VISCOUS HYPERSONIC AIR FLOW AROUND ELONGATED BLUNTED BODIES AT LARGE ANGLES OF ATTACK [CHISLENNOE ISSLEDOVANIE VIAZKOGO OBTEKANIIA UDLINENNYKH ZATUPLENNYKH TEL POD BOL'SHIMI UGLAMI ATAKI GIPERZVUKOVYM POTOKOM VOZDUKHAI

N. E. AFONINA, A. IU. VLASOV, and V. G. GROMOV IN: Hydroaeromechanics and space research . Moscow, Izdatel'stvo Nauka, 1985, p 53-65. In Russian. refs

A method for calculating a supersonic flow of a chemically nonequilibrium gas around an elongated blunted body at a large angle of attack is presented, which relies on the equations of a three-dimensional viscous shock layer that include all components of Euler and Prandtl equations. The region of the shock layer adjacent to the windward side of the body is considered. A numerical model is applied to the case of a flat triangular plate with cylindrical edges, oriented at angles of attack of 40 and 60 deg for a Reynolds number of 8500 and a Mach number of 24.1. In all cases, the maximum temperature is expected to appear near the critical point.

A85-37335

A SUPERSONIC INHOMOGENEOUS FLOW OF AN IDEAL GAS AROUND BLUNTED BODIES [OBTEKANIE ZATUPLENNYKH TEL SVERKHZVUKOVYM NERAVNOMERNYM POTOKOM IDEAL'NOGO GAZA]

L. I. ARKHIPOVA and M. G. LEBEDEV IN: Hydroaeromechanics and space research . Moscow, Izdatel'stvo Nauka, 1985, p 85-91. In Russian.

A supersonic gas flow, inhomogeneous both in its magnitude and direction, around a spherically blunted body is investigated numerically The solution relies on the finite difference nonstationary method of Babenko-Rusakov (1965). The geometrical pattern of the flow and the distribution of parameters in the shock layer are analyzed and expressed in terms of the dimensions and shape of the body, its location in the stream, and the adiabatic curve of the gas. The results are compared with solutions for a homogeneous flow and for a flow generated by a spatial source L.T.

A85-37336

A NONSTATIONARY TRANSITION PROCESS CAUSED BY INJECTION OF A GAS INTO THE NEAR WAKE OF A BODY IN A SUPERSONIC FLOW [NESTATSIONARNYI PEREKHODNYI PROTSESS, VYZVANNYI VDUVOM GAZA V BLIZHNII SLED ZA TELOM, OBTEKAEMYM SVERKHZVUKOVYM POTOKOM]

V. M. PASKONOV, T P. PETUKHOVA, and S. V. RUSAKOV IN Hydroaeromechanics and space research. Moscow, Izdatel'stvo Nauka, 1985, p. 91-102. In Russian. refs

A nonstationary axisymmetric flow of a viscous gas in the near wake of a spherically blunted cylinder, moving at a supersonic velocity, is numerically modeled on the basis of full Navier-Stokes equations for a viscous ideal heat-conducting gas. The computations are performed for a freestream Mach number of M = 3 and a Reynolds number of 200 and describe the decay or variations of the reverse-circulation current and the formation of a shock-wave structure in the flow.

A85-37337

GAS FLOW IN NOZZLES AND JETS [TECHENIE GAZA V SOPLAKH I STRUIAKH]

E. A ASHRATOV, T. G VOLKONSKAIA, and G S. ROSLIAKOV IN: Hydroaeromechanics and space research Moscow, Izdatel'stvo Nauka, 1985, p. 116-136. In Russian refs

Selected results of studies of gas flow in nozzles and jets are outlined The methods employed by the investigations include solutions to the inverse problem of nozzle theory, finite difference method, difference method, classic and layered methods of characteristics, and low-perturbation method Consideration is given to the flow in conical nozzles, flows with a pressure differential in circular nozzles, the influence of spatial effects on the nozzle characteristics, and the nonstationary starting of the nozzle The interaction of jets with a slipstream is also studied L.T.

A85-37338

INVESTIGATION OF THREE-DIMENSIONAL SEPARATED FLOWS [ISSLEDOVANIE TREKHMERNYKH OTRYVNYKH TECHENII]

G. N ANDREEV, A. I. GLAGOLEV, A. I ZUBKOV, B. E LIAGUSHIN, and V B. MINOSTSEV IN Hydroaeromechanics and space research. Moscow, Izdatel'stvo Nauka, 1985, p. 136-151 In Russian. refs

Results of experimental studies of supersonic and hypersonic flows around sharp and blunted bodies are presented. The shapes include a spherically blunted cone with a half-angle of divergence of 2 to 15 deg, cylinders whose front part is a spherical segment, segmentally conical bodies consisting of combinations of a spherical segment and a straight circular cone with a half-angle of divergence of 5 to 20 deg, and bodies similar to the latter but with an elliptic (semiaxis ratio of 2:1) cross section. The experiments were conducted for Mach numbers of the unperturbed flow ranging from 3 to 10, for angles of attack from 0 to 25 deg, and for Reynolds numbers (unperturbed flow) ranging from 5 x 10 to the 5th to 15 x 10 to the 7th. Pressure distributions, heat flux distributions, and flow characteristics in the separation zones are determined LT

A85-37340

THE SEPARATION OF A TURBULENT BOUNDARY LAYER WITHIN A TWO-FACE ANGLE BEFORE AN OBSTRUCTION [OTRYV TURBULENTNOGO POGRANICHNOGO SLOIA V DVUGRANNOM UGLE PERED PREPIATSTVIEM]

A. J. GLAGOLEV, A. J. ZUBKOV, and IU. A PANOV IN Hydroaeromechanics and space research. Moscow, Izdatel'stvo Nauka, 1985, p. 157-162 In Russian.

Supersonic flow at M = 3 around a cylinder aligned perpendicularly to the edge of a biplanar angle in the bisector plane is studied experimentally for angle openings of 45 and 135 deg. Pressure distributions and flow structure are determined near the cylinder in the presence of a turbulent boundary layer. Furthermore, the internal separation lines are defined for the region near the spatial separated flow before the cylinder. The interaction of the density increment with the boundary layer near the edge is also described. It is concluded that the length of the separated flow zone for the case considered is larger than that for a cylinder on a plate.

A85-37341

DETERMINATION OF AERODYNAMIC CHARACTERISTICS OF BODIES IN WEAKLY PERTURBED GAS FLOWS [OPREDELENIE AERODINAMICHESKIKH KHARAKTERISTIK TEL V SLABOVOZMUSHCHENNYKH POTOKAKH GAZA]

V. V EREMIN, IU. M LIPNITSKII, and IU. B. NEGOMETIANOV IN: Hydroaeromechanics and space research. Moscow, Izdatel'stvo Nauka, 1985, p. 163-170. In Russian.

A linear theory for computing the propagation of weak perturbations is used in conjunction with formulas for supersonic external problems of gas dynamics to assess the influence of inhomogeneities in flow fields on aerodynamic characteristics of a body Calculations are applied to examples of flow around cones in flat and axisymmetric supersonic tunnels, with consideration of some inhomogeneities of the model Numerical simulations performed for cones with angles of diverence ranging from 7.5 to 10 deg show that the magnitudes of balancing angles during the establishing of the oscillation center are quite different even for cones with identical midsections.

A85-37580*# North Carolina State Univ., Raleigh.

A REVIEW OF SOME APPROXIMATE METHODS USED IN AERODYNAMIC HEATING ANALYSES

F. R. DEJARNETTE (North Carolina State University, Raleigh, NC), H. H. HAMILTON, K. J. WEILMUENSTER (NASA, Langley Research Center, Space Systems Drv., Hampton, VA), and F. M. CHEATWOOD American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 11 p. refs

(AIAA PAPER 85-0906)

It is pointed out that preliminary design and optimization studies for new aerospace vehicles require techniques which can calculate aerodynamic heating rates accurately and efficiently. The method employed to calculate the flow field depends to a large extent on the shape of the vehicle, Mach number, Reynolds number, and Knudsen number. In the case of the aero-assisted orbital transfer vehicle (AOTV), a substantial portion of the flight will be in the transitional regime between continuum and free molecule flow. The present paper discusses some approximate methods which have been used to calculate heating rates on high-speed vehicles. Attention is given to the stagnation point and leading edges, the downstream region, the axisymmetric analog, laminar and turbulent heating rates, transition heating rates, gas models, and three-dimensional applications. G.R.

A85-37593#

NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FORE-AND AFTERBODY FLOWS OVER CAPSULE-TYPE VEHICLES AT ANGLES OF ATTACK

Y. YAMAMOTO (National Aerospace Laboratory, Chofu, Tokyo, Japan) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 16 p. refs

(AIAA PAPER 85-0924)

The thin-layer, three-dimensional Navier-Stokes equations are solved for hypersonic fore- and afterbody flowfields over capsule-type reentry vehicles. An implicit approximate factorization algorithm proposed by Beam and Warming has been used to obtain laminar numerical solutions at the following free stream condition. free stream Mach number of 7.0 with Reynolds number of 4.5 x 10 to the 5th. Body configurations are composed of a blunt nosed forebody and 20 deg conical afterbody followed by a cylinder Calculations proceed in two parts. Initially, solutions of the forebody flowfields are obtained. Then, remaining afterbody portion has been computed using previous solution as an upstream boundary. The results demonstrate the capability of the present numerical procedure for investigating the severe aerodynamic heating on the forebody and the detailed structure of three-dimensional separations around the afterbody.

A85-37594*# National Aeronautics and Space Administration. Johnson (Lyndon B.) Space Center,

COMPUTATIONAL METHODS FOR HYPERSONIC VISCOUS FLOW OVER FINITE ELLIPSOID-CONES AT INCIDENCE

C. P LI (NASA, Johnson Space Center, Aerosciences Branch, Houston, TX) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 13 p. refs

(AIAA PAPER 85-0925)

A numerical method, which is simpler than others currently in use, is proposed for determining the full viscous flow over a finite body in hypersonic stream at high altitude. It treats the shock layer surrounding the blunt foebody and the near wake behind the base simultaneously by formulating the Navier-Stokes equations in conformal and azimuthal-angle coordinates. The computational domain is confined to the body wall, outflow surface and the bow shock, which is adjusted along the coordinate normal to the wall in the course of iterations. Because of the optimal grid and a well developed alternating direction implicit factorization technique for the governing equations, reasonably accurate results can be obtained on a 30 by 36 by 6 grid with 400 time-marching iterations. Results for body shapes belonging to the ellipsoid-cone family are compared with the experimental data for the Apollo command module and the Viking aeroshell. Validation of the method based on self-consistency is also discussed. Author

A85-37621#

THE EFFECTS OF SURFACE DISCONTINUITIES ON CONVECTIVE HEAR TRANSFER IN HYPERSONIC FLOW

D. E. NESTLER (General Electric Co., Philadelphia, PA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 13 p. refs

(AIAA PAPER 85-0971)

This paper presents a survey of recent experimental data, prediction methods, and correlations for the effects of surface discontinuities on convective heat transfer. Types of surface discontinuities include: steps, cavities, gaps, and protuberances. Emphasis is placed on the hypersonic flow regime, including both laminar and turbulent boundary layer conditions. In addition to the survey aspects of the paper, an assessment of critical technology needs in this field is presented. Author

A85-37623#

STAGNATION POINT HEAT TRANSFER IN HYPERSONIC HIGH ENTHALPY FLOW

S. L. GAI, J. P. BAIRD (New South Wales, University, Duntroon, Australia), P. R. A. LYONS, and R. J. SANDEMAN (Australian National University, Canberra, Australia) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 6 p refs (AIAA PAPER 85-0973)

Stagnation-point heat-transfer measurements obtained under hypervelocity high-enthalpy reacting flows generated in a free piston-driven shock tunnel with a contoured nozzle are presented. A description of the facility, model, and instrumentation is given. The tests are conducted with either air or CO2 as the test gas and helium as the driver gas. It is shown that the range of stagnation enthalpies and temperatures is much higher than similar measurements by Miller et al. (1985). The results show that pronounced nonequilibrium flow effects result in reduced convective heat-transfer rates M.D.

A85-37626#

DENSITY AND VELOCITY PROFILES IN NON-EQUILIBRIUM LAMINAR BOUNDARY LAYERS IN AIR

J P. BAIRD, S. L. GAI (New South Wales, University, Duntroon, Australia), and P R. A. LYONS (Australian National University, Acton, Australia) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 7 p. refs

(AIAA PAPER 85-0976)

A senes of expenments were conducted in a free piston shock tunnel on a 456 mm long flat plate at zero incidence. The free stream velocities were varied from 1.78 to 7.3 km/s with a variation in free stream density between 0.0012 and 0.012 kg/cu m. Pitot pressure and profiles were measured and interferograms were taken from which the density profiles were deduced. From the Pitot and density profiles the velocity profiles were calculated. It is shown that the ratio of density boundary layer thickness to velocity boundary layer thickness varies with enthalpy. This effect is related to the Prandtl number and possible reasons for the behavior are discussed. Author

A85-37640#

LOW DENSITY AEROTHERMODYNAMICS

G. A. BIRD (Sydney, University, Sydney, New South Wales, Australia) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 10 p. refs

(AIAA PAPER 85-0994)

A review is made of the low density gas flows that are associated with the operation of current and projected spacecraft. Typical-applications are related_to_orbital contamination studies, the early stages of reentry, high altitude aerobraking, plume-vehicle and plume-atmosphere interactions, and the orbital drag problem. Criteria are established for determining whether a continuum or particle model is appropriate in particular cases. It is shown that satisfactory procedures now exist for the application of the Direct Simulation Monte Carlo (DSMC) method to real gas flwos involving nonequilibrium of the translational and internal modes, chemical reactions and thermal radiation. On the other hand, the necessary physical database is seriously deficient, particularly in regard to gas-surface interactions under orbital conditions, and chemical reaction cross-sections in the 8-10 e.v. energy range. It is concluded that both laboratory and in-orbit measurements will be needed if these deficiencies are to be remedied. Author

A85-37642#

THE DRAG OF SIMPLE SHAPED BODIES IN THE RAREFIED HYPERSONIC FLOW REGIME

G. KOPPENWALLNER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer experimentelle Stroemungsmechanik, Goettingen, West Germany) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 7 p. refs (AIAA PAPER 85-0998)

The drag behavior of simple shaped two-dimensional and axisymmetric bodies in hypersonic rarefied flow is summarized. The experimental data used was mainly obtained in the DFVLR hypersonic low density tunnels during the past 15 years. The body shapes analyzed include sphere, disk, cones cylinders and flat plates parallel to the flow. These shapes include bodies which have only pressure- and only friction drag Special attention is given to the frictional drag overshoot of flat plates in the near free molecular flow regime. Simple qualitative explanations for this overshoot and for the different behavior of twoand three-dimensional bodies are given. Author

A85-37643#

HYPERSONIC GAS DYNAMICS

H. T. NAGAMATSU (Rensselaer Polytechnic Institute, Troy, NY) and R. E SHEER, JR. (GE Research and Development Center, Schenectady, NY) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 12 p. (AIAA PAPER 85-0999) refs

Basic aerodynamic, heat transfer, and gasdynamic phenomena observed at flight Mach numbers from 5 to 35 with a maximum stagnation temperature of 11,000 K are studied experimentally in a combustion-driven 24-inch diameter hypersonic shock tunnel. The effects of vibrational relaxation and recombination of high-temperature nitrogen and air are investigated for reflected temperatures of up to 7000 K and maximum pressure of 500 psi. The experiments cover real gas flow over sharp and blunt bodies with smooth and rough surface and viscous flow over a flat plate Moreover, rarefied hypersonic flow effects on the flat plate heat transfer rates are studied in air at Mach numbers of 19.2 and 25.4 and in helium at Mach numbers of 22.8 to 86.8. MHD results for highly dissociated and ionized air plasma produced by shock Mach numbers from 10 to 32 with equilibrium plasma temperatures from 3600 to 11,000 K are obtained with transverse field strength of 2300 and 6500 gauss across the 4-inch diameter shock tube. IΤ

A85-37645#

MEASUREMENTS TRANSITION VIA **HEAT-TRANSFER** INSTRUMENTATION ON A 0.5 BLUNTNESS 9.75-DEG CONE AT MACH 7 WITH AND WITHOUT MASS ADDITION

A. H. BOUDREAU (USAF, Arnold Engineering Development Center, American Institute of Aeronautics and Air Force Station, TN) Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 8 p. refs

(AIAA PAPER 85-1004)

Wind tunnel tests have been conducted at Mach 7 on a blunt cone equipped with 9.75-deg half-angle heat-transfer instrumentation and a porous skin to determine the effects of mass addition on boundary-layer transition. Mass flow rates of 0.008 lbm/sec or greater were required to produce significant

effects on transition Analysis suggests that the movement of transition could be caused, at least in part, by the tripping effect of microscopic surface jets. Author

A85-37661*# Vanderbilt Univ, Nashville, Tenn

AERODYNAMIC TRANSITIONAL. HYPERVELOCITY SIMULATION AND SCALING IN LIGHT OF RECENT FLIGHT DATA

J. L. POTTER (Vanderbilt University, Nashville, TN) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 10 p. refs

(Contract NAG1-549)

(AIAA PAPER 85-1028)

Simulation and scaling procedures applicable to maneuvering vehicles for the transitional hypervelocity flow regime are discussed with reference to certain discrepancies between lifting reentry flight data and predicted results. Low-density hypervelocity wind-tunnel data are compared with CFD and in-flight measurements. A general correlation parameter for transitional flow is produced by incorporation of a new geometric term into a form of Revnolds number. It is shown that normalized drag coefficients of a variety of shapes, including spheres, blunt-nosed cones, lifting bodies, and an STS orbiter are correlated by the parameter A provisional bridging formula for the coefficients is presented. M.D.

A85-37675*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WEASURED AND PREDICTED VORTEX-INDUCED LEEWARD HEATING ON A BICONIC AT MACH 6 AND 10

C. G MILLER, S. E WILDER, P. A. GNOFFO (NASA, Langley Research Center, Space Systems Div., Hampton, VA), and S. A WRIGHT (NASA, Langley Research Center; System Development Corp., Hampton, VA) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA. June 19-21, 1985 16 p. refs

(AIAA PAPER 85-1061)

Detailed longitudinal and circumferential heating distributions were measured on a spherically blunted, 13 deg/7 deg biconic at angles of attack from 0 deg to 27 deg. The measurements were made in the Langley 20-inch Mach 6 tunnel and 31-inch Mach 10 tunnel to provide heating distributions at Mach 6 and 10 in air. The free-stream Revnolds number based on model length varied from 0.4 to 4.8 million at Mach 6 and 0.3 to 1.3 million at Mach 10. The basic trends in leeward heating are found to be described by a single parameter, the viscous interaction parameter. A decrease in this parameter results in a decrease in leeward heating for attached flow, an increase in heating for separated flow, and a forward movement of the separation region. The parabolized Navier-Stokes code for laminar flow qualitatively predicted the longitudinal and circumferential heating distributions CD.

A85-37879

THE FINITE ELEMENT FORMULATION OF AIRFLOW AROUND A DEFORMABLE WING BY USING THE INCREMENTAL FINITE ELEMENT METHOD

M. JOSIFOVIC and J. JANKOVIC (Beograd, Univerzitet, Belgrade, Yugoslavia) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 5, 1985, p. T 271, T 272

A special procedure for determining the control surface deflection which stabilizes the system of interaction between the fluid and the elastic body structure around a deformable wing is presented The finite element method is used to describe the physical phenomena occurring in this problem. A nonstationary matrix of the mathematical model of the system is obtained which is dependent on the angle of the control surface deflection. Using presented dynamical model of the the Interaction airflow-deformable wing, the deflection of the control surface which stabilizes the whole system is determined C.D.

A85-37927#

FLOW-FIELD MATRIX SOLUTION FOR FLOW ALONG ARBITRARILY TWISTED S1 SURFACE EMPLOYING NON-ORTHOGONAL CURVILINEAR COORDINATES

W. WU and H. YU (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, Feb. 1985, p. 21-26. In Chinese, with abstract in English. refs

Based upon a set of given discrete points on several stream lines, a method of fitting an arbitrarily twisted S1 stream surface was developed. The fitted surface obtained with this method is compared with that obtained with the analytic method, and the accuracy is about 0 004 percent, which is satisfactory for engineering applications. Employing nonorthogonal curvilinear corresponding nonorthogonal velocity coordinates and components, the stream-function equation governing flow along the arbitrarily twisted S1 stream surface was solved with the matrix method, and some numerical examples are presented. This method can also be used for S2 stream surfaces and other applications. Author

A85-37928#

QUASI-THREE-DIMENSIONAL BLADE DESIGN CODE

Q. WANG, G. ZHU, Y. ZHANG, and B WANG (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, Feb. 1985, p 27-32. In Chinese, with abstract in English. refs

Based on Wu's general theory of 3-D flow in turbomachine, an automatic code system for blade design of a subsonic axial-flow turbomachine has been developed. Using the code system, the things a user has to do are discussed, specifying the input data and investigating the calculation results. The code system, which includes several individual codes, is executed automatically without any personal interference. The code system can substantially reduce the time and personnel needed for a design work, and provides the possibility to choose among a large number of design schemes.

A85-37929#

THE SOLUTION OF TRANSONIC FLOW THROUGH THREE-DIMENSIONAL TURBINE BLADE

S JIANG and Z. JIANG (Qinghua University, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol 6, Feb. 1985, p. 33-36. In Chinese, with abstract in English. refs

A numerical technique with artificial viscosity is presented for the calculation of transonic flow through three-dimensional turbine blade. The problem is posed in the time-dependent form. In order to make the analysis manageable, the stream surfaces are assumed to be axisymmetric. Two examples are given. The solutions exhibit the position of shocks and static pressure distribution on the blade surface Author

A85-37930#

FAMILIES OF VARIATIONAL PRINCIPLES FOR THE SEMI-INVERSE AND TYPE-A HYBRID PROBLEMS ON A S2-STREAMSHEET IN MIXED-FLOW TURBOMACHINES

R. CAI and G. LIU (Shanghai Institute of Mechanical Engineering, Shanghai, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, Feb. 1985, p. 37-39. In Chinese, with abstract in English. refs

In this paper, two families of vanational principles (VPs) for the semiinverse and type-A hybrid problem on S2-steamsheet in mixed-flow turbomachines are developed. The momentum equation in an arbitrary quasi-orthogonal direction-y is chosen as the primary equation, and a corresponding image plane is introduced. Taking advantage of natural boundary conditions and artificial interfaces, these VPs provide a reliable theoretical basis for the F E. M. or other direct variational methods.

A85-37931#

A GENERAL THEORY OF HYBRID PROBLEMS OF FULLY 3-D COMPRESSIBLE POTENTIAL FLOW IN TURBO-ROTORS. I -AXIAL FLOW, STREAM FUNCTION FORMULATION

G. LIU (Shanghai Institute of Mechanical Engineering, Shanghai, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, Feb. 1985, p. 40-45. In Chinese, with abstract in English. refs

A85-37932#

COMPUTATION OF THE THRUST PERFORMANCE OF AXISYMMETRIC NOZZLES

Z. JIANG (Quinghua University, Beijing, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, Feb. 1985, p. 46-48 In Chinese, with abstract in English

A time marching method is used to compute the transonic nonviscous flow field and a finite difference method to compute the boundary layer of axisymmetric nozzles. The influence of the boundary layer on the nonviscous flow has been considered along with the calculated displacement thickness, using an iteration procedure. The thrust of the nozzle is then computed from the flow field parameters. The computed results are compared with experimental data, and the average relative error is about 2 percent, satisfying engineering needs Author

A85-38355#

A STUDY ON THE METHOD FOR SOLVING THE EQUATION OF SUBSONIC OSCILLATORY LIFTING-SURFACE THEORY. IV - COMPUTER PROGRAM SOLST 1

T. ICHIKAWA, K HIRAOKA, S. SUEMATSU, and A. DAITOKU Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no. 360, 1984, p. 34-45. In Japanese, with abstract in English. refs

A computer program SOLST 1 for calculating the lift distribution of oscillating wings has been developed based on a previous investigation. It is shown by numerical results that the method needs less spanwise integration points than other methods in order to obtain the same degree of accuracy. Author

A85-38362#

WIND TUNNEL EXPERIMENTS OF THE HIGH-PERFORMANCE ROTOR BLADES

T. TAKENAWA, Y. YOSHITAKE, S. IMAHASHI, and I. TAKANASHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 361, 1984, p. 89-93 in Japanese.

Experimental results of wind tunnel tests of helicopter composite blades are reported. The rotor blades used for testing consist of glass and Kevlar fibers, and new wing models, DKR-120B and -105B, are developed. It was found that the blades in combination with the new wings and the stool type wing edge reduced significantly the required torques Experimental results are given. S.H.

A85-38367#

EXPERIMENT OF TURBULENT ROUND JET PARALLEL TO GROUND PLANE

T OKAMOTO and M. YAGITA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no 361, 1984, p. 122-125. In Japanese, with abstract in English.

An experimental study on the effect of the plane on a round jet issued parallel to a ground plane is presented. The velocity and static pressure of the jet flow and the surface pressure of the ground plane were measured for various distances between jet and ground plane. The results show that: (1) the decay of the maximum velocity becomes slower than that of a round free jet with decreasing distance, (2) the spread perpendicular to the ground decreases with decreasing distance, and the position of maximum velocity is shifted from the axis of nozzle to the neighborhood of ground plane, and (3) the spread parallel to the ground increases more sharply than that of a round free jet. Author

A85-38370#

AERODYNAMIC CHARACTERISTICS OF THE WEIS-FOGH MECHANISM

M. TSUTAHARA and T KIMURA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no. 362, 1984, p. 154-162. In Japanese, with abstract in English. refs

Lighthill's two-dimensional inviscid-flow model (1973) for the Weis-Fogh mechanism is investigated. For the 'fling' (or opening) stage, the lift and the moment acting on the wing are calculated from the Lighthill solution. The effect of the angular acceleration due to wing rotation is also accounted for For the separating stage, a doubly-connected region of the flow-field is analyzed by transforming it into a circular ring. The circulation around the wing is determined by assuming that Kutta's condition is satisfied at the trailing edge, and the unsteady lift, drag, and moment are also calculated. It is found that the circulation can be made constant by taking the acceleration of the wing motion properly.

A85-38371#

CL BETA OF UNSWEPT FLAT WINGS IN SIDESLIP. II

A. ICHIKAWA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 362, 1984, p. 163-170. In Japanese, with abstract in English. refs

The paper deals with a numerical method for calculating the CI Beta of rectangular flat wings. The computational system is based on a discrete vortex method in order to take account of separated flow at the side edges. Two kinds of wings, one with sharp side edges and the other with conventional blunt ones, are used to examine the effect of side edge thickness on the flowfield around the edges and on the CI Beta. Comparison of the results of this method and experiment indicate good agreement of the CI Beta for a moderate range of C(L) The wings having sharp side edges show a substantial decrease in the CI Beta. Author

A85-38430

LOCAL INSTABILITY CHARACTERISTICS AND FREQUENCY DETERMINATION OF SELF-EXCITED WAKE FLOWS

W KOCH (Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Institut fuer theoretische Stroemungsmechanik, Gottingen, West Germany) Journal of Sound and Vibration (ISSN 0022-460X), vol. 99, March 8, 1985, p 53-83. refs

The proposal that a resonance-like mechanism controls the downstream discrete frequency self-excited vortex shedding process is discussed. It is shown that for symmetric blunt body wakes the quasi-parallel flow assumption together with the proposed resonance hypothesis leads to a bifurcation condition (a direct resonance condition) for the local instability eigenvalue. The same condition is found to separate a linearly absolute instability from a linearly convective instability and the critical basic wake profile corresponding to the resonance condition is found to be near the end of the potential core if the steady basic wake flow is modeled realistically, the pertinent frequency is close to experimentally found values For asymmetrical basic wakes there exists a limiting asymmetry beyond which no time-harmonic resonance appears possible, thus providing a link to mixing layers for which only time-attenuated resonances occur.

A85-38481

CONFIGURATION OF SHOCK WAVES CLOSING A LOCAL SUPERSONIC ZONE [O KONFIGURATSII SKACHKOV UPLOTNENIIA, ZAMYKAIUSHCHIKH MESTNUIU SVERKHZVUKOVUIU ZONU]

A. N. KRAIKO Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 49, Mar - Apr. 1985, p. 236-243. In Russian. refs

The problem of shock waves closing a local supersonic zone is analyzed, and the possibility of a reverse-lambda configuration is demonstrated. The first shock in this configuration occurs inside the local supersonic zone; an infinite discontinuity of second derivatives corresponding to the sonic line is then seem propagating along the c(+) characteristic from the shock nucleation point. This, in turn, can give rise to a second shock forming, together with the first shock, the above configuration. V L

A85-38483

DIFFRACTION OF A SINGLE PLANE WAVE BY A CONICAL WING [DIFRAKTSIIA PLOSKOI EDINICHNOI VOLNY NA V-OBRAZNOM KRYLE]

P. V. TRETIAKOV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 49, Mar.-Apr. 1985, p 251-257. In Russian.

The problem of the diffraction of a single plane wave by a conical wing moving at a supersonic velocity is solved using a linear formulation. The solution is based on an analysis of eigenfunctions for a class of self-similar solutions to a three-dimensional wave equation. A boundary value integral is obtained using a method similar to that discussed in an earlier study (Tretiakov, 1976) V.L.

A85-38488

THE ISOLATED NATURE OF SOLUTIONS WITH A STRONG ATTACHED SHOCK WAVE AT THE EDGES OF A CONICAL WING AND A WEDGE [OB IZOLIROVANNOM KHARAKTERE RESHENII S SIL'NYM PRISOEDINENNYM SKACHKOM UPLOTNENIIA NA KROMKAKH V-OBRAZNOGO KRYLA I KLINA]

A. V. GRISHIN Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 49, Mar.-Apr. 1985, p. 330-334. In Russian. refs

The problems of supersonic flow past an infinite wedge and a conical wing with subsonic flow behind an attached shock wave are analyzed using a subsonic approximation. In particular, the possibility of the existence of flow with a strong discontinuity in a plane perpendicular to the edge of the wing or the wedge is investigated in this connection, a linear analysis is made of boundary value problems for perturbations with respect to exact solutions with a plane shock. It is shown that the boundary value problems have a solution if the plane shock wave corresponding to an exact solution is weak (in the plane perpendicular to the edge) and have no solution if the shock wave is strong.

A85-38551

INSTABILITY OF PLANE-PARALLEL SUPERSONIC GAS FLOWS IN THE LINEAR APPROXIMATION [NEUSTOICHIVOST' PLOSKOPARALLEL'NYKH SVERKHZVUKOVYKH POTOKOV GAZA V LINEINOM PRIBLIZHENII]

P. I. KOLYKHALOV Akademia Nauk SSSR, Izvestila, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1985, p 10-16 In Russian. refs

It is shown that plane-parallel supersonic gas flows are linearly unstable. The rise time of instability is found to be proportional to the time required for sonic perturbations to cover a distance of the order of the characteristic scale of the flow. It is also shown that the unstable perturbations are actually acoustic waves within the flow. V.L.

A85-38555

STABILITY OF A STATIONARY SOLUTION TO THE ABLATION EQUATION [OB USTOICHIVOSTI STATSIONARNOGO RESHENIIA URAVNENIIA OBGARA]

V V LUNEV and I N. POLIAKOV Akademila Nauk SSSR, Izvestila, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1985, p. 96-103. In Russian. refs

The problem of the stability of bodies of stationary shape during aerodynamic heating is reduced to that of solving a linearized equation of ablation. In the plane case, the Cauchy problem for this equation has multiple solutions depending on the arbitrary distribution of the unknown functions with respect to the axis However, a physically meaningful regular solution is unique and can be found by solving an integral equation. For this case, symmetrical and nonsymmetrical perturbations are considered, and the damping of perturbations, initially localized in the front part of the body, is discussed. V.L.

A85-38559

SHADING AND INTERFERENCE EFFECTS DURING THE ROTATION OF A PLATE [EFFEKTY ZATENENIIA I INTERFERENTSII OT VRASHCHENIIA PLASTINY

S. G. IVANOV and A. M. IANSHIN Akademila Nauk SSSR, Izvestila, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1985, p. 140-148, In Russian, refs

The shading and interference effects resulting from the tumbling of a plate in a free-molecular stream are investigated analytically. The particle fluxes, pressure, and tangential stresses acting on the plate are determined with allowance for these effects. For a purely diffusive scheme of interaction of a gas with the plate surface, estimates are made of the relative contributions of shading and interference to the head resistance and the damping moment of the plate. V1

A85-38562

A STUDY OF THE CRITICAL FLOW RATE THROUGH CASCADES OF THIN SLIGHTLY BENT AIRFOILS USING THE LARGE-PARTICLE WETHOD (ISSLEDOVANIE KRITICHESKOGO RASKHODA RESHETKI TONKIKH CHEREZ SLABOIZOGNUTYKH PROFILEI METODOM KRUPNYKH CHASTITS1

IU. M. DAVYDOV, V. D. KULIKOV, and E V. MAIORSKII Akademila Nauk SSSR, Izvestila, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar - Apr. 1985, p. 182-185 In Russian. refs

The critical flow rate past plane cascades of wing profiles is investigated experimentally and analytically using the large-particle method. The analysis is carried out for subsonic velocities and varying angles at the entrance and high supersonic velocities at the exit. The critical flow rate is calculated as a function of the entrance angle for various types of cascades. V.L.

A85-38563

APPROXIMATE RELATIONSHIPS FOR DETERMINING PRESSURE AT THE SURFACE OF A SPHERE OR A CYLINDER FREE-STREAM FOR ARBITRARY MACH NUMBERS PRIBLIZHENNYE ZAVISIMOSTI DLIA **OPREDELENIIA** DAVLENIIA NA POVERKHNOSTI SFERY ILI TSILINDRA PRI PROIZVOL'NOM CHISLE MAKHA NABEGAIUSHCHEGO POTOKA]

A. N. POKROVSKII and L. G. FROLOV Akademia Nauk SSSR, Izvestila, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1985, p. 185-188. In Russian. refs

Simple analytical formulas are proposed for determining pressure at the surface of spheres or cylinders for any free-stream Mach number. The formulas are based on reported numerical data concerning pressure distribution on the surface of a sphere or a cylinder in transverse flow for theta = 0 $p_1/2$, where theta is the angle relative to the critical point along the mendional plane. A comparison is made between the results obtained and experimental data. V.L.

A85-38564

THE EFFECT OF THE BLUNTNESS SHAPE ON THE DRAG COEFFICIENT OF A BODY IN HYPERSONIC FLOW OF A RAREFIED GAS (VLIIANIE FORMY ZATUPLENIIA NA KOEFFITSIENT SOPROTIVLENIIA TELA V GIPERZVUKOVOM POTOKE RAZREZHENNOGO GAZA]

Akademila Nauk SSSR, Izvestila, Mekhanika I. N. LARINA Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr 1985, p. 190-192. In Russian.

The effect of the bluntness shape of a body in hypersonic flow of a rarefied gas on the flow field and aerodynamic characteristics is investigated analytically by considering flow past ellipsoids of revolution at zero angle of attack. The problem of flow in the transition mode is solved on the basis of a numerical analysis of the BGK kinetic model equation for a monoatomic gas. The results are found to be in good agreement with experimental data. V.L.

A85-38780#

BASIC AEROSTATICS - A TUTORIAL

D. M. LAYTON (U.S. Naval Postgraduate School, Monterey, CA) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 20-25.

(AIAA PAPER 85-0864)

A discussion is presented concerning the most fundamental aspects of aerostatic behavior in ambient temperature and hot gases which generate sufficient lift for use in lighter-than-air vehicles. Attention is given to the most beneficial relationships between such aerostatic lift and both aerodynamic and powered lift possibilities, as well as such secondary aerostatic phenomena as lift enhancement through solar heating of aerostat vehicle gas volumes, and the effects of varying atmospheric pressure and temperature conditions. OC.

A85-38782#

AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC EFFECTS ON A BODY OF REVOLUTION IN TURNING FLIGHT A. KING and J. DELAURIER (Toronto, University, Toronto, Canada) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 40-43. refs (AIAA PAPER 85-0866)

An investigation was made of the side forces acting on a streamlined body of revolution in steady turning flight. A rotating-arm water tank was built and instrumented to measure the radial force on the model and the angular velocity of the arm. A series of tests were run using a body of revolution with a fineness ratio of 5.2. The results are presented as a value for the nondimensional side force coefficient, K. Author

A85-38783#

AERODYNAMICS OF A NEW AEROSTAT DESIGN WITH INVERTED-Y FINS

S. P. JONES (TCOM, Columbia, MD) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers New York, American Institute of Aeronautics and Astronautics, 1985, p. 44-52 refs

(Contract F19628-83-C-0152)

(AIAA PAPER 85-0867)

The 365Y design combines the much-used TCOM 365 aerostat hull with an inverted-Y empennage, which has several advantages in handling, manufacture and the shedding of precipitation. Wind tunnel tests on a 1/72 scale model show the aerostat to be well-behaved with attached flow at low angles of pitch and yaw At yaw angles above 6 deg with pitch greater than 5 deg the onset of separation can be detected with the 'tufted' model and in the roll moment data. The experimental results have been fit to a theoretical model with empirical efficiency factors and a function to duplicate separation effects. A segmented theoretical model was used for stability analyses and nonlinear dynamic simulations. The results predict a stable aerostat capable of surviving in heavy turbulence. Author

A85-38789#

AN APPLICATION OF SOURCE-PANEL AND VORTEX METHODS FOR AERODYNAMIC SOLUTIONS OF AIRSHIP CONFIGURATIONS

K. Y. WONG, J. DELAURIER (Toronto, University, Toronto, Canada), and L. ZHIYUNG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China; Toronto, University, Toronto, Canada) IN Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 78-83. refs

(AIAA PAPER 85-0874)

A potential flow computational method is used to calculate the flow around traditional airship configurations. In this method, the basic building blocks of the singularity distribution consist of constant strength source-panels for the hull, and horseshoe vortices for the fins. The resulting Neumann boundary-value problem is solved as a system of linear algebraic equations to yield the pressure distribution, forces, and moments on the configuration. A number of examples are treated and the results are in general agreement with wind tunnel data, showing this to be a useful tool in the aerodynamic analysis of airship configurations. Author

A85-38790#

WIND TUNNEL INVESTIGATION OF THE INTERACTION OF AN AIRSHIP CONFIGURATION WITH LIFTING ROTORS

T. S. WONG, W. D. MCKINNEY, and J. D. DELAURIER (Toronto, University, Toronto, Canada) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 84-89. Research supported by Transport Canada and Natural Sciences and Engineering Research Council of Canada. refs

(AIAA PAPER 85-0875)

This article describes a series of wind-tunnel tests conducted on a 'genenc' airship configuration with lifting rotors. In particular, the phenomena studied included hull/rotor interaction and the combined hull and rotor-interference effects on the fins. These interaction studies were conducted for both the still-air hover and translational flight modes In general, the test results show that (1) a quad-rotor configuration heavy-lift airship in the still-air hover mode may incur problematic pitching oscillations when subjected to longitudinal gusts, (2) tail fin loads due to the lifting rotors are significant, and (3) side gusts may give rise to unexpected loads on the leeward fin and rotor. Author

A85-38922

A SECOND-ORDER APPROXIMATE METHOD FOR TRANSONIC SMALL-DISTURBANCE POTENTIAL FLOW AND ITS APPLICATION TO THE ANALYSIS OF FLOWS OVER AIRFOILS

K.-Y. SHEN (Shanghai Aviation Industrial Corp., Shanghai, People's Republic of China) and S.-J. LUO (Northwestern Polytechnical University, Xian, People's Republic of China) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 49, June 1985, p. 149-161. refs

A transonic small-disturbance equation retaining all second and some higher-order terms (i.e., the TSDH equation) is proposed for computing transonic flows over blunt leading edge airfoils in subsonic and supersonic free streams. Three difference schemes and relaxation techniques are studied numerically for obtained converged solutions, of which two succeed for both subsonic and supersonic free streams; the other can only be applied to subsonic free streams. Comparisons with reported results and experiments are made for the DSMA 523 and NACA 0012 airfoils. The agreements are generally satisfactory. Author

A85-38963#

THE COMPUTATION OF TRANSONIC NOZZLE FLOW-FIELD BY A TIME-DEPENDENT METHOD

D. FANG (National University of Defence Technology, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 10-18. In Chinese, with abstract in English. refs

The steady inviscid transonic nozzle flow is computed based on the time-dependent method. The Boundary-Fitted-Coordinates (BFC) system is adopted for generating a natural grid. The second-order MacCormack finite difference scheme is adopted for solution of the governing equations. The wall boundary condition is computed from characteristics formulation. The reflection boundary condition is used to evaluate the physical flow variables at the centerline. The results from this study agree very well with the test data. Author

A85-38965#

NUMERICAL SIMULATION OF THREE-DIMENSIONAL TRANSONIC FLOW IN A TURBOMACHINERY

Y. ZHANG (Chinese Academy of Sciences, Computing Centre, People's Republic of China) and M. SHEN (Qinghua University, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 29-36. In Chinese, with abstract in English. refs

Three-dimensional transonic flow in turbomachinery is simulated using the correct raddial momentum equation in integral form. The unsteady adiabatic energy equation for an inviscid perfect gas is used instead of conservation of enthalpy. The results are compared with those from Denton's computational scheme. The numerical solutions obtained with the present scheme show a correct trend and good convergence. C.D.

A85-38966#

THE NUMERICAL CALCULATION OF THE PRESSURE DISTRIBUTION OF SHARP EDGE SLENDER WINGS WITH LEADING OR SIDE EDGE VORTEX SEPARATION

Y. XIANG Acta Aerodynamica Sinica, no. 2, 1985, p. 37-43. In Chinese, with abstract in English. refs

In this paper, a convenient method is developed to calculate the aerodynamic characteristics and pressure distribution of slender wings with leading or side edge vortex separation in incompressible flow By use of a vortex lattice method, the leading edge Kutta conditions is employed to determine the strength of the vortex sheet, and an equivalent concentrated vortex line is adopted to simulate the leading edge vortex. Various kinds of slender wings are calculated using the method, and the results show good agreement with other methods and tests up to vortex breakdown. Author

A85-38967#

THE CHARACTERISTICS COMPATIBILITY CONDITIONS ON THE BOUNDARY POINTS ARE APPLIED TO TIME-MARCHING METHODS FOR TRANSONIC FLOW PAST PLANE CASCADES B LIN (Chinese Academy of Space Technology, Beijing, People's Republic of China), M. SHEN (Qinghua University, Beijing, People's Republic of China), and S. ZHOU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 44-50. In Chinese, with abstract in English. refs

In this paper, the characteristic compatibility system that is applied to the boundary points is derived under universal form. Methods of giving the boundary conditions for flow past plane cascades are discussed using characteristic theory. Numerical tests of the boundary conditions are done with some different approaches, and comparisons of their numerical results are presented. Author

A85-38969#

INVESTIGATION ON CONFIGURATIONS IN LONGITUDINAL DIRECTION WIND-TUNNEL TESTING OF FORWARD SWEPT WINGS

W. YE and R. XIAO (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 61-68. In Chinese, with abstract in English. refs

Based on a test of a low speed wind tunnel and the computation of aerodynamic load and transonic-supersonic area rule the aerodynamic characteristics of configurations with FSW are analyzed in this paper. The measures for improving aerodynamic performance of FSW are presented. By a symmetry principle, the calculations on the panel method and the area rule are applied to FSW. The results indicate that the configurations with FSW have better aerodynamic performance. The winglet is able to raise lift-drag ratio. The canard-FSW configuration and a small fairing panel inserted in the wing root apparently improve the flow field on the wing root. The spanwise lift distribution of FSW more easily approaches the optimum form than that of ASW, the configuration with FSW is able to reduce the wave drag.

A85-38972#

AN EXTENSION OF THE GENERALIZED VORTEX-LATTICE METHOD OF SUPERSONIC SIDESLIPPING WINGS

R. CHEN and M. HUANG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 83-87. In Chinese, with abstract in English. refs

One of the authors previously suggested a transformation which can be used to obtain the velocity components induced by a sideslipping lifting element from the formulas for calculating the components induced by a nonsideslipping one, so that Woodward's (1968) panel method can be extended to include sideslip cases. In this paper, the same transformation rule is applied to a skewed-horseshoe vortex in supersonic flows, and the generalized vortex-lattice method developed by Miranda et al. (1977) is extended to the case of sideslip. The advantages of the new method are that the panelizing of the wing and the arrangement of the element vortices and the control points are in the same manner as in nonsideslip cases. The aerodynamic derivatives of the rolling moment are calculated for plate delta and arrow wings. Comparison with exact results shows that the accuracy of the numerical results meets the needs of engineering use C.D.

A85-38981#

COMPUTATIONS OF PROJECTILE MAGNUS EFFECT AT TRANSONIC VELOCITIES

C. J. NIETUBICZ, W B. STUREK, and K. R. HEAVEY (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, MD) AIAA Journal (ISSN 0001-1452), vol. 23, July 1985, p. 998-1004. refs

A combined computational and experimental research program has been ongoing to develop a predictive capability for the Magnus effect that develops on spinning projectiles at angle of attack. This effort has been very successful in the supersonic regime and has now been extended to the transonic regime Utilizing the time-marching, thin-layer, Navier-Stokes computational technique, flowfield solutions have been obtained for a spinning 6-caliber-long, ogive-cylinder-boattail shape at Mach 0.91 and 2-deg angle of attack The computed results predict the correct development of the Magnus force along the body; and comparisons between the computational results and experiment are encouraging. Details of the flowfield solution, such as turbulent boundary-layer velocity profiles and surface pressure distributions, are presented. The surface pressure and viscous shear components of the Magnus effect are presented as a function of axial position. A complete set of aerodynamic coefficients has been determined from the flowfield solutions. The computations for this research effort were obtained using a CDC 7600 and a Cray 1S computer. Author

A85-38984*# Pennsylvania State Univ., University Park. CONICAL SIMILARITY OF SHOCK/BOUNDARY-LAYER INTERACTIONS GENERATED BY SWEPT AND UNSWEPT FINS

G. S. SETTLES (Pennsylvania State University, University Park, PA) and F. K. LU AIAA Journal (ISSN 0001-1452), vol 23, July 1985, p. 1021-1027. refs

(Contract NAG2-109; F49620-81-K-0018)

A parametric experimental investigation has been made of the class of three-dimensional shock wave/turbulent boundary layer interactions generated by swept and unswept leading-edge fins. The fin sweepback angles were 0-65 deg at 5, 9, and 15 deg angles of attack. Two equilibrium two-dimensional turbulent boundary layers with a freestream Mach number of 2.95 and a Reynolds number of 6.3 x 10 to the 7th/m were used as incoming flow conditions. All of the resulting interactions were found to possess conical symmetry of the surface flow patterns and pressures outside of an initial inception zone. Further, these interactions were found to obey_a simple conical similarity rule based on inviscid shock wave strength, irrespective of fin sweepback or angle of attack. This is one of the first demonstrations of similarity among three-dimensional interactions produced by geometrically dissimilar shock generators. Author

A85-38989#

NUMERICAL SOLUTION OF TWO- AND THREE-DIMENSIONAL ROTOR TIP LEAKAGE MODELS

A. R. WADIA (General Electric Co., Evendale, OH; General Motors Corp., Detroit Diesel Allison Div, Indianapolis, IN) AIAA Journal (ISSN 0001-1452), vol. 23, July 1985, p. 1061-1069. Previously cited in issue 16, p. 2294, Accession no A83-36258. refs

A85-38997#

STABILITY OF THE THIN-JET MODEL OF THE UNSTEADY JET FLAP

D. I. PULLIN and J. M. SIMMONS (Queensland, University, Brisbane, Australia) AIAA Journal (ISSN 0001-1452), vol. 23, July 1985, p 1118-1120. refs

A 'jet flap' is generated by the ejection of air from a spanwise slot at the trailing edge of an airfoil. In view of the success of numerical vortex sheet models of unsteady wakes, it has been useful to investigate the vortex sheet formulation of the thin jet in order to study its nonlinear behavior in a simple configuration; attention is given to the case of the periodic plunging motion of a wing-jet flap combination treated as an initial value problem, in order to avoid difficulties associated with downstream boundary conditions. The present finding of violent instability in the thin jet model is consistent with the severe instability problems discussed by Potter (1972), and indicates that the model is too unstable for practical use. O.C.

A85-39001#

TRANSONIC FLOW IN THE THROAT REGION OF RADIAL OR NEARLY RADIAL SUPERSONIC NOZZLES

B. F. CARROLL and J. C. DUTTON (Texas A & M University, College Station, TX) AIAA Journal (ISSN 0001-1452), vol. 23, July 1985, p. 1127-1129 refs

A transonic solution is presented that is applicable to annular nozzles whose throat flow is inclined at arbitrary, but large, angles to the nozzle axis-of-symmetry. This solution is a computationally efficient means of establishing a supersonic initial value line for space-marching supersonic calculations, and is applicable to the analysis of radial inflow and outflow, as well as planar geometries. A parametric study using the computer program of Carroll and Dutton (1984) was performed to establish guidelines for use of the transonic analysis. O.C.

A85-39021

THE FREE INTERACTION IN A SUPERSONIC FLOW OVER A POROUS WALL

M. A. PAGE (Monash University, Melbourne, Australia) and N RILEY (East Anglia, University, Norwich, England) Quarterly Journal of Mechanics and Applied Mathematics (ISSN 0033-5614), vol. 38, Feb. 1985, p. 79-92. refs

The present study is concerned with the free interaction which takes place when a supersonic stream flows past a plane wall, part of which is the surface of a bed of porous material. It is known that a polyurethane duct lining in a shock tunnel is extremely effective in reducing the strength of unwanted shock reflections. Clarke (1984) has considered the transient response of a bed of porous material to pressure changes at its upper surface due to the passage of a weak plane shock wave in the gas above it. In the current study, attention is given to the steady supersonic flow past a plane boundary, part of which is the surface of a bed of isotropic porous material. It is assumed that the flow in the porous medium is governed by Darcy's law. The results obtained are evaluated. The presence of a porous bed in a wall in the considered case is found to modify the flow to the extent that the distribution of pressure gradient is altered with a concomitant change in the position of flow separation, but the overall pressure rise is little changed. G.R.

A85-39058

ENGINE INLET INTERACTION WITH A PROP-FAN PROPULSION SYSTEM

D. D TANNER and T. A WYNOSKY (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) IN. Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p. 11-17.

(SAE PAPER 841478)

Pratt & Whitney participated in a cooperative model test program with NASA Lewis, Lockheed-Georgia and Hamilton Standard to evaluate chin inlet/propeller interactions using an advanced technology Prop-Fan model. The tests were conducted at the United Technologies Research Center's main wind tunnel using its propeller test rig and NASA Lewis's 2-ft diameter SR3 Prop-Fan model. The tests were done at several forward flight speeds, up to Mach 0.8, simulating both cruise and reverse thrust operation. Interaction effects with and without boundary layer diverters are discussed in terms of inlet recovery and installed thrust minus drag. These interaction effects are presented as a function of parameters such as power coefficient, advance ratio, mass flow ratio and Mach number

A85-39060* Douglas Aircraft Co., Inc., Long Beach, Calif AERODYNAMIC TEST RESULTS FOR A WING-MOUNTED TURBOPROP PROPULSION INSTALLATION

G. S. PAGE, H R WELGE (Douglas Aircraft Co., Long Beach, CA), and R. C. SMITH (NASA, Ames Research Center, Moffett Field, CA) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 27-33

(SAE PAPER 841480)

The paper provides an overview of the renewed interest in turboprop propulsion systems for future commercial transport designs. The potential operating cost advantage of advanced turbofan designs. Critical technology items for the aerodynamic installation of turboprop propulsion systems are presented, along with experimental results addressing the main technology issue for wing-mounted turboprop installations Nacelle installation effects are presented for overwing and underwing nacelles. The drag reduction for nacelle contouring is also shown. Wing/nacelle/power data are presented for the baseline wing geometry and for a wing modified to reduce the propeller power effects Author

A85-39063

INVESTIGATION OF TRANSONIC INLET DRAG CHARACTERISTICS

D. K. KRIVEC, R. T LING (Lockheed-California Co., Burbank, CA), and J. VADYAK (Lockheed-Georgia Co., Marietta, GA) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 69-80. refs

(SAE PAPER 841539)

Fourteen subsonic axisymmetric inlet models with various forebody contours and geometry parameters were tested in the NASA-Langley Research Center 16-foot transonic wind tunnel Test Mach numbers ranged from 0.59 to 0.96 A mass flow control throttle (translating plug) allowed mass flow ratios from 0.23 to 0.92. Force and pressure data were acquired for all fourteen inlets, with and without external boundary layer transition strips (grit). The force balance was found to be defective after completion of the test However, drag data were calculated from wake pressure rake data. Various inlet geometry effects on drag characteristics were analyzed. In particular, drag divergence Mach number was found to correlate with inlet thickness ratio. Experimental pressure and drag data were also compared with predictions from full potential transonic flow codes to verify their reliability and accuracy. The computer codes were found to be useful design tools that can help significantly reduce the number of inlet configurations to be examined experimentally. Author

A85-39064

DYNAMIC PRESSURE FLUCTUATIONS IN THE INTERNOZZLE REGION OF A TWIN-JET NACELLE

D E. BERNDT (Rockwell International Corp., North American Aircraft Operations, Los Angeles, CA) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 81-87 (SAE PAPER 841540)

The current trend of flying aircraft in a severe environment, i.e., high Mach numbers at low altitudes, has created interest in the impact of dynamic pressure fluctuations on nozzle hardware durability. Because of this interest, methods have been developed to obtain dynamic pressure data in the internozzle region of twin-jet aircraft models during wind tunnel testing Results from the wind tunnel tests have been analyzed to establish trends, such as the effect of flight variables and engine operating variables, on the dynamic pressure fluctuations. Comparisons have also been made between wind tunnel test results and flight test data. Author

A85-39200

COMPUTATION OF THREE-DIMENSIONAL FLOW USING THE EULER EQUATIONS AND A MULTIPLE-GRID SCHEME

C. KOECK (Matra S A., Velizy-Villacoublay, Yvelines, France) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, May 1985, p. 483-500 Research supported by the Direction des Recherches, Etudes et Techniques. refs

The unsteady Euler equations are numerically solved using the finite volume one-step scheme recently developed by Ni (1981). The multiple-grid procedure of Ni is also implemented. The flows are assumed to be homo-enthalpic; the energy equation is eliminated and the static pressure is determined by the steady Bernoulli equation; a local time-step technique is used. Inflow and outflow boundaries are treated with the compatibility relations method of ONERA The efficiency of the multiple-grid scheme is demonstrated by a two-dimensional calculation (transonic flow past the NACA 12 aerofoil) and also by a three-dimensional one (transonic lifting flow past the M6 wing). The third application presented shows the ability of the method to compute the vortical flow around a delta wing with leading-edge separation. No condition is applied at the leading-edge, the vortex sheets are captured in the same sense as shock waves. Results indicate that the Euler equations method is well suited for the prediction of flows with shock waves and contact discontinuities, the multiple-grid procedure allowing a substantial reduction of the computational time Author

A85-39205* Naval Ship Research and Development Center, Bethesda, Md

CIRCULATION CONTROL TECHNOLOGY APPLIED TO PROPULSIVE HIGH LIFT SYSTEMS

R. J. ENGLAR, J. H. NICHOLS, JR., M. J. HARRIS (David Taylor Naval Ship Research and Development Center, Bethesda, MD), J. C EPPEL, and M. D. SHOVLIN (NASA, Ames Research Center, Moffett Field, CA) IN: V/STOL An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 31-43. refs (SAE PAPER 841497)

Technology developed for the Circulation Control Wing high-lift system has been extended to augment lift by entraining and redirecting engine thrust. Ejecting a thin jet sheet tangentially over a small curved deflecting surface adjacent to the slipstream of a turbofan engine causes the slipstream to flow around that deflecting surface. The angle of deflection is controlled pneumatically by varying the momentum of the thin jet sheet. The downward momentum of the slipstream enhances wing lift. This concept of pneumatically deflecting the slipstream has been applied to an upper surface blowing high-lift system and to a thrust deflecting system was demonstrated in a series of investigations using a wind tunnel model and the NASA Quiet Short-hail Research Aircraft (QSRA). Full-scale thrust deflections greater than 90 deg were achieved. This mechanically simple system can provide increased maneuverability, heavy lift or overload capability, or short takeoff and landing performance. Author

A85-39210*#National Aeronautics and Space Administration.Ames Research Center, Moffett Field, Calif.PRESSURECOMPUTATIONAL/EXPERIMENTALPRESSURE

COMPUTATIONAL/EXPERIMENTAL PRESSURE DISTRIBUTIONS ON A TRANSONIC, LOW-ASPECT-RATIO WING

E. R. KEENER (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 545, 546; Abridged. Previously cited in issue 20, p. 2847, Accession no. A84-42345.

A85-39216#

MULTIGRID CALCULATION OF TRANSONIC FLOW PAST WING-TAIL-FUSELAGE COMBINATIONS

A. SHMILOVICH (Douglas Aircraft Co., Long Beach, CA; Cornell University, Ithaca, NY) and D. A. CAUGHEY (Cornell University, Ithaca, NY) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 581-586. refs

(Contract N00014-77-C-0033)

A computer program for calculating transonic potential flowfields about three-dimensional wing-tail-fuselage combinations has been developed. The transonic potential equation is approximated and solved numerically using a finite volume method on a boundary-conforming coordinate system. The multigrid technique is utilized to accelerate convergence of the relaxation scheme and, thus, allow computations about multiple-component airplanes with reasonable expenditure of computer resources. The wing-tail flow interaction is investigated and results indicate that the tail exerts a noticeable effect on the wing loading when the tail is located near the wing trailing edge. Author

A85-39219*# North Carolina State Univ., Raleigh. NUMERICAL AND EXPERIMENTAL DETERMINATION OF SECONDARY SEPARATION ON DELTA WINGS IN SUBSONIC FLOW

F. R. DEJARNETTE (North Carolina State University, Raleigh, NC) and S. H. WOODSON Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 602-608. Previously cited in issue 20, p. 2844, Accession no. A84-41340. refs (Contract NCC1-22; NCC1-46)

A85-39223#

AERODYNAMICS OF AN ASPECT RATIO 8 WING AT LOW REYNOLDS NUMBERS

J. F. MARCHMAN, III and A. A. ABTAHI (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 628-634. Previously cited in issue 07, p. 842, Accession no. A85-19630. refs (Contract N00014-84-K-0093)

A85-39224#

THEORETICAL CONSIDERATIONS IN THE AERODYNAMIC EFFECTIVENESS OF WINGLETS

K. ASAI (National Aerospace Laboratory, Tokyo, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 635-637. refs

An attempt is made to identify and explain the relative advantages of planar and nonplanar wings, by means of simple theoretical analyses taking into account such structural constraints as the wing root bending moment, which is presently used as an index of the structural weight of a wing. In addition, the influence of parasite drag has been included in a tradeoff study which employs empirical methodology. The parasite drag penalty was found to be crucial to the discussion of the relative advantages of a winglet and a tip extension, although most of the previous theoretical studies have not taken this into account. O.C.

A85-39225#

DYNAMIC OVERSHOOT OF THE STATIC STALL ANGLE

L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 637, 638. refs

The extensive set of experimental results for an airfoil in pitch-up motion presented by Daley and Jumper (1984) is compared with Encsson and Reding's (1976) analytic prediction of the dynamic overshoot of the static stall angle. Attention is given to the 'infinite Reynolds number limit' reached when the pitch-up rate exceeds a certain value. It is noted that, at high pitch-up rates, the dynamic overshoot of static stall is primanly due to the Karman-Sears (1983) wake effect. O.C.

A85-39226*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. DYNAMIC GROUND EFFECTS ON A TWO-DIMENSIONAL FLAT PLATE

Y.-S. CHEN (NASA, Marshall Space Flight Center, Huntsville, AL) and W. G. SCHWEIKHARD (Kohlman System Research, Inc., Lawrence, KS) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 638-640. refs

(Contract NAS8-35918)

The effect of time-variant vortex shedding is simulated by a sequence of discrete vortices convecting downstream in the wake of a two-dimensional flat plate whose lifting condition is modeled by means of the quasi-vortex lattice method. The boundary condition of this problem is specified in such a way that the tangency condition on the surface of the flat plate is satisfied; the boundary condition relative to the ground Significant lift changes are shown to occur, due to the dynamic ground effect, that are crucial in aircraft takeoff and landing transitions. O.C.

A85-39241* Royal Aircraft Establishment, Bedford (England). COMPUTER STUDIES OF HYBRID SLOTTED WORKING

COMPUTER STUDIES OF HABRID SLOTTED WORKING SECTIONS WITH MINIMUM STEADY INTERFERENCE AT SUBSONIC SPEEDS

D G. MABEY (Royal Aircraft Establishment, Bedford, England) and F. W. STEINLE (NASA, Ames Research Center, Moffett Field, CA) Aeronautical Journal (ISSN 0001-9240), vol. 89, April 1985, p. 135-148. refs

Currently there is renewed interest in the evaluation and reduction of steady wind tunnel wall interference, especially for large models. Evaluation of previous predictions for perforated and slotted tunnels suggests that a hybrid slotted tunnel (i.e., a slotted tunnel with closed slats and perforated slots) should offer minimum corrections for upwash, flow curvature and solid blockage. This suggestion is confirmed by the present computer studies of a range of rectangular hybrid slotted tunnels. The computer studies are for tunnel working section height to breadth ratios of 0.835 and 0.600 over the Mach number range from 0 to 0.85. Wings swept at 28 deg and 50 deg, with ratios of model span to tunnel breadth varying from 0 to 0.7, are considered. An idealized fuselage shape is used to predict solid and wake blockage corrections for the wall configurations selected on the basis of minimum upwash and curvature interference. Author

A85-39242

MODELLING VORTEX FLOWFIELDS BY SUPERCOMPUTERS WITH SUPER-SIZE MEMORY

A. RIZZI (Flygtekniska Forsoksanstalten, Bromma; Kungl. Tekniska Hogskolan, Stockholm, Sweden) Aeronautical Journal (ISSN 0001-9240), vol. 89, April 1985, p. 149-161. Research supported by the Control Data Corp. refs

The possibilities for studying fluid flow on the basis of mathematical models are considered. Fluid motion is governed by the Navier-Stokes equations. However, present day methods are unable to provide solutions to general three-dimensional problems, and modeling simplifications are-needed. One step along the way to a computer solution involves the transformation of the continuum problem posed by the Navier-Stokes equation to a discrete one. A network of grid points is laid out, and a large dynamical system

of nonlinear algebraic equations is to be solved. As the size of this system increases, the discrete model becomes an increasingly higher-order approximation to the asymptotic limit of the founding continuum model. This size is restricted by the capacity of the computer, and the utilization of a computer with a larger memory, in the considered case 16 million words of 64-bit precision, can lead to very significant advances regarding the obtainable solutions. Attention is given to classical leading-edge flows, leading-edge vorticity and turbulence, and the importance of supercomputers

GR.

A85-39245#

CORRELATION AND PREDICTION OF ROTATING STALL INCEPTION BY DIVERGENCE WETHOD

V. J. ZIKA ASME, Transactions, Journal of Fluids Engineering (ISSN 0098-2202), vol. 107, June 1985, p. 191-196. refs

An empirical correlation of rotating stall inception points of elementary compressors, modeled as equivalent diffusers, is presented. From it, two inception criteria for self-induced rotating stall are derived. Compressor blade rows are classified according to a geometric form parameter into two groups, subcritical and supercritical. The subcritical geometries stall at a constant kinematic area ratio, in what appears to be a pure rotating stall mode, which occurs before the airfoil stalls. In supercritical geometries, the rotating stall is delayed until it is triggered by the airfoil stall. Thus, for the latter geometries, the airfoil stall and rotating stall are coincident. In contrast to other diffuser-analog methods, the divergence method determines the stall angle and the stalled flow coefficient rather than the stalled pressure rise.

A85-39445

SIMILARITY PROPERTIES IN THE PROBLEM OF FLOW FROM A SUPERSONIC SOURCE PAST A SPHERICAL BLUNTNESS

IU. P GOLOVACHEV (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 28, July 1985, p. 1165-1171. refs

The problem of steady-state perfect gas flow from a supersonic spherical source past a spherical bluntness is discussed. Numerical solutions for the nonviscous gas equations, the boundary-layer equations, and the Navier-Stokes equations are given. Universal relations for the heat transfer and drag parameters which apply to a wide range of Mach and Reynolds numbers for different free-stream uniformities, are constructed. The results presented are based on numerical solutions of the problem for a gas with a specific heat ratio of 1.4.

A85-39578#

A COMPUTATIONAL STUDY OF THE UNSTEADY SHOCK-WAVE STRUCTURE IN A TWO-DIMENSIONAL TRANSONIC ROTOR

P. D. SPARIS (Thrace, University, Xanthi, Greece) Journal of Propulsion and Power (ISSN 0748-4658), vol 1, July-Aug. 1985, p. 261, 262; Abridged.

Some of the loss mechanisms associated with unsteady transonic flow in a two-dimensional cascade are discussed. For this purpose, the unsteady flowfield generated by a shifting inlet velocity profile modeling approximately the stator wake as a linear velocity profile is compared to the steady field created by a uniform inlet. Both flows are generated by a numerical solution of the Euler equations using the MacCormack difference scheme. The results indicate that there is considerable influence of the inlet flow unsteadiness on the location of the shock wave that moves upstream for a distance on the order of 15 percent of chord length. The shock also tends to oscillate with an amplitude 5 percent of chord length. These shock oscillations generate pressure waves propagating downstream of the rotor increasing the flow mixing losses They should also affect the boundary layer detrimentally. An overall effect of the shifting velocity deficit is 10 percent of steady-state lift. Author

A85-39581#

EXTERNAL COMPRESSION SUPERSONIC INLET ANALYSIS USING A FINITE DIFFERENCE TWO-DIMENSIONAL NAVIER-STOKES CODE

A. F. CAMPBELL, J SYBERG, and C. K. FORESTER (Boeing Military Airplane Co, Seattle, WA) Journal of Propulsion and Power (ISSN 0748-4658), vol 1, July-Aug. 1985, p. 279-285. Previously cited in issue 17, p. 2420, Accession no. A84-37216.

A85-39582#

STUDY OF AN ASYMMETRIC FLAP NOZZLE AS A THRUST-VECTORING DEVICE

C. C. WU (California State University, Los Angeles, CA) and W. L. CHOW (Illinois, University, Urbana, IL) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, July-Aug. 1985, p 286-291. Previously cited in issue 16, p. 2278, Accession no A84-35190 refs

(Contract DAAG29-79-C-0184; DAAG29-83-K-0043)

A85-39589#

SIMULATION OF WAKE PASSING IN A STATIONARY TURBINE ROTOR CASCADE

D. J DOORLY (University College, London; Oxford University, Oxford, England) and M. L. G. OLDFIELD (Oxford University, Oxford, England) Journal of Propulsion and Power (ISSN 0748-4658), vol 1, July-Aug. 1985, p. 316-318. Research supported by the Science and Engineering Research Council and Rolls-Royce, Ltd. refs

The present experiment has permitted the generation of wake-passing flow in a stationary cascade of turbine rotor blades that are mounted in a short-duration wind tunnel. Schlieren flow visualization and unsteady heat flux data were obtained for the case of a typical turbine blade profile operating at full scale Reynolds and Mach numbers. Experimental design flexibility has allowed assessments to be made of the effects of wake size, spacing, and combinations of wake passing and freestream turbulence. By running the wake generator at subsonic and sonic flow-relative speeds, studies have been conducted of the effects of wake passing with and without associated shock waves. O.C.

A85-39613#

DEVELOPMENT OF AN ACTIVE LAMINAR FLOW NACELLE

J. S. MOUNT and V MILLMAN (Rohr Industries, Inc., Chula Vista, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 15 p. refs

(AIAA PAPER 85-1116)

The work being done to explore the concept of active laminar flow control (LFC) for nacelles is described. It is shown that there is a potential for drag reduction through suppressing transition of the laminar boundary layer. The associated pumping losses and weight gains for typical structure and suction systems are examined. A flight test program using the Citation III, believed to be a practical and low-cost way to demonstrate LFC for an engine nacelle, is outlined. Some of the problems along the road to successful development, such as surface contamination and clearing, damage and repair, lightning strike, and liquid entry are considered. M D.

A85-39615#

SUBSTANTIATION OF THE APPLICABILITY OF VSAERO PANEL METHOD TO SUBSONIC INLET DESIGN

R. TINDELL and H POTONIDES (Grumman Corp, Bethpage, NY) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 15 p. refs

(AIAA PAPER 85-1119)

The results of application of the VSAERO panel code for inlet flowfield analysis of the Grumman design 698V/STOL aircraft are discussed. The code calculates the nonlinear aerodynamic characteristics of selected ducts in subsonic flow. Either Karman-Tsien or Prandtl-Meyer factors are used to approximate compressibility effects and velocity distributions are computed over the entire panel to derive streamlines. VSAERO also accommodates off-surface flowfield calculations. The V/STOL required a duct lip which does not experience separation over a wide range of angles of attack or during transition between horizontal and vertical flight modes. Additionally, flow distortion had to be minimized. The studies covered inlet-airframe integration effects, the inlet design and pressure distribution. Results are discussed for low-speed flight. M.S.K.

A85-39618#

UNSTEADY BLADE ROW INTERACTIONS IN A MULTI-STAGE COMPRESSOR

V. R. CAPECE, S. R. MANWARING, and S. FLEETER (Purdue University, West Lafayette, IN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p. USAF-supported research. refs

(AIAA PAPER 85-1134)

A three-stage research compressor has been utilized to investigate the multi-stage blade row interaction gust aerodynamics for the first time. The aerodynamic forcing functions as well as the chordwise distributions of the steady surface pressures and the first harmonic unsteady pressure differences on the first and second stage stator vane rows were experimentally determined over a range of operating and geometric conditions. This series of experiments determined that the complex unsteady aerodynamic loading on downstream blade rows is directly related to the forcing function to that blade row, with this forcing function significantly affected by multi-stage blade row interactions. These results have an implication towards the modeling of unsteady aerodynamic blade row interaction phenomena. Namely, the variations of the second stage unsteady data with forcing function waveform cannot be predicted by harmonic gust models. Author

A85-39658#

NUMERICAL SIMULATION OF A SUPERCRITICAL INLET FLOW

M.-S. LIOU (National Cheng Kung University, Tainan, Republic of China; Michigan, University, Ann Arbor, MI), W. L. HANKEY (Wright State University, Dayton, OH), and J. L. MACE (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p refs

(Contract F49620-82-C-0035; AF-AFOSR-84-0327)

(AIAA PAPER 85-1214)

The Reynolds-averaged, unsteady Navier-Stokes equations were solved numerically to predict flow-fields in a two-dimensional supersonic inlet. First, a brief description of numerical procedures, as well as boundary conditions is given. The discussion of calculated results follows. A flow at supercritical conditions was calculated and found to be unsteady. Hence, detailed spectral information for the computed data is given and the boundary-layer parameters, e.g., skin friction coefficients, are shown. Several physically interesting phenomena are discussed. The distribution of the entropy change indicating the performance of the inlet under the chosen set of conditions is given also.

A85-39659#

APPLICATION OF 3-D FLOW COMPUTATIONS TO GAS TURBINE AERODYNAMIC DESIGN

F. W. HUBER, R. J. ROWEY (United Technologies Corp., Engineering Div., West Palm Beach, FL), and R. R. NI (United Technologies Corp., Engineering Div., East Hartford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs

(AIAA PAPER 85-1216)

The application of three-dimensional flow modeling techniques to the aerodynamic design of high performance gas turbines is given. The general approach to three-dimensional flow computations, and formulation of equations and boundary conditions is included. In recent years these computational methods have been developed into valid and useful design tools, capable of iterative/interactive-utilization in the turbine-design-process. Pratt and Whitney Aircraft has applied these advanced design tools to several new turbine configurations to provide improved performance and reduced risk relative to that achievable using conventional 2-D or quasi 3-D analyses. Significant performance benefits have Author

A85-39661#

INVESTIGATION OF THE EFFECT OF TWO ENDWALL CONTOURS ON THE PERFORMANCE OF AN ANNULAR NOZZLE CASCADE

S. H. MOUSTAPHA (Pratt and Whitney Canada, Longueul, Quebec, Canada) and R. G. WILLIAMSON (National Research Council of Canada, Gas Dynamics Laboratory, Ottawa, Canada) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985, 11 p. refs

(AIAA PAPER 85-1218)

An annular nozzle cascade, of low aspect ratio and high flow turning, was tested with two different endwall contours over a range of exit flow conditions from subsonic to supersonic. Measurements were made of the distributions of exit total pressure and flow angle. Significant performance degradation occurred with increasing Mach number, particularly in the vicinity of the hub. Observed differences in radial loss distribution between the two nozzle builds were correlated with predicted static pressure differences on the endwalls. Author

A85-39685#

ON THE MODELLING OF A FULLY-RELAXED PROPELLER SLIPSTREAM

M. P. METCALFE (British Aerospace, PLC, Woodford, Ches., England) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 16 p refs (AIAA PAPER 85-1262)

A method for the solution of complete induced velocity equations is presented, in order to predict the effects of propeller airframe interference for an advanced turboprop. The method does not require simplification and permits the development of a model that provides the position of and velocities in self-consistent fully relaxed slipstream. Results are presented defining the induced swirl, and axial and radial velocities for a number of cases that can be validated using the General Momentum theory. The induced velocities and position of the slipstream can be determined within five iterations using the slipstream program proposed. L.T.

A85-39686*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COMPARISON OF ADVANCED TURBOPROP INSTALLATION ON SWEPT AND UNSWEPT SUPERCRITICAL WINGS AT TRANSONIC SPEEDS

J. R. CARLSON, O C PENDERGRAFT, JR. (NASA, Langley Research Center, Propulsion Aerodynamics Branch, Hampton, VA), and G R. BARTLETT (NASA, Langley Research Center; Vigyan Research Associates, Inc., Hampton, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p.

(AIAA PAPER 85-1264)

A series of wind-tunnel investigations were conducted to determine the aerodynamic interference associated with the over wing and under wing installation of a turboprop nacelle on 20 deg swept and unswept supercritical wings. The purpose of the investigations was to increase the understanding of the flow interactions involved with the nacelle turboprop integration and to obtain experimental data for the verification of computational prediction techniques. The models were tested in the Langley 16-Foot Transonic Tunnel at Mach numbers from 0.50 to 0.80 and at angles-of-attack from 0 to 5 deg. In addition, data at several propeller pitch angles and advance ratio settings were obtained. This paper which presents only the results of the over-the-wing nacelle installations shows that wing sweep had considerable influence on the installation interference. Large scale flow separation was observed on the swept wing at M = 0.8 Less

severe effects were observed at M=0.7 on the swept wing and for both M=0.7 and 0.8 on the unswept wing. Author

A85-39689#

NUMERICAL SOLUTIONS OF RAMJET NOZZLE FLOWS

J. A. SCHETZ (Virginia Polytechnic Institute and State University, Blacksburg, VA), F. S. BILLIG, and S. FAVIN (Johns Hopkins University, Laurel, MD) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p Navy-supported research. refs

(AIAA PAPER 85-1270)

Unsplit explicit McCormack unsteady/finite difference method is used to solve the equations of motion for nozzle flows in ramjets and scramjets. A turbulent kinetic energy model is employed to treat the turbulent transport taking place during the expansion process in scramjets with no throat at the end of the combustor. Consideration is given to the treatment of the chemistry by either frozen, equilibrium, or simple global finite rate model. Numerical methods for calculating the flowfield and performance of scramjet nozzles is presented, treating the nozzle core flow and the nozzle boundary layer separately. The method yields high computational capacity, making it possible to design efficient nozzles which operate with strongly nonuniform inflow profiles. L.T

A85-39697#

LOSS IN TURBOFAN THRUST CAUSED BY BOUNDARY LAYER GROWTH IN A NACELLE'S INLET AND EXHAUST DUCTS

W. M DOUGLASS AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 4 p. (AIAA PAPER 85-1281)

A different approach to the evaluation of the losses in a nacelle's inlet and exhaust ducts and how they effect the performance and operation of a turbofan engine is presented. The approach of this report is to evaluate the skin friction loss in the duct as a growth in boundary layer as opposed to the conventional method which evaluates the loss in terms of a pressure drop across the entire duct. Author

A85-39700^{*}# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. EFFECT OF A WING-TIP MOUNTED PUSHER TURBOPROP ON

EFFECT OF A WING-TIP MOUNTED PUSHER TURBOPROP ON THE AERODYNAMIC CHARACTERISTICS OF A SEMI-SPAN WING

J. C. PATTERSON, JR. (NASA, Langley Research Center, Hampton, VA) and G. R. BARTLETT (Vigyan Research Associates, Inc., Hampton, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 9 p. refs (AIAA PAPER 85-1286)

An exploratory investigation has been conducted at the NASA Langley Research Center to determine the installed performance of a wing tip-mounted pusher turboprop. Tests were conducted using a semispan model having an unswept, untapered wing with a air-driven motor located on the tip of the wing, with an SR-2 design high speed propeller installed on the rear shaft of the motor All tests were conducted at a Mach number of 0.70, at angles of attack of approximately -2 to +4 deg, and at a Reynolds number of 3.82 million based on the wing chord of 13 inches. The data indicate that, as a result of locating the propeller behind the wing trailing edge, at the wingtip, in the cross flow of the tip vortex, it is possible to recover part of the vortex energy as an increase in propeller thrust and, therefore, a reduction in the lift-induced drag as well. **A85-39728*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF RUNGE KUTTA TIME MARCHING SCHEME FOR THE COMPUTATION OF TRANSONIC FLOWS IN TURBOMACHINES

S. V. SUBRAMANIAN (NASA, Lewis Research Center, Cleveland, OH, Avco Corp., Avco Lycoming Div., Stratford, CT) and R. BOZZOLA (Avco Corp, Avco Lycoming Div., Stratford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs (AIAA PAPER 85-1332)

Numerical solutions of the unsteady Euler equations are obtained using the classical fourth order Runge Kutta time marching scheme This method is fully explicit and is applied to the governing equations in the finite volume, conservation law form. In order to determine the efficiency of this scheme for solving turbomachinery flows, steady blade-to-blade solutions are obtained for compressor and turbine cascades under subsonic and transonic flow conditions. Computed results are compared with other numerical methods and wind tunnel measurements. The present study also focuses on other important numerical aspects influencing the performance of the algorithm and the solution accuracy such as grid types, boundary conditions, and artificial viscosity. For this purpose, H, O, and C type computational grids as well as characteristic and extrapolation type boundary conditions are included in the solution procedure. Author

A85-39729# ACCURATE AND EFFICIENT SOLUTIONS OF TRANSONIC INTERNAL FLOWS

A. DADONE (Bari, Universita, Bari, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. Research supported by the Ministero della Pubblica Istruzione and Consiglio Nazionale delle Ricerche. refs (AIAA PAPER 85-1334)

The present paper provides a 'Modified Perturbative Lambda Formulation' for solving inviscid transonic flows. The proposed method takes correctly into account the transition from supersonic to subsonic flow conditions through a shock, thus allowing the coupling of these two regions and, therefore, the upstream movement of the shock. The modifications of the lambda formulation are derived from an analysis of a flux difference splitting methodology so that the proposed formulation and such methodologies perform very similarly in the shock transition region The accuracy and efficiency of the present formulation are demonstrated by computing both one-dimensional and arbitrary two-dimensional transonic flows. Author

A85-39736#

PERFORMANCE CHARACTERISTICS OF RECTANGULAR AND CIRCULAR THRUST AUGMENTING EJECTORS

M. E. FRANKE (USAF, Institute of Technology, Wright-Patterson AFB, OH) and G. UNNEVER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs

(AIAA PAPER 85-1344)

Effects of various parameters on the thrust augmentation of rectangular and axisymmetric circular cross section ejectors are studied. Ejector performance is shown to depend on primary nozzle area ratio and diffuser area ratio. Primary nozzle configuration, inlet position, and fluid injection angle are shown to affect thrust augmentation Continuous slot primary nozzles are compared with discrete slot primary nozzles in both the rectangular and circular ejectors. The effect of mixing plates on exit velocity profile and thrust agumentation is studied Results and trends are compared with the literature Author

National Aeronautics and Space Administration. A85-39738*# Langley Research Center, Hampton, Va.

CIRCULAR-TO-RECTANGULAR TRANSITION DUCTS FOR HIGH-ASPECT RATIO NONAXISYMMETRIC NOZZLES

J. R. BURLEY, II (NASA, Langley Research Center, Hampton, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. refs

(AIAA PAPER 85-1346)

The next generation fighter aircraft will be equipped with nonaxisymmetric multifunction jet engine exhaust systems. The circular-to-rectangular transition duct employed in these systems has been made longer with the objective to maintain uniform flow The weight of the exhaust system increases with increasing nozzle aspect ratio. The new design is to provide enhanced maneuvering and STOL performance. It is attempted to reduce the increase in weight as much as possible by new design strategies. The present paper has the objective to show through experimental data that the current design guidelines for transition ducts can be expanded so that shorter transitions are possible thereby reducing the nonaxisymmetric exhaust system weight penalty. G.R.

A85-39740#

STALL TRANSIENTS OF AXIAL COMPRESSION SYSTEMS WITH INLET DISTORTION

F. K MOORE (Cornell University, Ithaca, NY) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 13 p. refs (AIAA PAPER 85-1348)

A previously-derived system of differential equations, based on fluid mechanics, are extended to provide a theory to predict how rotating stall or surge will develop in an axial compression system under combined influences of inlet distortion and throttle ramping. Results are relevant to the problem of stagnation stall or gas turbines. It is found that stall margin is improved by large aerodynamic lag in the compressor. Both stall and recovery transients are considered. A distinction between axisymmetric and in-rotating-stall compressor performance characteristics leads to a concept of rotating-stall stability that explains the appearance of classic stall at low stage loading and the hysteresis associated with rotating stall. The influences of various system parameters are systematically explored, and it is found that large B parameter, tall compressor characteristic diagram, and rapid throttle closure all favor surge, while large distortion and small shut-off head relative to peak pressure rise both favor rotating stall When surge occurs, rotating stall is usually also present. Author

A85-39741#

AXIAL-FLOW COMPRESSOR STAGE POST-STALL ANALYSIS

W. T. COUSINS (Garrett Turbine Engine Co., Phoenix, AZ) and W. F. OBRIEN (Virginia Polytechnic Institute and State University, Blacksburg, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. USAF-supported research. refs

(AIAA PAPER 85-1349)

Rotating stall in a compressor stage is simulated by the numerical solution of a fluid dynamic model of an inlet guide vane and rotor row. The mathematical formulation of the model is described. Solutions for the flow upstream and downstream of the modeled stage are obtained for normal unstalled operation and for-a simulation-of-stable-rotating stall. Examples of the predicted velocity and pressure fields are shown, and conclusions are developed regarding recovery from rotating stall. The influence of the rotor row loss coefficient curve and other blade row design variables on model predictions are studied. Author

A85-39766#

PNS PREDICTED SHOCK LOCATION AND JUMP CONDITIONS AT SUPERSONIC AND HYPERSONIC SPEEDS

D. W. MAYER and J. Y. BALTAR (Boeing Military Airplane Co., Seattle, WA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs (AIAA PAPER 85-1407)

Progress has been made toward preparing a parabolized Navier-Stokes (PNS) code to support design of supersonic and hypersonic vehicles. Code preparation work includes both development and testing of the code, and as part of this, a study on the effects of mesh resolution and smoothing on solution accuracy was completed. This paper reports on these effects and discusses the implications of using PNS methods for propulsion system analysis. In particular, the ability of the code to accurately predict induced shock and boundary layer characteristics has been tested. Important findings are: (1) PNS codes can accurately predict induced shocks for inviscid flow, (2) induced shock locations predicted for viscous flow are qualitatively correct, and (3) turbulent boundary layer development can be accurately predicted in the supersonic and low hypersonic speed regimes. At present, code stability becomes an increasing problem above Mach 8. Additional modifications to the differencing scheme and energy equation formulation are planned to facilitate the use of the PNS code in the hypersonic speed regime. Author

A85-39767*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CALCULATION OF THREE-DIMENSIONAL, VISCOUS FLOW THROUGH TURBOMACHINERY BLADE PASSAGES BY PARABOLIC MARCHING

T. KATSANIS (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st. Monterey, CA, July 8-10, 1985 14 p. Previously announced in STAR as N85-23711. refs

(AIAA PAPER 85-1408)

The three-dimensional compressible Navier-Stokes equations are formulated in a rotating coordinate system, so as to include centrifugal and Coriolis forces The equations are parabolized by using a previously calculated inviscid static pressure field. The thin layer Navier-Stokes approximation, which neglects streamwise diffusion, is used. A body-fitted coordinate system is used. The streamwise momentum equation is uncoupled from the cross-stream momentum equation by using contravariant momentum components, and then using the contravariant velocity components as primary unknowns. To reduce problems with small separating regions, the Reyhner and Flugge-Lotz approximation is used. The energy equation is included to allow for calculation of heat transfer. The flow may be laminar, or a simple eddy-viscosity turbulence may be used. A number of curved ducts and an axial stator were analyzed, including cases for which experimental data are available. Author

A85-39768*# United Technologies Research Center, East Hartford, Conn.

NUMERICAL INVESTIGATION OF INTERNAL HIGH-SPEED **VISCOUS FLOWS USING A PARABOLIC TECHNIQUE**

O. L. ANDERSON and G. D. POWER (United Technologies Research Center, East Hartford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs

(Contract NAS1-17561)

(AIAA PAPER 85-1409)

A feasibility study has been conducted to assess the applicability of an existing parabolic analysis (ADD-Axisymmetric Diffuser Duct), developed previously for subsonic viscous internal flows, to mixed supersonic/subsonic flows with heat addition simulating a SCRAMJET combustor. A study was conducted with the ADD code modified to include additional convection_effects in the normal momentum equation when supersonic expansion and compression waves are present. A set of test problems with weak shock and expansion waves have been analyzed with this modified ADD method and stable and accurate solutions were demonstrated provided the streamwise step size was maintained at levels larger than the boundary layer displacement thickness. Calculations made with further reductions in step size encountered departure solutions consistent with strong interaction theory. Calculations were also performed for a flow field with a flame front in which a specific heat release was imposed to simulate a SCRAMJET combustor. In this case the flame front generated relatively thick shear layers which aggravated the departure solution problem. Qualitatively correct results were obtained for these cases using a marching technique with the convective terms in the normal momentum equation suppressed. It is concluded from the present study that for the class of problems where strong viscous/inviscid interactions are present a global iteration procedure is required.

A85-39779#

A FURTHER ASSESSMENT OF NUMERICAL ANNULAR DUMP DIFFUSER FLOW CALCULATIONS

W. SHYY (GE Research and Development Center, Schenectady, NY) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs

(AIAA PAPER 85-1440)

A further study has been conducted for a model dump diffuser. The results obtained from several flow calculations using the standard k-epsilon turbulence model on two levels of grid distribution are presented. It is found that a coarser grid distribution may yield a better agreement between the numerical prediction and the experimental data. Also, a lower order finite difference scheme may produce a more favorable theory-data comparison than the higher order ones. The findings suggest that the standard k-epsilon two-equation turbulence model is inadequate for predicting the detailed features of the flow studied here. The zonal grid approach, which divides the whole flow domain into several subregions and generates the grid system in each subregion according to its own need, is also much needed. Both the physical modeling and the numerical grid generation needs require extensive research effort. However, it appears that the essential qualitative flow characteristics were present in the numerical simulation; hence, the present model should be useful for studying the global behavior of the flow field. Author

A85-39792#

A SIMULATION TECHNIQUE FOR JET TEMPERATURE EFFECTS ON NOZZLE-AFTERBODY DRAG AT TRANSONIC MACH NUMBERS

W. L. PETERS (Calspan Corp., Arnold Engineering Development Center, Arnold Air Force Station, TN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p. refs

(AIAA PAPER 85-1463)

The objective of this investigation was to implement and demonstrate the performance of a technique for correcting nozzle/afterbody drag coefficient for jet temperature effects at transonic free-stream Mach numbers. The technique corrects axisymmetric nozzle afterbody drag coefficient for jet-temperature-related effects associated with inviscid jet plume shape and with jet mixing or entrainment Data were utilized from experiments conducted in the AEDC 1-ft and 16-ft transonic wind tunnels with two strut-mounted axisymmetric models incorporating a 15-deg afterbody boattail angle. The correction technique predicts jet temperature effects on afterbody drag coefficient (based on body diameter) within 50 drag counts at subsonic free-stream Mach numbers and 100 drag counts at supersonic free-stream Mach numbers. Author

A85-39793*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RESULTS OF AGARD ASSESSMENT OF PREDICTION CAPABILITIES FOR NOZZLE AFTERBODY FLOWS

L. E. PUTNAM (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) and N. C BISSINGER (Messerschmitt Boelkow Blohm GmbH, Muenich, West Germany) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 13 p refs (AIAA PAPER 85-1464)

This paper presents a brief review of an assessment conducted by AGARD Working Group 08 to determine the capabilities of theoretical methods for predicting the flow over nozzle afterbody configurations. A series of test cases were selected for which extensive experimental data were available. The assessment was limited to axisymmetric nozzle configurations with a jet simulated with high-pressure air. Contributions were solicited from researchers, identified by a literature search, who had developed methods for predicting such flows. Predictions made with methods that varied in complexity from multicomponent techniques to solutions of the Navier Stokes equations were received. The status of the theoretical methods for predicting nozzle afterbody flows is illustrated by comparison with the experimental measurements.

Author

A85-39874#

TWO-DIMENSIONAL TURBULENT FLOW ANALYSIS IN TURBOMACHINERY BY THE FINITE ELEMENT METHOD

M. IKEGAWA, S. NAKANO, and Y SHIKANO (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 7 p. refs (ASME PAPER 84-WA/FM-2)

A new finite element technique based on the two equation turbulence model and combined with a body-fitted curvilinear coordinate system is presented for analyzing two-dimensional turbulent flow in turbomachinery. The governing equations are integrated within a small control volume to produce conservation law forms for the unknown variables. The finite element technique is applied to these equations, where quadrilateral elements with four nodes are used for its formulation Resulting sets of algebraic equations are solved by the use of a relaxation method. It is shown that the present method gives encouraging results for turbulent flow analysis and provides an effective tool for estimating the performance of turbomachinery. Author

A85-39875#

AN INVESTIGATION OF LIFT AUGMENTATION OF TANDEM CASCADES

R. R. MANKBADI (Rutgers University, New Brunswick, NJ) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 7 p. refs

(ASME PAPER 84-WA/FM-3)

The role of the relative layout of tanndem cascades on the effective lift is considered. The metod of singularity is used to predict the effective life coefficient of two or three cascades of geometrically identical blades of different lengths placed relative to each other. In the case of a double cascade system with one set of blades shorter than the other, a considerable enhancement in life is obtained as the short blades are placed at the middle of the long ones. In the case of a three-element cascade system, an increase of as much as 32 percent in the effective lift is obtained at ideal incidence conditions. This lift augmentation was found to be basically due to optimizing the blade interference effect with no apparent increase in losses.

A85-39876#

FLOWFIELD AND PERFORMANCE MEASUREMENTS IN A VANED RADIAL DIFFUSER

P. PIEMSOMBOON, J C. DUTTON, and P. E JENKINS (Texas A&M University, College Station, TX) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec 9-14, 1984. 6 p Research supported by the Texas A&M University refs

(ASME PAPER 84-WA/FM-7)

The flow characteristics of a vaned radial diffuser typical of those currently used in centrifugal compressors have been determined experimentally by using a static diffuser test rig. The vortex test vehicle (VTV) portion of this rig was used to simulate the essential features of the flow leaving the impeller of an actual compressor. The mean flow phenomena at the diffuser entrance and the static pressure recovery along the diffuser passage have been determined. In addition, the flow angle and Mach number distributions at several key locations throughout the diffuser channel have been obtained. The most notable feature of the diffuser flowfield is the degree of nonuniformity in the inlet/leading edge Author region.

N85-27822*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AERODYNAMIC SUPERSONIC CHARACTERISTICS OF CANARD, TAILLESS, AND AFT-TAIL CONFIGURATIONS FOR **2 WING PLANFORMS**

P F. COVELL Jun. 1985 69 p refs

(NASA-TP-2434; L-15927; NAS 1.60:2434) Avail NTIS HC À04/MF A01 CSCL 01A

Aerodynamic characteristics of canard, tailless, and aft tail configurations were compared in tests on a general research model (generic fuselage without canopy, inlets, or vertical tails) at Mach 1.60 and 2.00 in the Langley Unitary Plan Wind Tunnel. Two uncambered wing planforms (trapezoidal with 44 deg leading edge sweep and delta with 60 deg leading edge sweep) were tested for each configuration. The relative merits of the configurations were also determined theoretically, to evaluate the capabilities of a linear theory code for such analyses. The canard and aft tail configurations have similar measured values for lift curve slope, maximum lift drag ratio, and zero lift drag. The stability decrease as Mach number increases is greatest for the tailless configuration and least for the canard configuration Because of very limited accuracy in predicting the aerodynamic parameter increments between configurations, the linear theory code is not adequate for determining the relative merits of canard, tailless, and aft tail configurations. Author

N85-27823*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STATIC AND DYNAMIC PRESSURE MEASUREMENTS ON A NACA 0012 AIRFOIL IN THE AMES HIGH REYNOLDS NUMBER FACILITY

J. B MCDEVITT and A. F. OKUNO Jun. 1985 78 p refs (NASA-TP-2485; A-85100; NAS 1.60:2485) Avail: NTIS HC A05/MF A01 CSCL 02A

The supercritical flows at high subsonic speeds over a NACA 0012 airfoil were studied to acquire aerodynamic data suitable for evaluating numerical-flow codes. The measurements consisted primarily of static and dynamic pressures on the airfoil and test-channel walls. Shadowgraphs were also taken of the flow field near the airfoil The tests were performed at free-stream Mach numbers from approximately 0.7 to 0.8, at angles of attack sufficient to include the onset of buffet, and at Reynolds numbers from 1 million to 14 million. A test action was designed specifically to obtain two-dimensional airfoil data with a minimum of wall interference effects. Boundary-layer suction panels were used to minimize sidewall interference effects. Flexible upper and lower walls allow test-channel area-ruling to nullify Mach number changes induced by the mass removal, to correct for longitudinal boundary-layer growth, and to provide contouring compatible with the streamlines of the model in free air. E.A.K.

N85-27824*# Scientific Research Associates, Inc., Glastonbury, Conn

USERS MANUAL FOR COORDINATE GENERATION CODE **CRDSRA**

S. J SHAMROTH Jun. 1985 17 p refs

(Contract NAS1-15214) (NASA-CR-172584, NAS 1.26:172584) Avail. NTIS HC A02/MF A01 CSCL 01A

Generation of a viable coordinate system represents an important component of an isolated airfoil Navier-Stokes calculation. The manual describes a computer code for generation of such a coordinate system. The coordinate system is a general nonorthogonal one in which high resolution normal to the airfoil is obtained in the vicinity of the airfoil surface, and high resolution along the airfoil surface is obtained in the vicinity of the airfoil leading edge. The method of generation is a constructive technique which leads to a C type coordinate grid. The method of construction as well as input and output definitions are contained herein. The computer code itself as well as a sample output is being submitted to COSMIC. Author

N85-27825*# Scientific Research Associates, Inc., Glastonbury, Conn.

USER'S MANUAL FOR AIRFOIL FLOW FIELD COMPUTER CODE SRAIR

S. J. SHAMROTH Jun. 1985 60 p refs (Contract NAS1-15214)

(NASA-CR-172585; NÁS 1.26:172585) Avail: NTIS HC A04/MF

A01 CSCL 01A A two dimensional unsteady Navier-Stokes calculation procedure with specific application to the isolated airfoil problem is presented. The procedure solves the full, ensemble averaged Navier-Stokes equations with turbulence represented by a mixing length model. The equations are solved in a general nonorthogonal coordinate system which is obtained via an external source. Specific Cartesian locations of grid points are required as input for this code. The method of solution is based upon the Briley-McDonald LBI procedure. The manual discusses the analysis, flow of the program, control steam, input and output Author

N85-27826# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.

SOME EFFECTS OF SWEEP DIRECTION AND STRAKES FOR WINGS WITH SHARP LEADING EDGES

D. I. A POLL and C. H QIU (Peking Inst. of Aeronautics and Astronautics) May 1984 33 p refs

(CA-8421; ISBN-0-947767-088) Avail: NTIS HC A03/MF A01

An experimental investigation has been carried out to compare the effects of sweep direction upon the aerodynamic characteristics of three wing planforms, each with sharp leading edges. The wings have biconvex aerofoil sections which allow them to be tested in both the forward-swept and backward-swept configurations without changing the section profile. Measurements of lift, drag and pitching moment have been made for angles of incidence in the range -5 deg to +50 deg at a mean chord Reynolds number of approximately 15 x 10 to the 5th power and Mach number of 0.1 To complement the force and moment data a comprehensive series of oil-flow visualizations are also presented. In addition the aerodynamic characteristics of simple strakes (wing root fillets) have been studied for both the swept-forward and swept-back configurations Author

N85-27827# Cranfield Inst. of Tech., Bedford (England) Aerodynamics Div.

ON THE EFFECT OF WING TAPER AND SWEEP DIRECTION **ON LEADING EDGE TRANSITION**

D. I. A. POLL and D. J. PAISLEY Dec. 1984 25 p refs

(CA-8435; ISBN-0-947767-096) Avail NTIS HC A02/MF A01 An experimental study has been made of the conditions necessary to produce transition in a swept attachment-line boundary layer which is subjected to disturbances from trip wires of various sizes The boundary layer considered is that formed on a long tapered cylinder which has been tested in both the backward

swept and forward swept configurations. Results from these tests are compared with previous work on an untapered model. Some important similarities and some puzzling differences have been found. Finally, consideration is given to the practical implications of this work. It is suggested that a forward swept wing may be capable of supporting a laminar attachment-line flow at a much higher free-stream Reynolds number than a corresponding swept back wing. Author

N85-27828*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL STUDY OF POROUS AIRFOILS IN TRANSONIC **FLOW**

C. L. CHEN (Colorado Univ., Boulder), C. Y. CHOW (Colorado Univ., Boulder), T L HOLST, and W R. VANDALSEM May 1985 23 p refs

(NASA-TM-86713, REPT-85209, NAS 1 15.86713) Avail NTIS HC A02/MF A01 CSCL 01A

A numerical study was made to examine the effect of a porous surface on the aerodynamic performance of a transonic airfoil. The pressure jump across the normal shock wave on the upper surface of the airfoil was reduced by making the surface below the shock porous. The weakened shock is preceded by an oblique shock at the upstream end of the porous surface where air is blown out of the cavity. The lambda shock structure shown in the numerical result qualitatively agrees with that observed in the wind tunnel. According to the present analysis, the porous airfoil has a smaller drag and a higher lift than the solid airfoil. Author

N85-27829# National Aeronautical Establishment, Ottawa (Ontario).

AN INTRODUCTION TO VORTEX BREAKDOWN AND VORTEX CORE BURSTING

J L HALL Mar 1985 29 p refs

(NAE-AN-28; NRC-24336; AD-A155324) Avail: NTIS HC A03/MF A01

The phenomenon of vortex breakdown, also known as vortex core bursting is introduced. The first part of the report presents some important elements of basic vortex theory The second part reviews the research that was done on vortex breakdown. An overview of the historical development of vortex breakdown research and a summary of the current state of knowledge on the subject are also included. Author

N85-27830# National Aeronautical Establishment, Ottawa (Ontario). Low Speed Aerodynamics Lab.

WING TUNNEL INVESTIGATION OF DYNAMIC STALL OF AN NACA 0018 AIRFOIL OSCILLATING IN PITCH

R. H. WICKENS Feb 1985 71 p refs (NAE-AN-27; NRC-24262; AD-A154717) Avail: NTIS HC A04/MF A01

This report presents aerodynamic data on an NACA 0018 airfoil oscillating in pitch in the NAE 2m X 3m Low Speed Tunnel. The purpose of the test was to simulate the dynamic aerodynamic behavior of a Vertical Axis Wind Turbine blade section at the equatorial plane under the dynamic stall conditions which may occur at low ratios of tip speed to wind speed. Measurements were made of wing surface pressure time histories at various chordwise locations, during a complete cycle of oscillation. The dynamic effects on nose suction pressures were seen to increase their magnitude and to delay flow breakdown to a higher angle of attack. Integration of wing pressures furnished normal and chordwise forces during the angle of attack cycle. The behavior of these parameters showed that dynamic stall for wing angles of attack up to 30 degrees, occurred about 5 degrees later than for the equivalent steady flow case. This phenomenon resulted in an increase in normal force of about 20% and an increase in chordwise force of about 40% when the wing is pitching to 30 degrees.

Author

N85-27831# Naval Postgraduate School, Monterey, Calif. A METHOD TO CALCULATE THE PARAMETERS OF WINGS OF ARBITRARY PLANFORM M.S. Thesis E. M. BARBER Dec. 1984 42 p

(AD-A152689) Avail: NTIS HC A03/MF A01 CSCL 20D

The computation method developed in this thesis proceeds from the theory developed by Jones (Ref. 1) His final equations are first rewritten in matrix format. They are then organized into computational sequences that must be translated into computer programming language to calculate the aerodynamic parameters of wings of arbitrary planform. GRA

N85-27832# Air Force Inst. of Tech, Wright-Patterson AFB, Ohio. School of Engineering.

AERODYNAMIC PERFORMANCE OF A WING IN GROUND EFFECT USING THE PANAIR PROGRAM M.S. Thesis

A. R GOETZ Dec 1984 68 p (AD-A153303; AFIT/GAE/AA/84D-7) Avail: NTIS HC A04/MF

A01 CSCL 20D

The primary objective of this thesis is to correlate computed theoretical data with experimental data for wings in ground effect. This investigation uses the PANAIR computer program--a higher-order panel method to predict the lift and drag characteristics of an aspect ratio two wing, with and without endplates, operating at low speed in ground effect. The effects of altitude, trailing edge flap deflection and angle of attack are considered. Numerical results are compared with subsonic wind tunnel experimental data For both the numerical and experimental methods, the image model technique is used to simulate ground effect. Excellent agreement between numerical results and experimental data is achieved for the wing without endplates down to low (approximately 10% of wing chord) altitudes For the wing with endplates, numerical results are in good agreement with experimental data for altitudes greater than approximately 20% of the wing chord. PANAIR results diverged from experimental data at lower altitudes because the model did not attempt to account for spanwise flow between the bottom of the endplate and the ground, and other viscous effects which tend to become dominant These include a static pressure increase beneath the wing and wake distortions behind the GRA configuration.

N85-27833# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Zellenaerodynamik.

DESIGN OF A BASIC PROFILE FOR A LOW SWEEP AIRFOIL. PART 2: EXPERIMENTAL INVESTIGATION ON THE DFVLR-W1 AIRFOIL PROFILE IN THE BRUNSWICK TRANSONIC WIND TUNNEL

G WICHMANN 1985 62 p refs In GERMAN, ENGLISH summary Report will also be announced as translation (ESA-TT-917)

(DFVLR-FB-85-01-PT-2; ISSN-0171-1342) Avail NTIS HC A04/MF A01, DFVLR, Cologne DM 19.50

The airfoil DFVLR-W1 was investigated in a transonic wind tunnel at free transition in the Mach number range between 0.5 and 0.81, at a Reynolds number 6 million. The influence of different locations of transition fixing was investigated. Results are presented as aerodynamic coefficients, airfoil performance boundaries, and pressure distributions. It is shown that the design requirements are met by the airfoil. A comparison with theoretical results indicates the applicability of the computer codes used in the design process. Author (ESA)

N85-27834# Technische Hogeschool, Delft (Netherlands) Dept. of Mathematics and Informatics

METHODS UPWIND-DIFFERENCE FOR AERODYNAMIC PROBLEMS GOVERNED BY THE EULER EQUATIONS

B VANLEER 1984 18 p refs Presented at 15th AMS/SIAM Summer Seminar on Large-Scale Computations in Fluid Mech., La Jolla, Calif, 27 Jun - 8 Jul. 1983

(REPT-84-23) Avail: NTIS HC A02/MF A01

Upwind-difference schemes for the solution of the steady Euler equations are interpreted as projection-evolution schemes, with a numerical stage (interpolation of discrete initial values) and a physical stage (computation of fluxes). The schemes are compared with a central-difference scheme, stabilized by explicit dissipation. Upwind schemes are more robust, but take longer. Author (ESA)

N85-27835# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

TRANSONIC MACH NUMBER DETERMINATION IN A BLOW-DOWN WIND TUNNEL WITH SOLID WALLS AND A DOWNSTREAM THROAT

W. J. BANNINK and P. G. BAKKER Oct. 1983 34 p

(VTH-LR-402) Avail: NTIS HC A03/MF A01

Calibration measurements of the transonic flow in a wind tunnel (test section: 28 cm x 253 cm) with solid walls are described. Along the tunnel center line the static pressure distribution was measured, with and without a model in the test section. Using the static pressure distributions, the distribution of the ratio of the effective sonic cross-sectional area was determined. Far upstream of the model (14 chord lengths) the ratio is constant, meaning that no influence of the model is felt there. In that region reference positions in the tunnel side wall, where the pressures can be used to determine the free stream Mach number of the tunnel flow, were chosen. Author (ESA)

N85-27836# National Aerospace Lab. Amsterdam (Netherlands).

AERODYNAMIC RESEARCH IN PREPARATION FOR A NEW TRANSPORT AIRCRAFT WITH SUPERCRITICAL DUTCH WINGS

13 p 1983 In DUTCH; ENGLISH summary Sponsored by Netherlands Agency for Aerospace Programs

(B8580077) Avail: NTIS HC A02/MF A01

An aerodynamic design procedure for a supercritical wing, based on the viewpoint that the pressure distribution determines its characteristics more then the geometry is developed. In the absence of a computer program for the calculation of three-dimensional transonic flow, a procedure is applied in which it is assumed that the difference between the transonic and the subsonic pressure distribution around a two-dimensional airfoil determines the same relation around the three dimensional wing. In order to limit the number of solutions, weight factors are applied in the calculations In an iterative process to find a geometry satisfying the geometrical constraint, a video terminal coupled to a CYBER-72 computer is utilized. Wind-tunnel experiments prove that the design procedure yields satisfactory results.

Author (ESA)

Deutsche Forschungs- und Versuchsanstalt fuer N85-27837# Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Instationaere Aerodynamik.

ANALYSIS OF UNSTEADY PRESSURE MEASUREMENTS ON A AIRFOIL WITH A HARMONICALLY SUPERCRITICAL OSCILLATING TRAILING EDGE FLAP AT SUBSONIC AND TRANSONIC SPEEDS

H. S. MURTHY (National Aeronautical Lab., Bangalore, India) Jul 1984 79 p refs in GERMAN; ENGLISH summary Sponsored by German Academic Exchange Service (DAD)

(DFVLR-FB-84-49; ISSN-0171-1342) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 26.50

Unsteady pressure distributions measured in a transonic wind tunnel on a supercritical airfoil of 13% maximum thickness with an oscillating trailing edge flap were analyzed. The influences of oscillation frequency, flap mean deflection, and incidence on the unsteady pressure distribution are discussed in the Mach number range of 0.3 to 0.85; the effects of the oscillation amplitude at M = 0.78 are also analyzed. Unsteady lift and moment coefficients obtained from unsteady pressure distributions are discussed.

Author (ESA)

N85-27838# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst fuer Theoretische Stroemungsmechanik.

METHODS FOR DESIGN AERODYNAMICS OF MODERN TRANSPORT AIRCRAFT

H. SOBIECZKY Dec. 1984 74 p refs In GERMAN; ENGLISH Report will also be announced as translation summary (ESA-TT-923)

(DFVLR-FB-85-05; ISSN-0171-1342) Avail: NTIS HC A04/MF A01, DFVLR, Cologne DM 23

A concept to obtain shock-free transonic flow for design aerodynamics of aircraft and turbomachinery is outlined. The method of elliptic continuation or method of fictitious gas represents a starting point for operational computational procedures to obtain supercritical airfoils and wings. Design examples illustrate the value of shock-free configurations for aerodynamic efficiency enhancement. The application of supercritical flow in aerodynamic concepts is mentioned. Author (ESA)

N85-28155# Joint Publications Research Service, Arlington, Va. CHARACTERISTICS OF STEADY-STATE HYPERSONIC FLOW ABOUT BLUNTED BODIES WITH DISCONTINUITIES IN **GENERATORS Abstract Only**

V. D. SEROVA In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 80-81 15 May 1985 Transl. into ENGLISH from Vestn. Leningr. Univ.: Mat. Mekhan. Astron. (Leningrad), v. 13, no 3, Jun. 1984 p 80-85 Avail: NTIS HC A06/MF A01

The BVLR method is employed to calculate the multi-shock axisymmetrical problem of hypersonic flow. The processes occurring during axisymmetrical shock wave interactions are assessed qualitatively. Comparison of the pressure behavior as a function of the longitudinal coordinate at points on the surface of smooth and discontinuous cones indicate that even a small discontinuity results in a major qualitative and quantitative difference in the threshold distribution curves. Author

N85-28158# Joint Publications Research Service, Arlington, Va. SUPERSONIC FLOW AROUND BLUNT WEDGE Abstract Only S. V. MANUYLOVICH In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 82 15 May 1985 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti I Gaza (Moscow), no. 4, Jul. - Aug. 1984 p 137-140

Avail: NTIS HC A06/MF A01

Supersonic flow of a perfect gas around a semi-infinite body in the form of a plane wedge with blunt leading edge is analyzed. The problem is assumed to be asymptotic with respect tot he longitudinal coordinate and is solved by the method of asymptotic expansion. The gas is assumed to have a C sup p/ ratio independent of the temperature and its uniform unperturbed motion is assumed to satisfy the Euler equations. The oncoming stream is assumed to flow in the direction parallel to the plane of symmetry of the wedge and to split symmetrically along the faces of the latter Author

N85-28161# Joint Publications Research Service, Arlington, Va. METHOD OF CALCULATING SEPARATION FLOW OF SUBSONIC GAS STREAM AROUND WINGS Abstract Only S. M. BELOTSERKOVSKIY, V. N. KORZHNEV, and S. D. SHIPILOV In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 84 15 May 1985 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti i Gaza (Moscow), no. 4, Jul. - Aug. 1984 p 141-147 Avail: NTIS HC A06/MF A01

The nonlinear problem of steady subsonic flow of a gas around a wind was solved by discrete vortices for compressible fluids. The corresponding differential equation for the potential of perturbed velocities, with the boundary condition of an impermeable wing surface, is solved separately and differently for two regions. The velocity integrals for the semifinite corridor_around_the_wing and containing the vortex trail are evaluated by a numerical iteration process, after the two subregions are subdivided into respectively finite and semi-infinitely long rectangular parallelepipeds. In the

remaining space outside this region the potential of perturbed velocities is linearizable and, with the aid of a Prandlt-Glauert transformation, its differential equation is reduced to the Laplace equation in appropriate coordinates. The analytical solution for this region depends on the solution for the corridor. The method was validated on two test problems. A range of angles of attack which corresponds to stabilization of nosing vortex filaments are revealed. Two estimates are given for the critical angle of attack, namely a lower bound at which the iteration process ceases to converge relative to the aerodynamic load and an upper bound where the shape of the vortex sheet and the lift coefficient and the pitching moment coefficient begin to change from one iteration to the next.

N85-28923*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WIND-TUNNEL EVALUATION OF A 21-PERCENT-SCALE POWERED MODEL OF A PROTOTYPE ADVANCED SCOUT HELICOPTER

A. E. PHELPS, III and J. D. BERRY Washington NASA, Washington Jun. 1985 76 p refs Prepared in cooperation with Army Aviation Systems Command, St. Louis

(Contract DA PROJ. 1L1-62209-AH76)

(NASA-TP-2420; L-15895; NAS 1.60:2420; AVSCOM-TR-85-B-2) Avail NTIS HC A04/MF A01 CSCL 01A

An exploratory wind tunnel investigation of a 21 percent scale powered model of a prototype advanced scout helicopter was conducted in the Langley 4 by 7 Meter Tunnel The investigation was conducted to define the overall aerodynamic characteristics of the Army Helicopter Improvement Program (AHIP), to determine the effects of the rotor on the aerodynamic characteristics and to evaluate the effect of a mast mounted sight on the aircraft stability characteristics. Tests covered a range of thrust coefficients, advance ratios, angles of attack and angles of sideslip and were run for both rotor on and rotor off configurations. Results of the investigation showed that the prototype configuration was longitudinally unstable with angle of attack for all configurations tested. The instability was due to unfavorable interference effects between the horizontal tail and the wake shed from the engine pylon and rotor hub, which caused a loss of horizontal tail effectiveness. The addition of the mast mounted sight had little effect on the stability of the model, but it caused an alteration in the rotor lift distribution that resulted in substantial interference drag for the sight. Author

N85-28924*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STATIC INVESTIGATION OF SEVERAL YAW VECTORING CONCEPTS ON NONAXISYMMETRIC NOZZLES

M L. MASON and B. L. BERRIER Jun. 1985 219 p refs (NASA-TP-2432; L-15890; NAS 1.60:2432) Avail: NTIS HC A10/MF A01 CSCL 01A

A test has been conducted in the static test facility of the Langley 16-Foot Transonic Tunnel to determine the flow-turning capability and the effects on nozzle internal performance of several vaw vectoring concepts. Nonaxisymmetric convergent-divergent nozzles with throat areas simulating dry and afterburning power settings and single expansion ramp nozzles with a throat area simulating a dry power setting were modified for yaw thrust vectoring. Forward-thrust and pitch-vectored nozzle configurations were tested with each yaw vectoring concept. Four basic yaw vectoring concepts were investigated on the nonaxisymmetric convergent-divergent nozzles: (1) translating sidewall, (2) downstream (of throat) flaps, (3) upstream (of throat) port/flap; and (4) powered rudder. Selected combinations of the rudder with downstream flaps or upstream port/flap were also tested. A single yaw vectoring concept, post-exit flaps, was investigated on the single expansion ramp nozzles. All testing was conducted at static (no external flow) conditions and nozzle pressure ratios varied from 2.0 up to 10.0. Author N85-28925# National Aerospace Lab., Tokyo (Japan).

A METHOD OF DETERMINING THE SUCTION VELOCITY FOR LAMINAR FLOW CONTROL OF TWO-DIMENSIONAL AIRFOIL IN INCOMPRESSIBLE FLOW

Y. ISHIDA 1984 23 p refs In JAPANESE; ENGLISH summary

(NAL-TR-845; ISSN-0389-4010) Avail: NTIS HC A02/MF A01 A design method for laminar flow control of two-dimensional airfoils in incompressible flows is described. The method can be used for determining the suction velocity required to keep the boundary layer on an airfoil surface laminar to a given velocity required to keep the boundary layer on an airfoil surface laminar to a given chordwise distance under given design conditions. The design method consists of two parts. The first deals with the direct problem, i.e., the calculation of the boundary layer characteristics for any given suction velocity by a new integral method and the application of Michel's criterion of transition point to determine if the transition occurs or not. The second part deals with the inverse problem, i.e., the calculation of the suction velocity for any given R sub theta the Reynolds number based on the momentum thickness, which satisfies Michel's criterion. The results of the second part are used as initial input data of the required suction velocity in the first part. The method has been applied to two airfoils, NASA GA(W)-1 and NACA 64A010, and good results have been obtained. Author

N85-28926# Vrije Universiteit, Brussels (Belgium). Dept of Fluid Mechanics.

TURBULENCE STRUCTURE IN THE BOUNDARY LAYERS OF AN OSCILLATING AIRFOIL Final Technical Report, Jan. - Dec. 1983

J D. RUYCK and C. HIRSCH Dec. 1983 91 p (Contract DAJA45-83-C-0021; DA PROJ. 1T1-61102-BH-57) (AD-A153631, VUB-STR-14) Avail: NTIS HC A05/MF A01 CSCL 20D

The main objective of this work is to provide experimental information about velocity fields and turbulence structures in unsteady flows. A NACA 0012 airfoil oscillates around an axis at 25% chord distance from the leading edge, with a sinusoidal motion. Instantaneous distributions of velocity as well as all non-zero Reynolds stresses are determined in the profile boundary layers. Measurements are performed at various incidences, from non-stalled to deep stalled flow conditions. The reduced frequency is 0.3 at a chord Reynolds number of 300,000. A slanted rotating hot wire is used and the angular calibration characteristics of the wire are applied in order to detect and measure reversed flows. Instantaneous detailed flow and turbulence patterns of the periodic separation vortex are presented and discussed. These patterns are obtained from traverses at 8 chordwise positions along the suction side of the blade. GRA

N85-28927# Air Force Armament Lab., Eglin AFB, Fla. SUBSONIC AND TRANSONIC AERODYNAMICS OF A WRAPAROUND FIN CONFIGURATION

R. H. WHITE, R. S. BUFF, W. H. HATHAWAY, and G. L. WINCHENBACH 15 Jan. 1985 12 p

(AD-A153646, AFATL-TR-85-22) Avail NTIS HC A02/MF A01 CSCL 20D

Subsonic and transonic aerodynamic data for a wraparound fin configuration are presented. Free-flight aeroballistic tests to obtain these data were conducted at atmospheric pressure and over a Mach number range of 0.6 to 1.35. The aerodynamic coefficients and derivatives presented in this paper were extracted from the position-attitude-time histories of the experimentally measured trajectories using nonlinear numerical integration data reduction routines. Results of this analysis indicate that a dynamic instability exists above Mach 1.0 and is related to an out-of-plane side moment which is dependent of the pitch angle. The stability boundaries associated with this side moment are mapped. Designers should consider this moment whenever wraparound fins are used GRA

N85-28928# Analytical Methods, Inc., Redmond, Wash. A STUDY OF AERODYNAMIC CONTROL IN STALLED FLIGHT LEADING-EDGE VORTEX FORMATION ANALYSIS Final Report, Dec. 1981 - Aug. 1984

J. K. NATHMAN Wright-Patterson AFB, Ohio AFWAL Feb. 1985 69 p refs

(Contract F33615-81-C-3626)

(AD-A153758; AFWAL-TR-84-3090) Avail: NTIS HC A04/MF A01 CSCL 20D

This report describes the theory and application of VORSEP, a wake preprocessor for panel methods that use an iterative procedure to determine the position of strongly interacting vortex sheets. The estimation of the wake geometry is based on slender body theory with separation. An unsteady, two-dimensional airfoil program was automated with the addition of routines to interpolate cross-sectional geometry from arbitrary three-dimensional bodies, generate multi-core wakes and synthesize a three-dimensional wake structure. Leading-edge wakes for a delta, straked wing and double delta are constructed and used in VSAERO, a three-dimensional panel method. The wake structures compare reasonably well to experimentally observed vortex core positions, while calculated pressures on the wings with the estimated wakes compare well near the nose but less well near the trailing edge.

N85-28929# Naval Postgraduate School, Monterey, Calif. A COMPUTATIONAL METHOD FOR WINGS OF ARBITRARY PLANFORM M.S. Thesis

C. S. JONES Dec. 1984 66 p

(AD-A153788) Avail: NTIS HC A04/MF A01 CSCL 20D

The computational method developed in this thesis permits the calculation of the aerodynamic performance of a wing of arbitrary planform. Both basic and additional lift are analyzed. This treatise is restricted to thin wings in steady, inviscid, incompressible flow. The method uses a grid system of control points over the wing semi-span. The circulation over the wing is considered variable with discrete values at the specified grid points. Finite difference equations are used to determine these discrete values. Control point indeterminacies are evaluated analytically. Matrix inversion is required for solution by the method presented A brief summary of the principal computational relations is included No numerical results are yet available but are expected during the next phase of this research. GRA

N85-28930# Analytical Methods, Inc., Redmond, Wash. A STUDY OF AERODYNAMIC CONTROL IN STALLED FLIGHT LONG LAMINAR SEPARATION BUBBLE ANALYSIS Final Report, Dec. 1981 - Aug. 1984

F. A. DVORAK and D. H. CHOI Wright-Patterson AFB, Ohio AFWAL Feb. 1985 35 p refs

(Contract F33615-81-C-3626)

(AD-A153850; AFWAL-TR-84-3091) Avail NTIS HC A03/MF A01 CSCL 20D

This report describes an analysis method for laminar separation bubbles (long or short) on two-dimensional airfoil sections at incidence A viscous/potential flow iterative procedure was chosen due to its simple and efficient nature. The boundary layer procedure is a finite-difference method, sometimes referred to as the Bosx Scheme, and uses the Cebeci-Smith two-layer, eddy viscosity model for turbulence closure. The potential flow is calculated in such a way-that-it-gives-constant-pressure along the surface inside the bubble, The coupled calculation procedure has been applied to the NACA 64A006 airfoil and satisfactory results have been obtained. GRA

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A85-37489

NUMERICAL SOLUTION OF THE MINIMUM-TIME FLIGHT OF A GLIDER THROUGH A THERMAL BY USE OF MULTIPLE SHOOTING METHODS

J. LORENZ (Fraunhofer-Institut fuer Festkoerpertechnologie, Munich, West Germany) Optimal Control Applications and Methods (ISSN 0143-2087), vol. 6, Apr.-June 1985, p. 125-140. refs

The problem of the time-optimal flight of a glider through a given thermal is treated with the calculus of variations. The resulting two-point boundary value problem is solved using the multiple shooting method. Solutions are obtained for various parameter values. For special values of these parameters, a branching of the solutions is observed. Additional solutions are obtained for which the control variable and the normal load factor are constrained by their maximum allowed values.

A85-37540

PROTECTION OF MATERIALS AND TECHNICAL EQUIPMENT AGAINST BIRDS [ZASHCHITA MATERIALOV I TEKHNICHESKIKH USTROISTV OT PTITS]

V. D. ILICHEV, ED (Akademila Nauk SSSR, Nauchnyi Sovet po Biopovrezhdenilam, USSR) Moscow, Izdatel'stvo Nauka, 1984, 240 p In Russian For individual items see A85-37541 to A85-37544.

Consideration is given to the forecasting of seasonal bird migrations in order to reduce the number of collisions between bird flocks and aircraft. Radar techniques to observe and track migrating bird flocks are described, and some practical techniques to reduce bird populations near airports are recommended. Particular attention is given to the use of chemical, acoustic, and optical repellants.

A85-37541

CHEMICAL PREPARATIONS FOR PROTECTING AIRCRAFT AGAINST BIRDS [KHIMICHESKIE SREDSTVA ZASHCHITY LETATEL'NYKH APPARATOV OT PTITS]

B V. BOCHAROV IN: Protection of materials and technical equipment against birds Moscow, Izdatel'stvo Nauka, 1984, p. 72-81. In Russian refs

The use of chemical preparations to reduce the incidence of collisions between bird flocks and aircraft near airports is discussed. Consideration is given to a number of candidate compounds currently being tested in the Soviet Union and the West, including avitrol-100; alpha-chlorasol; and cholestenne derivatives. The possible ecological hazards involved in the large scale use of pesticides for bird repellant applications are described, and the possibility of developing an olfactory repellant which would be harmless to small mammals and man is considered I.H.

A85-37542

THE STUDY OF BIRD MIGRATION OVER A WATER AREA IN THE NORTHWESTERN PORTION OF THE BLACK SEA AND ADJACENT AREAS IN ORDER TO PREVENT BIRD-AIRCRAFT COLLISIONS [IZUCHENIE MIGRATSII PTITS NAD AKVATORIEI SEVERO-ZAPADNOI CHASTI CHERNOGO MORIA I SOPREDEL'NYKH TERRITORII S TSEL'IU PREDUPREZHDENIIA STOLKNOVENII IKH S SAMOLETAMI]

A. I. KORZIUKOV IN: Protection of materials-and-technical equipment against birds. Moscow, Izdatel'stvo Nauka, 1984, p 139-143. In Russian. refs

THE EFFECTIVENESS OF ACOUSTIC REPELLANTS IN FRIGHTENING BIRDS AWAY FROM AIRPORTS [EFFEKTIVNOST' AKUSTICHESKIKH REPELLENTOV PRI OTPUGIVANII PTITS V USLOVIIAKH AERODROMOV]

V. S SHEVIAKOV and A. V. TIKHONOV IN: Protection of materials and technical equipment against birds. Moscow, Izdatel'stvo Nauka, 1984, p. 176-188. In Russian. refs

The results of a Soviet program to investigate the possibility of repelling birds from airports by means of acoustic devices are reported. The devices examined in the program consisted of an amplifier, a microphone, and a cassette tape recorder. The audible range of the devices (for humans) was 25-150 meters. Data are given for the effectiveness of different frequencies, power levels and device orientations in relation to the observed behavioral patterns of seagulls, doves, and starlings. Optimum pulse durations and frequencies are given in a table.

A85-37544

OBSERVATION OF BIRDS IN THE FLIGHT PATH OF AIRCRAFT - AN IMPORTANT STAGE IN THE PREVENTION OF BIRD STRIKES [OBNARUZHENIE PTITS NA PUTI SAMOLETOV -VAZHNYI ETAP PREDUPREZHDENIIA KONFLIKTNYKH SITUATSII]

V. E. IAKOBI IN: Protection of materials and technical equipment against birds Moscow, Izdatel'stvo Nauka, 1984, p. 189-199. In Russian. refs

It is shown that radar tracking of bird flocks can be an important factor in preventing collisions with aircraft near airports, or when aircraft visibility conditions are poor. The compilation of maps showing bird hazard areas in different seasons of the year is discussed, and some examples of bird hazard alert systems currently in use at airports in Belgium, Holland, West Germany, and the USSR are described. The methods used by the main airport of Talinn, Estonia to frighten birds away from aircraft runways during peak traffic hours are also discussed I.H

A85-37693

EXAMINATION OF FIRE SAFETY OF COMMERCIAL AIRCRAFT CABINS

W. L JOHNSTON and P. T. CAHALANE (Texas A & M University, College Station, TX) SAFE Journal, vol 15, Summer 1985, p 4-9 refs

Recommendations for raising the existing levels of aircraft cabin fire safety are presented which are based on safety analyses, research of published documents on the subject, and opinions of various aviation safety experts. The recommendations include setting standards for smoke or fire detectors in lavatories and requirements for installations on transports; installation of automatic thermal discharge-type fire extinguishers to sense and extinguish fires in and adjacent to lavatory waste receptacles, requiring protective breathing equipment, including smoke goggles, that meet new minimum performance standards; and rulemaking on fire-blocking materials and cabin emergency lighting. V.L.

A85-38304

STRATOSPHERIC FLIGHTS WITH LARGE POLYETHYLENE BALLOONS FROM EQUATORIAL LATITUDES

R. T. REDKAR (Tata Institute of Fundamental Research, Hyderabad, India) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol 5, no. 1, 1985, p. 13-16. refs

Research (ISSN 0273-1177), vol 5, no. 1, 1985, p. 13-16. refs Starting with average 50 percent success for stratospheric balloon flights during 1959-1969 and attaining 100 percent success during 1972-1973, the success record dropped to 50 percent during 1974-1979 Through a critical analysis of 59 flights made from Hyderabad and 21 flights made from other equatorial bases, revised design criteria were proposed for balloons to be flown from equatorial latitudes, which were accepted by M/S Winzen International Inc. (WII), U.S.A. and have again raised the success record to 93 percent for 15 flights made since April 1980. A revised analysis for 71 flights made from 1965 to 1984 has been presented. Stratospheric circulation over Hyderabad indicating predominance of easterlies with mesospheric westerlies descending occasionally into stratosphere has been discussed. Author

A85-38307

LONG-DURATION FLIGHTS USING WIR (INFRARED BALLOON SYSTEM) [VOLS DE LONGUE DUREE SOUS MONTGOLFIERE INFRAROUGE MIR]

P MALATERE (Centre National d'Etudes Spatiales, Toulouse, France) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol 5, no. 1, 1985, p 23-26 in French

The scientific aspects of MIR, a long-duration balloon system are discussed. MIR is a hot air balloon which uses infrared radiation from the earth as a heat source and its volume of 36,000 cu m allows it to carry a payload of 50 kg. The results of various experimental flights involving measurements of stratospheric gravity waves in the Southern Hemisphere, are reported, and the balloon's performance is evaluated. Future applications of MIR are also considered. M.D

A85-38308

FIRST RESULTS OF A STRATOSPHERIC EXPERIMENT USING A MONTGOLFIERE INFRA-ROUGE (MIR)

J. P POMMEREAU, F DALAUDIER, J. BARAT, J. L. BERTAUX, F. GOUTAIL, and A. HAUCHECORNE (CNRS, Service d'Aeronomie, Verrieres-le-Buisson, Essonne, France) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no 1, 1985, p. 27-30. refs

An original stratospheric experiment performed in South Africa in December 1983 on board the new log-duration balloon system (MIR) developed by the Centre National d'Etudes Spatiales in France is described. The results of the experiment together with the performances reached in flight are presented. It is shown that the thermal budget of MIR allows it to fly in the tropics even above the worst cloud conditions and that the balloon's CHACAL HF transmission system which consists of two receiving stations in South Africa and Brazil is adequate to cover the whole Southern Hemisphere if a third receiving station is set up in Australia. The measurements in flight show that temperatures lower than - 80 C can be observed in the tropics. M.D.

A85-38309* Wyoming Univ., Laramie. THE UNIVERSITY OF WYOMING'S SMALL SCIENTIFIC BALLOON PROGRAM

D. J. HOFMANN, J. M ROSEN, N. T. KJOME, G L. OLSON, and D W MARTELL (Wyoming, University, Laramie, WY) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 31-34 NASA-NSF-NOAA-Army-Navy-FAA-USAF-supported research. refs

Over 500 small scientific balloons have been launched by the University of Wyoming's Atmospheric Physics Group from 26 locations over the globe in a study of stratospheric aerosol physics and chemistry which began in 1971 These flighs have led to a basic understanding of the evolution of sulfurous gases, injected into the stratosphere by major volcanic eruptions, into sulfuric acid aerosol droplets The recent use of new, thin film balloon technology, to reduce cost and simplify launch techniques, has been a major advantage to the program. Author

BALLOON SYSTEM AND BALLOON-BORNE EXPERIMENTS IN CHINA

Y.-D. GU (Chinese Academy of Sciences, Institute of High-Energy Physics, Beijing, People's Republic of China) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no 1, 1985, p. 35-38.

The Chinese scientific balloon project started in 1979, which consists of a 1500 sq m launching site complete with telecontrol, PCM and FM telemetry, and meteorological and communications equipment, is described. A series of 500 to 50,000 cu m zero-pressure natural-shape balloons which serve for scientific observations are found to have a maximum payload weight of 250 kg and a flight duration up to 18 hrs. Some properties of the balloons, as well as the typical static launching method, are discussed The balloon system is used to perform experiments on primary cosmic rays, high-energy nuclei-nuclei interactions, X-ray, gamma-ray, and infrared astronomy, atmospheric and space physics, and remote sensing.

A85-38311

DEVELOPMENT OF BALLOON-BORNE REEL-DOWN AND-UP WINCH SYSTEM

Y. MATSUZAKA, T. YAMAGAMI, J. NISHIMURA (Tokyo, University, Tokyo, Japan), and M D. YAMANAKA (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no 1, 1985, p. 41-44. refs

Balloon-borne winches, which can reel down and up scientific instruments repeatedly, have been developed since 1981 in order to observe stratospheric vertical microstructures. The instrument is suspended by a kevler wire through a transverse-curn ropeguide, and its depth is accurately measured by counting numbers of spool rotations and ropeguide turns. Battery consumption is minimized by utilizing an efficient decelerator and a hysteresis brake. In 1983, a 12-kg payload was successfully reeled up and down through 1 km for three cycles at 24 km altitude. The capability of the winch is being improved, and in May 1984 a 22-kg payload Author was reeled down, up to 3 km from a balloon.

A85-38312* Harvard Univ., Cambridge, Mass. A NEW REELING TECHNIQUE FOR VERY LONG EXTENSION SCANNING IN THE STRATOSPHERE

N. L. HAZEN and J. G. ANDERSON (Harvard University, Cambridge, MA) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 45-48. NASA-supported research. refs

A balloon-borne winching system has been developed for extending a very long tether with payload down into the stratosphere and recovering it, this has been flight proven by being carrried to an altitude of 40 km, lowering a 62-kg stratospheric photochemistry experiment 12 km at a descent velocity of about 6-8 m/sec and recovering it at comparable velocities. During the first flight, the data gave no evidence of dynamic instabilities due to the system or the stratospheric interactions. The future utility of this payload is discussed with attention to the design factors that bound the range of performance of this type of system.

Author

A85-38315

ASSURING PAYLOAD SECURITY IN FLIGHT AND RECOVERY - DESIGN APPROACHES AND FLIGHT EXPERIENCE

N. L. HAZEN (Harvard University, Cambridge, MA) (COSPAR. Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 57-60. refs

Maintaining the functional integrity of a scientific balloon payload must-consider not only the landing shock, but also a number of other risks associated with launch, flight, landing, and recovery. In this paper, the major risks are described along with the design factors and approaches to protection represented in five payload

examples ranging in mass from 60 kg to 1900 kg. Structural design for shock protection, packaging design, external protection and active development stow systems are considered, and effectiveness assessed in the light of over twenty flights and recoveries. Author

A85-38316

AN ALTERNATE APPROACH TO VERY LONG DURATION BALLOONING IN THE NORTHERN HEMISPHERE

D. R. J. BALL (National Scientific Balloon Facility, Palestine, TX) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol 5, no. 1, 1985, p. 61-64.

A plane to achieve balloon flights of 2 or more weeks in the northern hemisphere is outlined. The results of 21 separate simulations of this flight plan are presented and discussed. The simulations are based on rocketsonde wind observations which are compiled to arrive at a continuous time/altitude depiction of the wind regime over the flight path. Simulated flight durations vary from 3 to 31 days and exhibit a wide variety of trajectory types. Author

A85-38777#

NORTH WARNING SYSTEM AIRSHIP FEASIBILITY STUDY

W. S. MUELLER, R. E. ADAMS, D. B BAILEY (U.S Naval Material Command, Naval Air Development Center, Warminster, PA), and N. J. MAYER IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 1-6. (AIAA PAPER 85-0858)

A study was performed at the Naval Air Development Center to determine the feasibility of using nonrigid airships to transport maintenance teams to unmanned radar sites in northern Canada The investigation included a technology assessment of existing airships as well as a sizing study to determine airship volume and horsepower characteristics for logistics operations in an arctic environment. The results of this investigation show that airships uniquely satisfy the requirements of the arctic transport mission, however, developmental efforts, particularly in the areas of ground handling and payload transfer, are required to produce a viable airship transportation system Author

A85-38778#

AEROSTAT OPERATIONS IN THE MARINE TETHERED ENVIRONMENT

J. C. PERRY, R. VORTHMAN (U.S. Coast Guard, Washington, DC), and R. G. BURGIO (TCOM, Columbia, MD) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28. 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p 7-15.

(AIAA PAPER 85-0860)

The present small, nonrigid aerostat, when tethered to a 194-ft U.S. Coast Guard vessel, constitutes an airborne radar platform which has been successfully used in surveillance for drug traffic interdiction. This system has lower operating costs than similarly equipped aircraft platforms, while furnishing surveillance coverage that is more extensive than that available from naval surface vessels. A two-month performance trial has demonstrated that the system can be effectively maintained at sea with a minimum of land-based support. OC.

A85-38779#

HIGH ENDURANCE LIGHTER THAN AIR (HELTA) PROGRAM

J L. WEBSTER (U.S. Coast Guard, Office of Research and Development, Washington, DC) IN. Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers New York, American Institute of Aeronautics and Astronautics, 1985, p. 16-19.

(AIAA PAPER 85-0861)

The U.S. Coast Guard's High Endurance Lighter-Than-Air (HELTA) program is based on the lease of an existing-LTA-vehicle of sufficient size and performance capabilities to perform a wide variety of representative mission scenarios for evaluation. The tasks to be evaluated encompass (1) coordinated operations with surface ships and aircraft; (2) command, control and communications functions; and (3) radar/IR sensor platform operations. Any future LTA vehicle will have to be larger and faster than existing types, however, and possess greater payload and endurance. The HELTA test program will help elucidate many questions concerning that future vehicle. 00

A85-38785#

WHAT AN AIRSHIP MANUFACTURER FACES IN A CERTIFICATION PROGRAM TODAY

J H. PORTER and D. EVANS (Grace Aircraft Corp., Eugene, OR) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 58-62. refs (AIAA PAPER 85-0870)

Certification requirements are noted to play a major role in the design, development and construction phases of new airships; an organization can accordingly expedite certification by anticipating FAA inspections' points of emphasis, as detailed by FAR 21's Advisory Circular AC 21.24-1. The certification requirements encompass airframe structural design, control systems, landing gear, personnel and cargo accommodations, fire protection, lightning protection, hull envelope construction, power-plant specifications, subsystems, and operating limitations. O.C.

A85-38792#

THRUST VECTORED TAKE-OFF, LANDING AND GROUND HANDLING OF AN AIRSHIP

B. L. NAGABHUSHAN and N. P. TOMLINSON (Goodyear Aerospace Corp., Defense Systems Div., Akron, OH) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 100-107. refs (AIAA PAPER 85-0877)

Take-off. landing and around level maneuverability characteristics of a modern airship having twin, vectorable thrustors were analyzed using an advanced airship flight simulation Effect of thrust tilting on tail clearance, angle of attack and ground distance were examined for several V/STOL modes in which the airship was light, heavy or in equilibrium. Significance of prevailing winds in these cases in improving the vehicle performance are illustrated. Airship response to control inputs and wind disturbances in near ground operations were simulated., It was found that ground plane excursions of the vehicle in the latter case could be reduced by selective use of thrust application rate and operator time lag. Consequences of thrust vectoring on the overall vehicle systems design and operation are discussed. Need for heading and altitude autopilots as well as a state of the art wind vector monitor at the pilot station are also presented. Author

A85-38793#

AN INVESTIGATION INTO THE HOVERING BEHAVIOUR OF THE LTA 20-1 AIRSHIP IN CALM AND TURBULENT AIR

J. D. LOWE (Toronto, University, Toronto, Canada) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 108-114. refs (AIAA PAPER 85-0878)

A preliminary study has been made of the ability of the LTA 20-1 to hover in a turbulent environment close to the ground. It was found that translational velocity disturbances to the vehicle's state can easily be corrected with small displacements of the control devices. Author

N85-27839*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. ICE SHAPES AND THE RESULTING DRAG INCREASE FOR A NACA 0012 AIRFOIL

W. OLSEN, R. SHAW, and J. NEWTON 12 Jan. 1984 31 n refs Presented at the 22nd Aerospace Sci. Meeting, Reno, Nev., 9-12 Jan. 1984; sponsored by AIAA

(NASA-TM-83556, E-1935; NAS 1.15:83556) Avail: NTIS HC A03/MF A01 CSCL 01C

Experimental measurements of the ice shapes and resulting drag increases were measured in the NASA-Lewis Icing Research Tunnel. The measurements were made over a large range of conditions (e.g., airspeed and temperature, drop size and liquid water content of the cloud, and the angle of attack of the airfoil). The measured drag increase did not agree with the existing correlation. Additional results were given which are helpful in understanding the ice structure and the way it forms, and in improving the ice accretion modeling theories. There are data on the ice surface roughness, on the effect of the ice shape on the local droplet catch, and on the relative importance of various parts of the ice shape on the drag increase. Experimental repeatability is also discussed. Aubor

N85-27840# Rotterdam Aviation Association (Netherlands). ROTTERDAM AIRPORT AND THE COMMON MARKET May 1984 32 p refs

Avail: NTIS HC A03/MF A01

The possibilities offered to airline companies to operate within the European Economic Community from Rotterdam airport, in light of Community directive 83/416/EEC, are presented. The routes must be within the Community, be at least 400 km long (except where natural barriers make air travel necessary), and use aircraft weighing 30 tons at takeoff, carrying up to 70 passengers plus freight. Author (ESA)

N85-27841 Joint Publications Research Service, Arlington, Va. USSR REPORT: TRANSPORTATION

29 Aug. 1984 44 p Transl. into ENGLISH from various Russian articles

(JPRS-UTR-84-025) Avail: NTIS HC A03

This U.S.S.R. report presents research and development data in the area of transportation. The test flight of IL-76TD long-range transport variant is reported.

N85-27842 Joint Publications Research Service, Arlington, Va. TEST FLIGHT OF IL-76TD LONG-RANGE TRANSPORT VARIANT

V. BELIKOV In its USSR Rept.: Transportation (JPRS-UTR-84-025) p 1-3 29 Aug. 1984 Transl. into ENGLISH from Izvestiya (Moscow), 21 May 1984 p 1 Avail: NTIS HC A03

The unique uses of the IL-76TD long-range Transport Variant are addressed. Flight characteristics that contribute to the efficiency of the IL-76TD cargo aircraft are discussed. Flight tests carried out under emergency conditions are reported. B.W.

N85-28932 Deutsches Museum, Munich (West Germany) AIR TRAFFIC: INSTRUMENTS, AIRPORTS, COMPANIES, POST, CARGO AND PASSENGERS [LUFTVERKEHR: GERAETE, HAEFEN, GESELLSCHAFTEN, POST, FRACHT, PASSAGIERE] M. MATTHES 1984 92 p refs in GERMAN Sponsored by Bundesministers fuer Bildung und Wissenschaften Avail: Issuing Activity

A historical review of air traffic is presented. The first motorized aircraft, the beginning of air traffic; from bomber aircraft to long distance aircraft; jet aircraft replacing the propeller aircraft; supersonic air traffic; large aircraft; and outlook of air traffic are discussed. Author (ESA)

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based); and air traffic control

A85-37803

NATCS - NAVIGATION AIDED TARGET CONTROL SYSTEM FOR MULTIPLE DRONE APPLICATIONS

D. G. MORGAN (Vega Precision Laboratories, Vienna, VA) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p 16-24.

Modern military target drone scenarios require control systems that communicate rapidly with multiple high speed drones, provide position location and are cost and space effective. This paper describes a system for communicating with multiple target drones using existing TACAN and/or IFF transponder RF links Demonstration flight test data and additional system capabilities such as ship location and over the horizon command control are also described Author

A85-37808

AUTOCALIBRATION OF A LASER GYRO STRAPDOWN INERTIAL REFERENCE/NAVIGATION SYSTEM

K. M. WEFALD and C R. MCCLARY (Honeywell, Inc., St. Louis Park, MN) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 66-74.

The inertial reference system considered in the present paper uses the stability of a laser gyro and state-of-the-art electronics to provide reliable performance. The units are flying in 126 aircraft operated by 19 airlines. In 1982, the manufacturer of the system recognized that the serviceability of the system would be enhanced by auto calibration and began development of auto calibration techniques for all three axes of the gyros and the level axes of the accelerometers Approaches for an implementation of automatic bias calibration (Autocal) were explored The Autocal configuration selected employs a three state filter using final position error as the measurement to estimate gyro biases. Attention is given to a Kalman filter overview, a gyro Autocal functional description, an accelerometer Autocal functional description, and test results.

G.R.

A85-37810 INTEGRATED INERTIAL SENSOR ASSEMBLY PROGRAM STATUS

R. E. EBNER (Litton Systems, Inc., Woodland Hills, CA) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 91-98.

Litton has constructed an Advanced Development Model (ADM) of an Integrated Inertial Sensor Assembly (IISA), on contract to the U.S. Naval Air Development Center. IISA is designed to provide all sensor needs for modern military aircraft, including flight control and navigation, with reduced avionics cost through the use of redundant skewed inertial navigation sensors. Various design aspects of using six ring-laser gyros and six inertial-grade accelerometers in two, separated clusters are described. The redundancy_management_mechanization and the system design features for maximum flight safety are given. Navigation performance limits of strapdown INS, including the effects of skewed sensors, are presented A85-37825* Jet Propulsion Lab, California Inst. of Tech, Pasadena.

GPS-BASED CERTIFICATION FOR THE MICROWAVE LANDING SYSTEM

C. L. THORNTON, L. E. YOUNG, S C. WU, and J. B. THOMAS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc, 1984, p. 256-263. NASA-supported research. refs

An MLS (microwave landing system) certification system based on the Global Positioning System (GPS) is described. To determine the position history of the flight inspection aircraft during runway approach, signals from the GPS satellites, together with on-board radar altimetry, are used. It is shown that the aircraft position relative to a fixed point on the runway at threshold can be determined to about 30 cm vertically and 1 m horizontally. A requirement of the system is that the GPS receivers be placed on each flight inspection aircraft and at selected ground sites. The effects of different error sources on the determination of aircraft instantaneous position and its dynamics are analyzed. M.D.

A85-37829

A COMPARISON OF SEVERAL DIGITAL MAP-AIDED NAVIGATION TECHNIQUES

C. A. BAIRD and M. R ABRAMSON (Harris Corp., Melbourne, FL) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 286-293. refs

Digital terrain maps can be used to provide position fixes for navigation systems using several different procedures. These methods include modifications to account for terrain nonlinearities and to extend performance to regions of lower signal-to-noise ratios. This paper utilizes simulations to evaluate the effectiveness of these modifications and compares the performance of the different procedures. The simulations used are based on both synthetically generated and Defense Mapping Agency maps. These maps are combined with statistically generated errors and measured flight test data to provide both a series of controlled experiments, as well as a realistic basis of comparison. The results of these simulations are compared to analytically developed performance predictions. Author

A85-37830

PASSIVE NAVIGATION BY TRIANGULATION AND TRACKING OF UNDISTINGUISHED FEATURES IN SUCCESSIVE HIGH-RESOLUTION IMAGES

J T. GALKOWSKI and P. J GALKOWSKI (IBM Corp., Federal Systems Div., Owego, NY) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 294-300. Research supported by the IBM Independent Research and Development Program refs

A passive navigation technique using the optical spectrum in an environment which provides good contrast (not desert, ocean, fog, or high haze) and good illumination is presented. The major difference between the technique proposed here and those based on landmark tracking is that it exploits features of opportunity rather than features corresponding to previously surveyed landmarks. Features of opportunity are selected from the pool of those discernable in a digitized image obtained from a camera. They are tracked as they move across the scene, by sampling it with successive high resolution images. This motion is induced by the motion of the airborne platform on which the camera is mounted. Coordinates of these features are transmitted for use by the navigation system.

A85-37831#

EVALUATION OF RADIONAVIGATION SYSTEMS

R. D. TILL (FAA Technical Center, Atlantic City, NJ) IN PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 301-305. refs

The Federal Aviation Administration (FAA) Technical Center has been evaluating various navigation systems for nonprecision approach application Loran C and the Global Positioning System (GPS) have been flight tested and evaluated in rotary and fixed wing aircraft. The results of some of these tests are presented in this paper Author

A85-37832

GLOBAL POSITIONING SYSTEM AS A SOLE MEANS FOR CIVIL AIR NAVIGATION

R. BRAFF (Mitre Corp., McLean, VA) and J BRADLEY (FAA, Washington, DC) IN: PLANS '84 - Position Location and Navigation Symposium, San Diego, CA, November 26-29, 1984, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1984, p. 306-311 refs

The Global Positioning System (GPS) is scheduled to be deployed in 1988 Discussions are now being held between DOD and DOT/FAA on whether the funded GPD constellation of 18 satellites plus 3 operating spare satellites, and its control segment, provide sufficient coverage redundancy and integrity to be approved by the FAA as a fully capable supplemental or sole means navigation system in the National Airspace System. The issues involved and the status of the joint DOD and DOT/FAA work to resolve them are summarized. A concept for disseminating the integrity information to user receivers, via geostationary satellites, is described The description illustrates the operational and technical considerations involved in providing the required integrity for a satellite based navigation system.

A85-38313

A BALLOON TRACKING SYSTEM THAT USES THE VHF OMIDIRECTIONAL RANGE (VOR) NETWORK

T L. THOMPSON (NOAA, Aeronomy Laboratory, Boulder, CO) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no 1, 1985, p 49-51

The development of an inexpensive balloon navigational package that uses the VHF omnidilectional range (VOR) system is discussed. The balloon system uses the principle of triangulation between stations to yield position information. It is shown that stations must be selected for good angles and signal integrity, and that it is necessary to mentally average the VOR radials for best results. Results from several flights in Palestine, Texas indicate that the system which is commonly used. The typical accuracy of the down point prediction is found to be + or -1 mile M.D.

A85-38314

AN AUTOMATIC NAVIGATION AND ASPECT SENSING SYSTEM FOR X-RAY ASTRONOMY

J G. GREENHILL, B FRANKLIN, and A. SPRENT (Tasmania, University, Hobart, Australia) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 53-56. Research supported by the Australian Research Grants Committee. refs

An automatic navigation and aspect sensing system is being developed for use in trans-Australia and possible globe circling balloon flights by the University of Tasmania stabilized platform for X-ray astronomy. This system comprises an Omega receiver, a three-axis magnetometer, alt-az. Mounted CID camera, and an on-board computer. The computer uses the Omega receiver output or other dead reckoning information together with the magnetometer data to calculate the approximate position of selected bright stars. It then drives the camera to each of these positions in turn and determines from the camera output the precise coordinates relative to the platform of each of these stars. From this information it fixes the geographic coordinates of he platform to within a few nautical miles and determines the true platform azimuth with a precision of approximately 0.1 deg. These data are passed to the platform aspect control computer via a senal link. Author

A85-38526

INSTITUTE OF NAVIGATION, NATIONAL TECHNICAL MEETING, SAN DIEGO, CA, JANUARY 17-19, 1984, PROCEEDINGS

Washington, DC, Institute of Navigation, 1984, 252 p. For individual items see A85-38527 to A85-38547.

A low-cost, multifunction strapdown inertial sensor for tactical applications is considered along with a ring laser gyro inertial reference system, the helicopter flight test of a ring laser gyro attitude and heading reference system, redundancy management in strapdown navigation systems, codeless GPS systems for positioning of offshore platforms and 3D seismic surveys, and marine positioning with a GPS-aided inertial navigation system Attention is given to the evolution of manned space avionics, coverage characteristics of the baseline Navstar GPS satellite constellation, Phase III GPS integration options for aircraft platforms, design and test evaluation of a marine integrated navigation system, ring laser gyro navigation for surface ships, fiber-optic gyroscopes, a high-accuracy strapped down accelerometer, and a hemispherical resonator gyro Other topics explored are related to commercial aviation GPS navigation set architecture, a radionavigation systems evaluation program for the 1990 census, and federal navigation planning GR

A85-38528#

THE ARING 704 RING LASER GYRO INERTIAL REFERENCE SYSTEM

R. R. SHOQUIST (Honeywell, Inc , St Louis Park, MN) IN Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p 11-19.

It is pointed out that the advent of the ring laser gyro (RLG) has caused a technological revolution in the design of aircraft inertial navigation and reference systems. This solid-state, precision, angular rate sensor is ideally suited for highly reliable strapdown system configurations. The RLG uses two beams of light counter-rotating within a closed triangular path. The present investigation is concerned with an RLG system for airliners. This system combines the solid-state strapdown properties of the laser gyro with advanced digital electronics. Attention is given to the RLG Inertial Reference System (IRS) in-service experience, RLG IRS designed-in reliability, aspects of testing, a RLG IRS system description, and future RLG navigation-related products. G R

A85-38529#

HELICOPTER FLIGHT TEST OF A RING LASER GYRO ATTITUDE AND HEADING REFERENCE SYSTEM

J. NIEMELA, V. DELGUERCIO (U.S. Army, Aviation Systems Command, Colts Neck, NJ), J WELKER, and M S. KLEMES (Litton Industries, Guidance and Control Systems Div, Woodland Hills, CA) IN: Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 20-23.

In the case of helicopters, accurate data are needed on the vehicle's dynamic state for navigation, flight control, and, in the case of military application, weapon direction. Previous generation helicopter systems employed separate vertical and direction gyroscopes to perform this function. Current strapdown systems provide a large performance improvement over the older systems. However, future systems will probably require additional improvements. In 1980, an analysis was initiated with the aim to study the performance requirements of a ring laser gyro (RLG) Attitude and Heading Reference System (AHRS) operated with various navigation aids. The definition of performance requirements led to a preliminary system design A follow-on hardware demonstration program was also formulated. Attention is given to

an RLG AHRS system description, a flight test plan devised for an instrumented UH-1H helicopter, and test results. G.R.

A85-38530#

REDUNDANCY MANAGEMENT IN STRAPDOWN NAVIGATION SYSTEMS

C. R. GIARDINA and E. G. LUXFORD (Singer Co., Kearfott Div., Wayne, NJ) IN: Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 24-28.

The evolution of ring laser gyros and improvements in their performance has made it possible to develop strapdown navigation systems which achieve the accuracy previously associated with gimballed systems (0.5 to 1.0 nmi/h error rates). The computational capability of computers used in these systems has been increased by the development of VHSIC technology. Attention is given to aspects of system specification, reasons for software enhancement of hardware in detecting failures, an optimum system configuration, the determination of failed components, the reliability of gyro and accelerometer subsystems, accelerometer reliability, computer reliability, numerical results, and significant conclusions. G.R.

A85-38538#

COMMERCIAL AVIATION GPS NAVIGATION SET ARCHITECTURE

M. A. STURZA (Litton Systems, Inc., Aero Products Div., Canoga Park, CA) IN: Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 149-153. refs

This paper describes a GPS Navigation Set specifically designed for commercial aviation applications. The design philosophy for this set has been to minimize RF signal processing in favor of digital signal processing and to minimize hardware digital signal processing in favor of software digital signal processing. This philosophy has resulted in a unique architecture. This architecture is described and its impact on performance and cost are discussed. Features of the set unique to the commercial aviation application are presented.

A85-38541#

PROGRAM TO SUPPORT THE APPROVAL OF SUPPLEMENTAL NAVIGATION AIDS IN THE NATIONAL AIRSPACE SYSTEM

P. D. ABRAMSON (U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA) IN: Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings Washington, DC, Institute of Navigation, 1984, p. 168-171.

The Federal Aviation Administration (FAA) has established a network of short range air navigation facilities based upon the VHF Omnidirectional Range (VOR) and Distance Measuring Equipment (DME). VOR/DME is an internationally accepted, widely used system of navigation which provides excellent high altitude coverage in the continental United States (CONUS). There are regions, however, in the CONUS and offshore which do not have adequate coverage to fully support users of the airspace. In these regions, supplemental navigation aids are being considered which can provide increased coverage to augment the more traditional VOR/DME system. The purpose of this paper is to suggest a program to investigate and ultimately approve the use of such supplemental navigational aids.

A85-38647

COMMUNICATION IN AUTOMATED AIR-TRAFFIC-CONTROL SYSTEMS [SVIAZ' V AVTOMATIZIROVANNYKH SISTEMAKH UPRAVLENIIA VOZDUSHNYM DVIZHENIEM]

O. S. NABATOV and N. S. VDOVICHENKO Moscow, Izdatel'stvo Transport, 1984, 288 p. In Russian. refs

Principles for the design of communication channels and networks in automated ATC systems are presented. Attention is given to the development of systems for digital signal processing and transmission, devices for the transmission of digital and analog signals, and integrated digital communication networks. Algorithms for the operation of these communication systems are presented, and their implementation through integrated-circuit devices and microcomputers is discussed. B.J.

A85-39458

ALGORITHMS FOR IMPROVED, HEADING ASSISTED, MANEUVER TRACKING

C. C. LEFAS (Nuclear Research Centre, Athens, Greece) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, May 1985, p. 351-359. Research supported by EUROCONTROL. refs

The evolution of the SSR mode S system makes it possible to receive airborne measurements at the ground station. The possibility of using data-linked heading measurements to assist present trackers to track maneuvering aircraft is investigated. The quality to be expected from heading measurements is investigated from available on-board recordings. Maneuver detection and false measurement rejection schemes are developed, and finally suitable maneuver tracking filters are constructed and evaluated. Author

N85-27843*# Textron Bell Helicopter, Fort Worth, Tex. INVESTIGATION OF IMAGING AND FLIGHT GUIDANCE CONCEPTS FOR ROTORCRAFT ZERO VISIBILITY APPROACH AND LANDING

W. L. MCKEOWN Aug. 1984 172 p refs (Contract NAS2-11364) (NASA-CR-166571; T-3771; NAS 1.26:166571) Avail: NTIS HC A08/MF A01 CSCL 17G

A simulation experiment to explore the use of an augmented pictorial display to approach and land a helicopter in zero visibility conditions was conducted in a fixed base simulator. A literature search was also conducted to determine related work. A display was developed and pilot in-the-loop evaluations were conducted. The pictorial display was a simulated, high resolution radar image, augmented with various parameters to improve distance and motion cues Approaches and landings were accomplished, but with higher workloads and less accuracy than necessary for a practical system. Recommendations are provided for display improvements and a follow on simulation study in a moving based simulator. Author

N85-27844# Federal Aviation Administration, Washington, D.C. NATIONAL AIRSPACE REVIEW, CHANGE 1 Interim Report Jan. 1985 119 p Supersedes AD-A147768

(AD-A152369; AD-E900434) Avail NTIS HC A06/MF A01 CSCL 17G

Since the summer of 1982, the Federal Aviation Administration (FAA) has been hosting task group working sessions of the National Airspace Review (NAR). The NAR is a cooperative venture by the aviation industry and government. The NAR is comprehensively reviewing current air traffic controller procedures, flight regulations, and airspace for the purpose of validating the current system or identifying near-term changes which will promote greater efficiency. As a component of the National Airspace System Plan, the NAR will provide the operational framework for moving into the next generation National Airspace System (NAS). In the area of procedures, task groups have covered: terminal services, weather programs, traffic flow management, helicopter operations, separation standards and the National Flight Data System. GRA

N85-27847# National Aerospace Lab., Amsterdam (Netherlands). Hoofdafd. Vliegtuigen.

FLYING IN SPITE OF THE WEATHER

F. J. ABBINK 3 Aug. 1984 85 p refs In DUTCH; ENGLISH summary Presented at Neth. Assoc. for Aeron. Eng. Symp. on Aviation Meteorol., Delft, 13 Apr. 1984

(NLR-MP-84021-U; B8560217) Avail: NTIS HC A05/MF A01

The impact of weather on aircraft design, propulsion, avionics and on board equipment, and on air traffic control is surveyed. Flight hazards in different weather conditions are described in relation to impact on flight safety and operation costs. N85-27848# National Aerospace Lab., Amsterdam (Netherlands) Afd. Vliegtuigen

DEVELOPMENTS IN THE AREA OF AIR TRAFFIC CONTROL SYSTEMS AND THE RELATION WITH METEOROLOGY

T. H. M. HAGENBERG Mar. 1984 27 p refs in DUTCH; ENGLISH summary Presented at Neth. Assoc. for Aeron. Eng. Symp. on Aviation Meteorol., Delft, 13 Apr 1984 (NLR-MP-84029-U; AD-B089436L) Avail NTIS HC A03/MF A01

Avionic systems such as secondary surveillance radar and microwave landing systems potential for further automation in air traffic control systems are discussed. The organization of air traffic services and the relation of these services with meteorology are outlined Author (ESA)

N85-27849# National Aerospace Lab., Amsterdam (Netherlands).

A SYSTEM FOR TAKE-OFF AND LANDING MEASUREMENTS (STALINS)

1983 In DUTCH; ENGLISH summary Sponsored by 12 p Netherlands Agency for Aerospace Programs

(B8580072) Avail: NTIS HC A02/MF A01

A high accuracy inertial system for measuring the flight path during takeoff and landing was developed to create independence from airfield equipment. Using a Litton LTN-58 inertial system, a RASP antenna, and a data processing computer program, an accuracy of 2 m in X and Y directions and 0.15 m in altitude is obtained. Author (ESA)

Defence Research Establishment, Ottawa. N85-28933# (Ontario).

A GENERAL AREA AIR TRAFFIC CONTROLLER SIMULATION USING COLOUR GRAPHICS

B. J. FORD Sep. 1983 151 p Original contains color illustrations

(Contract DREO-890)

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(AD-A153634) Avail: NTIS HC A08/MF A01 CSCL 17G

The increased speed of aircraft and a greater density of air traffic are overtaxing air traffic controllers. Automation of some portions of the controller's information and the use of color to highlight dangerous situations will make the controller's work easier and possibly more accurate. One of the major aims of the study is to show that the use of a different colors to indicate varying distances between aircraft is a definite improvement over a monochrome display. The other major aim is to study the advantages and disadvantages of vector display and raster display technologies when applied to the air traffic controller scenario. A new set of graphics display routines was developed to be used for the simulation. Much consideration was given to the best methods to optimize the display routines, with attention given to real-time constraints. GRA

N85-28935# Sandia Labs., Albuquerque, N. Mex THE AFTI/F16 TERRAIN-AIDED NAVIGATION SYSTEM

D. D. BOOZER, M. K. LAU, and J. R. FELLERHOFF 1985 7 p refs Presented at the Natl Aerospace and Electron. Conf., Dayton, Ohio, 20 May 1985 (Contract DE-AC04-76DP-00789)

(DE85-008411; SAND-85-0223C; CONF-8505116-1) Avail NTIS HC A02/MF A01

A recursive, real time, terrain aided navigation algorithm, AFTI/SITAN, was designed for use on the Advanced Fighter Technology Integration (AFTI) F16 aircraft. The algorithm implemented in a Zilog Z8001 microprocessor, can reliably locate the aircraft's position within a 926-m (0.5 nm) CEP circle and accurately estimate its position continuously (3 Hz). The design and execution of the algorithm are described, and simulation results using actual flight test data are presented. A median accuracy of less than 100 m was achieved over gently rolling, forested terrain using cartographic-based digital terrain elevation data. DOE

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-37182#

FATIGUE LIFE EVALUATION PROGRAM FOR THE KFIR AIRCRAFT

A. BROT (Israel Aircraft Industries, Ltd., Engineering Div., Tel Aviv, Israel) IN. Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p 36-40.

A fatigue life evaluation program has been developed to provide fleet safety and economy for Kfir aircraft in service. The program includes damage-tolerance analysis, specimen, component, and full scale fatigue testing. In addition, the fatigue program led to several design improvements which increased the fatigue resistance of the aircraft A fleet-monitoring program has been developed which allows for safe and economical inspections of each individual aircraft in service Author

A85-37188#

CRACK PROPAGATION ANALYSIS OF LONGITUDINAL SKIN **CRACKS IN A PRESSURIZED CABIN**

H. MOR (Israel Aircraft Industries, Ltd., Engineering Div., Tel Aviv, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 78-83. refs

The crack growth of longitudinal skin cracks in pressurized cabins is affected by a bulging phenomenon. The bulging of cracks causes an increase in the stress intensity at the crack tips, in between frames, and damps out at the frames. This paper presents an analytical method which accounts for the bulging effect of one bay cracks. The method is based on thin shell theory results as presented by Folias (1977), and an empirical formulation presented by Swift for two bay cracks. It is supported by test results

Author

A85-37206# CONCEPTS AND APPLICATION OF AIRCRAFT DAMAGE

TOLERANCE ANALYSIS D. BROEK (FractuResearch, Inc., Columbus, OH) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 268-276. refs

This paper discusses the objectives of damage tolerance analysis. Subsequently, justification is given for the use of linear elastic fracture mechanics concepts as a basis for analysis. It is then demonstrated that the major sources of error are in the input rather than in the analysis per se, and that accuracy will not be improved through the use of fracture mechanics concepts with somewhat wider limitations. Finally, it is shown that relatively simple stress histories are quite adequate for damage tolerance analysis. Author

SOFTWARE-ENGINEERING ELEMENTS IN THE PROBLEM OF THE OPTIMAL DESIGN OF LIFT SYSTEMS FOR FLIGHT VEHICLES [ELEMENTY MATEMATICHESKOI TEKHNOLOGII V PROBLEME OPTIMAL'NOGO PROEKTIROVANIIA NESUSHCHIKH KOMPLEKSOV LETATEL'NYKH APPARATOV] A. N. PANCHENKOV, IU. F. ORLOV, G. I. ANTOSHKINA, M. N. BORISIUK, V. D. MISHCHENKO, and R. IU. SHLAUSTAS IN: Applied software packs: Development techniques (Pakety pnkladnykh program. Tekhnologiia razrabotki). Novosibirsk, Izdatel'stvo Nauka, 1984, p. 110-123. In Russian. refs

The structure of the applied-program package POLET for the optimal design of flight-vehicle lift systems is presented. The initial premises and main problems of optimal design are examined, and the problem modules and general program of POLET are described.

A85-37408

AIRCRAFT SERVICE TESTING OF ULTRASONICALLY WELDED PANELS

T. RENSHAW (Fairchild Republic Co., Farmingdale, NY) IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 686-695. refs

An account is given of the development of a proprietary process for the service testing of ultrasonically welded aircraft structure panels, such as those of the central fuselage section of the A-10 attack aircraft. Attention is given to the weld bonding operations schedule and the various stresses to which a structural panel is subjected during such processing. O C.

A85-37488

INSTATIONARY DOLPHIN FLIGHT - THE OPTIMAL ENERGY EXCHANGE BETWEEN A SAILPLANE AND VERTICAL CURRENTS IN THE ATMOSPHERE

J. L. DE JONG (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands) Optimal Control Applications and Methods (ISSN 0143-2087), vol. 6, Apr.-June 1985, p. 113-124. refs

A solution is presented, based on a simple dynamic model of a sailplane, to the optimal control problem formulated for the case of a dolphin flight trajectory defined as instationary and involving brusque and strongly varying normal loads. The optimal trajectory entails flying at small or negative normal loads in downraft regions; in upraft regions the sailplane is accelerated to nearly the point of maximal atmospheric velocity, where at high normal loads it 5-m forced to climb. The problem is solved numerically for a 15-m racing class LS-3 craft, covering a number of different widths and strengths of the vertical currents.

A85-37945

TWEETY-BIRD REPLACEMENT

R. BRAYBROOK Air International (ISSN 0306-5634), vol 28, June 1985, p. 273-277; 279, 280.

An account is given of the development history, design features, and performance capabilities of the T-46A aircraft that will replace the T-37B as the U.S. Air Force's primary jet-engined trainer. The T-46A has a pressurized cabin that permits flight at over 10,000 m, thereby avoiding general aviation traffic. The two F109-GA-100 engines used are turbofans which yield exceptionally quiet operation Attention is given to competing designs over which the T-46A triumphed, and the armaments that can be incorporated by an attack/trainer variant that includes four underwing hardpoints and is intended for the export market. O.C.

A85-37946

A 320 - THIRD GENERATION AIRBUS

Air International (ISSN 0306-5634), vol. 28, June 1985, p. 281, 282, 285, 288-290 (5 ff.).

After presenting a history of the design development phase of the Airbus European consortium's efforts toward the production of the A300 airliner, attention is given to the design features and performance capabilities of the new generation A320. Two fuselage sizes are offered, of which the smaller, A320-100 seats 154 passagers and the larger A320-200 seats 172, at 81-cm pitch. A delay expenenced in arriving at an agreement among the Airbus consortium's partners on their respective launching cost shares was used by the design staff to further refine their product and to clarify engine requirements. The CFM56-5 and V2500 turbofan engines, both rated at 23,500 lbs of thrust, were chosen as powerplant alternatives. O.C.

A85-38243

MIRAGE 2000 FIGHTER COMBINES ACCELERATION, LOW-SPEED STABILITY

R. R. ROPELEWSKI Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, June 24, 1985, p. 38, 39, 41 (3 ff.).

An evaluation is made of the Mirage 2000B two-seat fighter's cockpit instrument suite, flight control characteristics, and combat mission profile performance. Little difference is noted between the weight and flight performance of this two-seat variant and its single seat counterpart, due to the elimination of the latter's twin 30-mm cannon. Both seats are equipped with HUDs, but that of the rear position merely duplicates the forward unit's data. Impressive turn capabilities are demonstrated throughout the flight envelope; the fly-by-wire control system uses inputs from the aircraft's air data computer to limit load factor and angle of attack throughout the operating range. Attention is given to the effectiveness of the airborne radar's air-to-air combat and air-to-ground ranging modes OC

A85-38244

SOVIETS TAILOR CARGO TRANSPORT FOR REMOTE-SITE OPERATIONS

D. E. FINK Aviation Week and Space Technology (ISSN 0005-2175), vol 122, June 24, 1985, p 55, 56.

The design features and probable airlift performance capabilities of the C-5 Galaxy-like An-124 large cargo transport aircraft recently exhibited by the USSR at the Paris Air Show are discussed. Several design features are noted which facilitate operation from unimproved runways at remote oil exploration and geological survey sites. The four turbofan engines used are in the 50,000-lb thrust class, and fitted with thrust reversers. A hinged nose section allows the deployment of a self-contained loading ramp. The design incorporates 12,000 lbs of composite materials in nonloadbearing airframe structures. A range of 4500 km is associated with the full payload of 330,000 lb O.C

A85-38245

TELEDYNE RYAN FOCUSES R & D EFFORT ON NEW RPVS, TARGET VERSIONS

K F. MORDOFF Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, June 24, 1985, p. 89-91, 93.

An evaluation is made of proprietary development efforts aimed at the production of: (1) high altitude, long endurance RPV platforms for the relay of communications and the gathering of intelligence and targeting information, (2) 2,500-lb class RPVs for tactical penetration missions, and (3) mini-RPVs and drones for use in target or surveillance missions. The first of the above categories has engendered the 85-foot wingspan 'Spirit' RPV, which will conduct communications, electronic intelligence, sonobuoy monitoring and long range weather surveillance missions Over-the horizon targeting and cruise missile early warning and tracking missions are also envisioned for Spirit. O.C.

A85-38302

THE LIMITS OF STRATOFILM

J. L. RAND (Winzen International, Inc., East San Antonio, TX) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol 5, no 1, 1985, p. 5-8.

An abnormally large number of catastrophic failures have occurred in recent years which have prompted a number of investigations. This paper documents the efforts by Winzen engineers to determine the cause oof these dangerous failures. It is concluded that catastrophic failure will occur if internal caps separate from the wall of the balloon at too low an altitude. Cap separation may be prevented by the use of external caps.

Author

A85-38303* National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.

RECENT MATERIALS PROBLEMS RELATING TO CATASTROPHIC BALLOON FAILURES

I. S. SMITH (NASA, Wallops Flight Center, Wallops Island, VA) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 9-11

Balloons fabricated of thin polyethylene materials have provided relatively inexpensive and reliable scientific research platforms for approximately three decades. Reliability of the modern day balloon, as launched by the U.S.A National Scientific Balloon Facility (NSBF), has been approximately 85 percent. Recent balloon failures, coupled with an increased ocurrence of catastrophic failures, created grave concern over the integrity of the present balloon inventory of the U.S.A. National Aeronautics and Space Administration (NASA). An investigative team was established by NASA to review the circumstances surrounding the catastrophic determine the cause and to balloon failures, make recommendations to correct the problem and to prevent its reoccurrence. The most probable cause of failure as determined by the investigation was the polyethylene balloon film, although the film had passed the established standard quality control measures of the film manufacturer. The approach, findings, and conclusions of the investigation are presented along with planned procedures to assure future quality balloon film for NASA balloons. Author

A85-38306

EXTERNAL CAPS - AN APPROACH TO STRESS REDUCTION IN BALLOONS

K. H HAZLEWOOD (National Scientific Balloon Facility, Palestine, TX) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no 1, 1985, p 21, 22.

Recent findings of the catastrophic balloon failures investigation in the U.S. indicate that very large gross inflations, in balloons using present design philosophy, over-stress currently available materials. External caps are proposed as an economic approach to reducing those stresses to an acceptable level. Author

A85-38321

FEASIBILITY STUDIES OF 'POLAR PATROL BALLOON'

J. NISHIMURA, K. TSURUDA (Tokyo, University, Tokyo, Japan), M. KODAMA (Yamanashi Medical College, Yamanashi, Japan), and H FUKUNISHI (National Institute of Polar Research, Tokyo, Japan) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 87-90. refs

Engineering and meteorological feasibilities of circum-south-polar ballooning project, called 'Polar Patrol Balloon (PPB)', for space and geophysical researches are studied. It is planned to use zero-pressure balloons mounting an auto-ballasting system, utilizing the non-sunset condition in mid-summer. PPB will be launched to a level higher than 30 km from an observational base in the Antarctica and come back there by a circumpolar wind. It is predicted that the circumpolar period may be a few weeks in the case of mid-summer 30 km-level flight and its meridional deviation after a circumpolar flight may be within a few hundreds kilometers. Auto-ballasting and ARGOS-tracking, have been tested, and some on-board data accumulation systems and power supply are being developed. If a collaboration with foreign bases is possible, results of PPB should be much more successful especially concerning simultaneous observations at various latitudes. Author

A85-38358#

MINIMUM-TIME PATH THROUGH WIND FIELDS

K. KATO and T NAKASHIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 360, 1984, p. 66-71. In Japanese, with abstract in English

Numerical results are given concerning the minimum-time path through a region of position dependent wind fields. Five wind fields are used three are defined analytically, while the other two are composed from measured weather charts. Optimum paths thus obtained suggest the possibility of fuel savings when applied to flights across the Pacific Author

A85-38360#

RESEARCH TREND IN ADVANCED TECHNOLOGY HELICOPTER

A. AZUMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no 361, 1984, p. 74-82. In Japanese refs

Recent helicopter developments are surveyed stressing improvements in speed, noise reduction, survivability and cost reductions Using composite materials, such as graphite epoxy, glass fiber, Nextel/polyimide, and Kevlar, for airframes the cost of manufacturing and weight can be reduced. Survivability can be improved by installing more than two engines. Vibration control systems such as nodal suspension and automatic flight controls including fly-by-wire and fly-by-fiber are detailed. The current status in manufacturing the BO-105 (for emergency medical service) is discussed.

A85-38361#

NATURAL FREQUENCIES AND FLIGHT LOADS OF COMPOSITE MAIN ROTOR BLADE FOR HELICOPTER

M. OHTOMO, K SAITO, S. BANDO, A KAKINUMA, and N. SERA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 361, 1984, p. 82-88 In Japanese.

The natural frequency and flight load of a helicopter composite blade are investigated, emphasizing the flight test. The blade weighs 10 5 kg and consists of glass fiber for the spar, Kevlar fiber for the skin, and carbon fiber for the T.E. strip. The natural frequencies of the rotor blade both in motion and stationary conditions are measured, and compared with the calculated values. In flight tests, loads of the blade and airframe and control forces are measured. It was found that no difference in variable loads exists between the composite and metal blades, with the composite blade stronger than the metal one Specifications of the composite blade and diagrams showing experimental results are included. S H.

A85-38365#

STUDY ON THE COMFORTABILITY OF HELICOPTER - FLIGHT TEST OF ACOUSTIC NOISE LEVEL

T ITO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no. 361, 1984, p. 101-110. In Japanese.

In order to reduce the acoustic noise level, the inner construction materials of helicopters are investigated, and their testing methods are described. The acoustic noise level is characterized and measured at various stages, such as take-off, horizontal flight, autorotation, climbing, and hovering. It was found that a glass wool base and glass-nylon cloth combination reduced significantly the acoustic noise. Rubber sheets in combination with a glass wool base showed a similar effect. Experimental results are given.

A85-38434

WHO NEEDS ADVANCED-TECHNOLOGY AIRLINERS?

D LEARMOUNT Flight International (ISSN 0015-3710), vol 127, June 1, 1985, p. 77-80.

An evaluation is made of three leading airliner manufacturer's plans toward meeting carriers' demand for an airliner in the 140-170-seat capacity range While Boeing and McDonnell Douglas have chosen not to respond to this market with a third-generation, new-technology aircraft, respectively continuing production of the 737-300 and MD-80 series aircraft instead, Airbus Industrie will

proceed with a design whose degree of new-technology integration more nearly approximates the projected third technological generation. Attention is presently given to the design features and prospective performance advantages of the A-320. O.C.

A85-38437

AV-8B-MEAN MARINE V/STOL MACHINE

M. GAINES Flight International (ISSN 0015-3710), vol. 127, June 1, 1985, p. 148-151.

An evaluation is made of the mission capability enhancements that accrue to the AV-8B, state-of-the-art variant of the Harrier VTOL attack aircraft in virtue of its incorporation and integration of advanced avionics and weapon delivery systems. An on-board oxygen generation system is used which obviates liquid oxygen supply requirements on long flights and amphibious ship operations. The stability Augmentation System employs a Departure Resistant System which facilitates safe aircraft handling at up to 122 deg angle-of-attack. An Angle Rate Bombing System renders the AV-8B highly accurate in its role as an air-to-ground weapons platform. The AV-8B will be delivered to the RAF for Central European Service under the designation GR 5, with minor differences in armament. O C.

A85-38438

LHX - A GIANT LEAP

M. GAINES Flight International (ISSN 0015-3710), vol. 127, June 1, 1985, p. 167-171.

Two versions of the state-of-the-art technology helicopter designated 'LHX' by the U.S. Army will replace current members of the light helicopter fleet in the 1990s: a scout/attack, or 'Scat', and a utility, 'Util', variant. The two LHX aircraft will employ the same engines and rotor elements; an overall commonality of 70 percent is anticipated. Unit flyaway cost of the Scat will be no more than \$6 million in 1984 dollars, while the Util will be no more than \$4 million. A total of 48 mission scenarios have been defined for the Scat version. Four Hellfire antitank missiles, two Stinger Post air-to-air missiles, and a gun system, constitute the armament requirements for Scat, which must be readily transportable aboard C-17, C-141, and C-5 airlifters. Low audio, visual, radar, and IR signatures are also demanded. Attention is given to several manufacturer's preliminary design determinations in the LHX competition. O.C

A85-38440

SOMETHING OLD, SOMETHING NEW

G. WARWICK Flight International (ISSN 0015-3710), vol. 127, June 1, 1985, p 182-184.

An assessment is made of the performance enhancements obtainable in helicopters and fixed wing aircraft by the development to technological maturity of the oblique-wing, forward swept wing, rotating/fixed 'X-wing', and flying wing configurations. Advancements in composite materials, computer-aided design methods, digital electronics, and electromechanical control devices, are noted to be uniquely capable of addressing outstanding operational problems in such long-considered configurational possibilities as the flying wing, with its intrinsic control instability, and the X-wing, in which a very stiff helicopter rotor is transformed into a set of four, back- and forward-swept wing surfaces. The flying wing configuration is suggested to be the basis of the U.S. Air Force's 'Stealth' bomber. O.C.

A85-38781#

AN AERODYNAMIC PERFORMANCE MODEL FOR HYBRID HEAVY LIFT SYSTEMS

B. M. PERSHING and M. J. ANDERSON (Aerospace Corp., El Segundo, CA) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 26-39. Sponsorship:-U.S.-Department of Agriculture. - refs (Contract USDA-53-04H-1-1-8488N)

(AIAA PAPER 85-0865)

A description is presented of a hybrid heavy lift system aerodynamic performance model which is employed in a timber harvesting econometric simulation developed for the USDA Forest Service. The model is capable of treating both multi-rotor hybrid systems, and single and tandem rotor helicopters, with positive and negative buoyancy. The model computes vehicle size, aerodynamic characteristics, basic performance capability, and time and fuel required to perform a timber yarding cycle. Comparison of predicted performance is made with H-34 and S-64 helicopter flight data and with S-64 yarding cycle field operation, the effects of winds and vehicle drag on yarding performance are shown.

Author

A85-38784#

THE DESIGN AND DEVELOPMENT OF THE GRACE AIRCRAFT GAC-20 AIRSHIP

J. R. THEILE (Grace Aircraft Corp., Eugene, OR) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 53-57. (AIAA PAPER 85-0869)

The Grace Aircraft GAC-20 is an all new airship being designed and built in compliance with the newly proposed Federal Aviation Administration General Airworthiness Standards for Airships. As such it is designed specifically for type certification and commercial use. This paper is a review of the design and development of the GAC-20. The mission profile and configuration are discussed as well as many important factors of the design. Major components discussed include the control car, propulsion system, landing gear, fins, control system, and envelope. Author

A85-38786#

THE CYCLO-CRANE - A NEW CONCEPT TO HEAVY VERTICAL LIFT

A. G. CRIMMINS (Aerolift, Inc., Tillamook, OR) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 63-67.

(AIAA PAPER 85-0871)

AeroLift represents one of the very few organizations devoted to the design, development, and construction of a hybrid aircraft. The Cyclo-Crane is a hybrid aircraft that utilizes aerostatic lift combined with aerodynamic lift and thrust. The Cyclo-Crane will offer heavy lift services, analogous to helicopter operations at a cost projected to be on the order of 25 percent of helicopters. The Cyclo-Crane concept is valid up to 75 tons of sling-load capability. The Cyclo-Crane combines the economical aerostatic lift from nonflammable helium with rotating airfoils to provide low cost, heavy lift service not previously available. Author

A85-38787#

DESIGN OF A SMALL AIRSHIP

J. THOMPSON IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 68-72.

(AIAA PAPER 85-0872)

A small (2 person) airship is nearing completion. The envelope is of 28,000 ft 3 volume with a fineness ratio of 3.15. Propulsion is a Honda 1200cc liquid cooled engine, a toothed-belt reduction drive and shrouded prop. The envelope was shaped by a novel procedure to yield a contour with first and second derivatives that are smooth and continuous. Author

A85-38788#

THE NEED TO RETURN TO HYDROGEN IN AIRSHIPS

M. BREDT (Buz Airship Co., New Orleans, LA) IN⁻ Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 73-77.

(AIAA PAPER 85-0873)

The prohibitively high cost of helium outside North America prompts reconsideration of hydrogen's use as the lifting gas of LTA vehicles which have been designed to minimize the risks associated with hydrogen's flammability. Hydrogen can also serve a double role, as lifting gas and fuel. Attention is given to principles for the design of LTA vehicles incorporating lightweight, fire-retardant materials forming a rigid airframe. The use of reciprocating, hydrogen-fueled engines is noted to be able to furnish a substatial degree of buoyancy control. A wind turbine-powered hydrogen production infrastructure deployed along airship routes is considered as the basis for LTA financing and servicing. O.C.

A85-38791#

PROGRESS REPORT ON THE ENGINEERING DEVELOPMENT OF THE MAGNUS AEROSPACE LTA 20-1 AIRSHIP

J. DELAURIER, W. D. MCKINNEY, J. D. LOWE, D. R UFFEN, and A. S. KING (Toronto, University, Toronto, Canada) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 90-99. refs (AIAA PAPER 85-0876)

Engineering research and development has been performed on the Magnus Aerospace Corporation's LTA 20-1, which is a unique heavy-lift airship design utilizing buoyancy, vectored thrust, and the Magnus effect for vertical lift. Its configuration consists of a large sphere rotating crosswise to its flight direction about end axles, from which a half ring-wing yoke is suspended. Attached to the yoke is a gondola and propulsive units. This unprecedented vehicle has required comprehensive engineering analysis, resulting in a candidate configuration for which favorable flight-dynamic behavior and performance have been predicted. This paper describes the work performed over the last two years, which includes wind-tunnel testing flight-dynamic analyses, structural calculations, performance predictions, and flying-model experiments Author

A85-38796*# Systems Technology, Inc., Hawthorne, Calif. CONTROL RESPONSE MEASUREMENTS OF THE SKYSHIP-500 AIRSHIP

H. R. JEX, J. R. HOGUE (Systems Technology, Inc., Hawthorne, CA), and P. GELHAUSEN (NASA, Ames Research Center, Moffett Field, CA) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers New York, American Institute of Aeronautics and Astronautics, 1985, p. 130-141. refs (AIAA PAPER 85-0881)

An examination is conducted of the Skyship 500's dynamic response to control inputs from elevators, rudders, and throttles at zero, 25, and 40 kts indicated airspeed Input frequency sweeps were made with pitch and turn controls at 25 and 40 kts, ranging in frequency from about 0.03 to 1.5 Hz. FFT data analysis was then applied to compute describing functions for each run. Frequency responses are noted to be very smooth, and comparisons, between repeat runs indicate excellent agreement. Summary plots of the faired describing functions from each run form the core of the data presented. These data constitute a comprehensive and reliable data base on which to predicate future dynamic simulation mathematical models of small airship dynamic response. O.C.

A85-38798#

A NEW CONCEPT OF HYBRID AIRSHIP

B. LINDENBAUM, D. L. QUAM, and W. T. GRADY (Aerial Mobility, Inc., Dayton, OH) IN Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 153-160.

(AIAA PAPER 85-0868)

An evaluation is made of a novel hybrid airship configuration, in which the powered lift-propulsion system is separated from the LTA unit in such a way as to permit the latter to move freely in the horizontal direction over small distances without significant restraint from the LTA unit. Attention is given to the case of a 25-ton payload hybrid airship's performance and physical characteristics, in light of practical airlifting tasks. The precision of the present hybrid airship configuration's pick-up and placement of underslung loads is noted. O.C.

A85-38850

THE AERODYNAMICS OF THE TU-154B AIRCRAFT [AERODINAMIKA SAMOLETA TU-154B]

T. I. LIGUM, S. IU. SKRIPNICHENKO, and A. V. SHISHMAREV Moscow, Izdatel'stvo Transport, 1985, 263 p. In Russian.

The aerodynamic aspects of the flight operations of the commercial Tu-154B aircraft with NK-8-2u turbofan engines are examined. The discussion covers the flight performance characteristics, flight conditions, and stability and controllability, including flight at large angles of attack and special flight conditions. Recommendations concerning aircraft operation under unfavorable meterological conditions are given, as are recommendations for reducing noise during the take-off. Ways to reduce fuel consumption during flight operations are discussed. V.L.

A85-38875

FUNDAMENTALS OF THE FLIGHT OPERATIONS OF HELICOPTERS: AERODYNAMICS [OSNOVY LETNOI EKSPLUATATSII VERTOLETOV: AERODINAMIKA]

A. M. VOLODKO Moscow, Izdatel'stvo Transport, 1984, 256 p. In Russian. refs

The theoretical and experimental fundamentals of the aerodynamics of single-rotor and coaxial-rotor helicopters are reviewed using a simple mathematical formalism and flight test results for the commercial helicopters Mi-8 and Ka-32. In particular, attention is given to the principal parameters and aerodynamic characteristics of the rotor and the rotor blade, pulse and vortex theories of the rotor, the rotor control system, and forces and moments acting on the rotor. Emphasis is placed on the physical meaning of the phenomena and processes involved and on how they affect the flight operations. V.L.

A85-39066* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RESULTS OF A WIND TUNNEL/FLIGHT TEST PROGRAM TO COMPARE AFTERBODY/NOZZLE PRESSURES ON A 1/12 SCALE MODEL AND AN F-15 AIRCRAFT

O. C. PENDERGRAFT, JR. (NASA, Langley Research Center, Hampton, VA) and J. NUGENT (NASA, Flight Research Center, Edwards, CA) IN Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 101-110. refs

(SAE PAPER 841543.)

In 1975 NASA Dryden Flight Research Facility received the No. 2 prototype F-15 aircraft from the USAF to conduct the F-15 Propulsion/Airframe Interactions Program. About the same time, NASA Langley Research Center acquired a 1/12 scale F-15 propulsion model, whose size made it suitable for detailed afterbody/nozzle static pressure distribution studies. Close coordination between Langley and Dryden assured identical orifice locations and nozzle geometries on the model and aircraft. This paper discusses the sequence of the test programs and how retesting the model after completion of the flight tests greatly increased the ability to match hardware and test conditions. The expenence gained over the past decade from involvement in the program should prove valuable to any future programs attempting to match wind tunnel and flight tests conditions and hardware.

Author

A85-39125

CHARACTERISTICS OF THE OSCILLATIONS OF A TAIL UNIT IN A FLOW OF AN INCOMPRESSIBLE GAS [O KHARAKTERE KOLEBANII OPERENIIA S RULEM V POTOKE NESZHIMAEMOGO GAZA]

V. A. PAVLOV, S. K. CHERNIKOV, and M. I. GERSHTEIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 98-100. In Russian.

The steady-state self-oscillations of a tail unit in a flow of an incompressible gas, with the rudder hinged in a statically indeterminate manner, is investigated analytically. It is noted that the nonzero frontal stiffness of the rudder results in a qualitative modification of the self-oscillations. An analysis of the behavior of

the tail unit indicates that the amplitude of the oscillations at flow velocities higher than a critical value is stable and limited in magnitude; the amplitude decreases as the flow velocity increases. V.L.

A85-39164 SECONDARY POWER GENERATION SYSTEM CONSIDERATIONS FOR ADVANCED AIRCRAFT

R. H. ANDERSON (General Dynamics Corp., Fort Worth, TX) IN: Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 95-104.

(SAE PAPER 841604)

A generalized approach to secondary power generation for advanced military aircraft is presented. The objectives of such an approach are given along with a flow chart of the analysis. The individual elements of the approach are discussed, including the mission of the weapon system under study, hardware information sources, baseline aircraft design and its requirements, hardware concepts, and system evaluation and selection Both peacetime and wartime implications are considered. A generalized example of a power generation selection trade study that was actually performed for a single engine fighter aircraft is given. C D.

A85-39202* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPUTER STUDY OF A JET FLAP ASTVOL 'HARRIER'

S. B. WILSON, III and L. D. LIPERRA (NASA, Ames Research Center, Moffett Field, CA) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 1-13. refs

(SAE PAPER 841457)

A study of the costs/benefits trade-off was conducted for an Advanced Supersonic Short Takeoff and Vertical Landing (ASTOVL) aircraft incorporating a jet flap. The data used were the theory of let flaps and high aspect ratio nozzles, experience with a V/STOL aircraft study performed for NASA Ames Research Center in February 1982, and a high performance aircraft-synthesis program (ACSYNT). The methodology was to accurately model the supersonic Harrier V/STOL aircraft design on ACSYNT, and then modify the design by both adding high aspect-ratio nozzles in place of the rear (core-flow) nozzles on the Pegasus-type turbofan engine, and integrating these nozzles on each wing's trailing edge, thus creating a jet flap. The predicted performance advantages (increase in maximum lift coefficient with flap deflection and horizontal thrust recovery) were traded off against the disadvantages (additional weight and thrust loss due to ducting) on two representative missions. Author

A85-39204

SERIES FLOW TANDEM FAN - A HIGH-SPEED V/STOL PROPULSION CONCEPT

T. W. CLINGINGSMITH (LTV Aerospace and Defense Co., Dallas, TX) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 23-29, refs

(SAE PAPER 841496)

A promising high speed V/STOL propulsion concept, the series flow tandem fan (SFTF), was analyzed by Vought for a single engine airplane configuration. The SFTF propulsion system was evaluated for size, performance and technology issues by engine companies under contract. Under contract to the Naval Air Propulsion Center (NAPC), Vought assessed engine contractor definition of baseline and alternate SFTF propulsion systems when installed in a representative aircraft concept. This paper summarizes the results of these studies and shows the impact on VTO thrust requirements, exhaust temperature and airplane performance. Further, the effect of STOVL criteria on vehicle sizing and engine design is being studied under a follow-on contract.

TWIN TILT NACELLE V/STOL AIRCRAFT

M. A. ESKEY, S. B. WILSON, III (NASA, Ames Research Center, Moffett Field, CA), W. VALCKENAERE (Grumman Aerospace Corp., Bethpage, NY), and J P LAREAU (US Naval Air Systems Command, Washington, DC) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p 67-81. refs (SAE PAPER 841556)

This paper describes the second government-conducted, piloted flight simulation of the Grumman Design 698 V/STOL (vertical and short takeoff and landing) aircraft. Emphasis is on the aircraft's handling qualities as rated by various NASA, Navy, and GAC pilots with flight experience ranging from CTOL (conventional take-off and landing) to V/STOL aircraft. The Design 698 had been modified to resolve the flight problems that were of most concern to the pilots in the first investigation (Phase I) Those problems included an adverse nonminimum phase (NMP) acceleration response in both the longitudinal and lateral axes, a large thrust-response lag, and adverse ground effects. The adverse NMP acceleration is an attribute of the vertical vanes (a Grumman patent) positioned in the fan exhaust flow. The primary modifications included using the vertical-vane deflection as a thrust spoiling method, the addition of the cross-shafted propulsion system, and the implementation of two velocity and attitude control modes (standard and precision) for speeds below 50 knots. Author

A85-39211*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif

APPLICATIONS OF STATE ESTIMATION IN AIRCRAFT FLIGHT-DATA ANALYSIS

R. E BACH, JR. and R. C. WINGROVE (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, July 1985, p. 547-554. Previously cited in issue 19, p 2798, Accession no. A83-41919. refs

A85-39212*# Virginia Polytechnic Inst. and State Univ., Blacksburg

CLASSICAL AND NEO-CLASSICAL CRUISE-DASH OPTIMIZATION

K. D. BILIMORIA, E. M. CLIFF, and H. J. KELLEY (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 555-560. Previously cited in issue 20, p. 2851, Accession no. A84-42366. refs

(Contract NAG1-203)

A85-39217*# Boeing Commercial Airplane Co, Seattle, Wash. WINGLET EFFECTS ON THE FLUTTER OF A TWIN-ENGINE TRANSPORT-TYPE WING

K. G. BHATIA, K. S. NAGARAJA (Boeing Commercial Airplane Co, New Product Div., Seattle, WA), and C. L. RUHLIN (NASA, Langley Research Center, Configuration Aeroelasticity Branch, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 587-594. Previously cited in issue 15, p. 2117, Accession no. A84-34907. refs

A85-39221#

APPROACH TO INTERIOR NOISE CONTROL. I - DAMPED TRIM PANELS

C. I. HOLMER (Cabot Corp., E-A-R Drv., Indianapolis, IN) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 618-623. Previously cited in issue 01, p. 4, Accession no. A85-10900. refs

A85-39554# TOWARD A UNIFYING THEORY FOR AIRCRAFT HANDLING QUALITIES

R. A HESS (California, University, Davis, CA) and I. SUNYOTO Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p. 440-446. Previously cited in issue 06, p. 720, Accession no. A84-17966. refs

A85-39616#

MEETING THE 1985 FAA NOISE REGULATIONS WITH OLD ENGINES AND MODERN ACOUSTIC TECHNOLOGY

K S. IRWIN (Tracor Aviation, Inc., Goleta, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA. July 8-10, 1985, 7 p.

(AIAA PAPER 85-1120)

The application of FAR Part 36 Stage 2 noise limitations to four engine aircraft on January 1, 1985, generated the requirement to quiet the engines of earlier generation aircraft such as the Boeing 707. With reengining proven impractical for the 707, an approach was developed that achieved the required noise reductions through a combination of (1) Nacelle modifications incorporating the advanced acoustical liner material DynaRohr(TM) for noise attenuation, (2) reduced landing flap settings requiring lower thrust (and hence lower noise) on approach, and (3) a modest reduction in maximum gross takeoff weight, resulting in improved climb gradients. This paper describes the design approach, ground tests, flight tests, analyses, and results that led to FAA Certification of the Tracor/Shannon Quiet 707 in early 1985 Author

A85-39698*# McDonnell Aircraft Co., St. Louis, Mo

THE INVESTIGATION OF INLET/NOZZLE FLOWFI COUPLING USING COMPACT PROPULSION SIMULATORS FLOWFIELD

D. E. ZILZ (McDonnell Aircraft Co., St. Louis, MO) and R. O. BAILEY (NASA, Ames Research Center, Advanced Aerodynamics Concepts Branch, Moffett Field, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 13 p refs

(AIAA PAPER 85-1284)

An investigation of airframe/propulsion system flowfield coupling has been conducted in the Ames 11-Foot Transonic Wind Tunnel at Mach numbers from 0.40 to 1.40 and at angles-of-attack from -2 to +20 deg. Propulsive flows were simulated by flow-through, jet-effects, and turbo-powered simulators (CMAPS) techniques. The configuration was a 10 percent scale model of a VSTOL canard/wing fighter configuration with twin podded engine nacelles and nonaxisymmetric nozzles. Localized flowfield interactions were present and inlet-nozzle flowfield coupling was identified at supersonic flight conditions. The configuration with simultaneous inlet and nozzle flow simulation (CMAPS) exhibited lower drag supersonically than the flow-through/jet-effects configuration During this first wind tunnel application of twin simulators in a full aircraft configuration, the CMAPS and control system proved to be a flexible, reliable testing method. Author

A85-39785#

THE INTEGRATION OF A NEW CONCEPT IN VTOL AIRCRAFT PROPULSION

P. S. MOLLER (Moller international, Davis, CA) AIAA. SAE. ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 7 p refs

(AIAA PAPER 85-1448)

Operational benefits and penalties of a lifting-fan VTOL aircraft, intended largely for commuter and other civil purposes, is examined Two (6-fan and 8-fan) models are considered; the 6-fan version, which is currently in the testing stage, is characterized by a top speed of 235 mph, maximum payload of 900 lbs, hover ceiling of 9,500 ft, and operational ceiling of 16,000 ft. Among propulsion-related problems, attention is paid to power-to-weight ratio requirements as a function of hover characteristics, engine or lifting component failure tolerance, and efficient cruise. Finally, thrust vectoring, hover control capability, and noise considerations are discussed. L.T.

A85-39786#

STARDUSTER - A SOLAR POWERED HIGH ALTITUDE AIRPLANE

R. J BOUCHER (Astro Flight, Inc., Marina del Rey, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. refs (AIAA PAPER 85-1449)

This paper presents an analysis of a proposed solar powered high altitude airplane called 'Starduster'. Starduster is designed to reach extreme altitudes exceeding 200,000 feet and, although flight is limited to the daylight hours, long distance flights over thousands of miles are possible. Vehicle configurations are examined and subsystem functional requirements are defined. Author

A85-39789#

PROPULSION INFLUENCES ON AIR COMBAT

P. W. HERRICK (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs (AIAA PAPER 85-1457)

The influences of aircraft propulsion systems on the conduct and outcome of air-to-air combat are traced from World War I to the foreseeable future. Propulsion characteristics are shown to heavily impact fighter aircraft performance, maneuverability, detectability, persistence, tactics, range, vulnerability, and weapons utilization. World War I influences relate to propeller/gun positioning and rotary/stationary engine choices. Post World War I benefits accrued from propeller, engine, and fuel advances. World War II air combat was affected by propeller influences, fuel injection, engine cooling, supercharging, and engine installation Jet engines provided speed, altitude, and damage tolerance at the expense of fuel economy, threat awareness, and missile susceptibility. Future propulsion advances will provide supersonic cruise and supermaneuverability while reducing aircraft detectability. Author

A85-39869#

THE DEVELOPMENT OF THE GENERALIZED ESCAPE SYSTEM SIMULATION PROGRAM

D. A FENDER (Ketron, Inc., Warminster, PA) and L. A. DAULERIO (U.S Naval Material Command, Naval Air Development Center, American Society of Mechanical Engineers, Warminster, PA) Winter Annual Meeting, New Orleans, LA, Dec 9-14, 1984 8 p. refs

(ASME PAPER 84-WA/DSC-20)

A program is described which generates six-dimensional trajectory predictions for the aircraft, the seat/occupant, the occupant alone, and the seat alone for existing or developmental seat ejection systems, and evaluates the effects of such systems and components as seat catapults, rails, rockets, stabilization mechanisms, and parachute systems on the trajectories. The study also deals with the means of determining orientations between model elements, handling of large tables of aerodynamic coefficient data, minimization of memory requirements, and accuracy verification of the final model. LT.

N85-27851 Messerschmitt-Boelkow-Blohm G.m.b H., Ottobrunn (West Germany).

DEVELOPMENT OF A FUSELAGE FORWARD SECTION IN CARBON FIBER REINFORCED PLASTIC (CFRP) TYPE OF [ENTWICKLUNG CONSTRUCTION EINES RUMPFVORDERTEILES IN CFK-BAUWEISE]

M. VOGLSINGER Oct. 1984 44 p In GERMAN (MBB/LFA34/CFK/PUB/008) Avail: Issuing Activity

A complete fuselage nose made of CFRP was developed and manufactured. Cost and time constraints imposed compromises, such as testing at room temperature without humidity and no buckling loading up to rupture. The main goals of the experimental program are nevertheless achieved and the suitability of this type of construction is demonstrated A CFRP portion of 50% is shown to be a sensible upper limit; a sufficient static strength is obtained; a mass reduction of 18% can be obtained; the reproducibility of the production method is demonstrated; and the higher CFRP

material and equipment costs are shown to be compensated by a reduced assembly cost. Author (ESA)

W85-27852*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FRICTION AND WEAR BEHAVIOR OF ALUMINUM AND COMPOSITE I-BEAM STIFFENED AIRPLANE SKINS

K. E. JACKSON Jun. 1985 28 p refs Prepared in cooperation with Army Structures Lab., Hampton, Va.

(NASA-TM-86418; NAS 1.15:86418; USAAVSCOM-TM-85-B-2) Avail: NTIS HC A03/MF A01 CSCL 01C

Friction and wear behavior was determined for I-beam stiffened skins constructed of aluminum, graphite-epoxy composite, and glass hybrid composite under abrasive loading conditions typical of those occurring on the underside of a transport airplane during an emergency belly landing. A test apparatus was developed to abrade the test specimens on actual runway surface under a range of pressures (2-5 psi) and velocities (16-50 mph). These parameters were chosen to fall within the range of conditions typical of an airframe sliding on a runway surface. The effects of the test variables on the wear rate and the coefficient of friction are discussed and comparisons are made between the composite materials and aluminum. In addition, the test apparatus was equipped to monitor the temperature variations on the backside of the skins during abrasion and these results are presented.

Author

Author

N85-27853# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.

AN ASSESSMENT OF THE SUITABILITY OF THE BHGA STRUCTURAL TEST RIG FOR AERODYNAMIC TESTING OF HANG GLIDERS

E. A. KILKENNY Feb. 1985 29 p refs

gained from existing aerodynamic test facilities.

(CA-8505; ISBN-0-947767-185) Avail: NTIS HC A03/MF A01 In response to a proposal by the BHGA to use their structural test rig to carry out aerodynamic testing of hang gliders, the existing structural test facility and the modifications already made for aerodynamic testing are described. Improvements to the instrumentation are discussed together with an assessment of the

flow quality and recommendations made, based on experience

W85-27854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ROTORCRAFT RESEARCH TESTING IN THE NATIONAL FULL-SCALE AERODYNAMICS COMPLEX AT NASA AMES RESEARCH CENTER

W. WARMBRODT, C. A. SMITH, and W. JOHNSON May 1985 90 p refs

(NASA-TM-86687; REPT-85140; NAS 1.15:86687) Avail. NTIS HC A05/MF A01 CSCL 01C

The unique capabilities of the National Full-Scale Aerodynamics Complex (NFAC) for testing rotorcraft systems are described. The test facilities include the 40- by 80-Foot Wind Tunnel, the 80- by 120-Foot Wind Tunnel, and the Outdoor Aerodynamic Research Facility. The Ames 7- by 10-Foot Subsonic Wind Tunnel is also used in support of the rotor research programs conducted in the NFAC. Detailed descriptions of each of the facilities, with an emphasis on helicopter rotor test capability, are presented. The special purpose rotor test equipment used in conducting helicopter research is reviewed Test rigs to operate full-scale helicopter main rotors, helicopter tail rotors, and tilting prop-rotors are available, as well as full-scale and small-scale rotor systems for use in various research programs. The test procedures used in conducting rotor experiments are discussed together with representative data obtained from previous test programs. Specific examples are given for rotor performance, loads, acoustics, system interactions, dynamic and aeroelastic stability, and advanced technology and prototype demonstration models. B.W.

N85-27855*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ADDITION OF FLEXIBLE BODY OPTION TO THE TOLA COMPUTER PROGRAM, PART 1 Final Report

J. W. DICK and B. J. BENDA Oct. 1975 402 p refs 2 Vol. (Contract NAS1-13259)

(NASA-CR-132732-1; NAS 1.26:132732-1) Avail: NTIS HC A18/MF A01 CSCL 01C

This report describes a flexible body option that was developed and added to the Takeoff and Landing Analysis (TOLA) computer program. The addition of the flexible body option to TOLA allows it to be used to study essentially any conventional type airplane in the ground operating environment. It provides the capability to predict the total motion of selected points on the analytical methods incorporated in the program and operating instructions for the option are described. A program listing is included along with several example problems to aid in interpretation of the operating instructions and to illustrate program usage. Author

N85-27856*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ADDITION OF FLEXIBLE BODY OPTION TO THE TOLA COMPUTER PROGRAM. PART 2: USER AND PROGRAMMER DOCUMENTATION

J. W. DICK and B. J. BENDA Oct. 1975 205 p refs 2 Vol (Contract NAS1-13259)

(NASA-CR-132732-2; NAS 1.26:132732-2) Avail: NTIS HC A10/MF A01 CSCL 01C

User and programmer onented documentation for the flexible body option of the Takeoff and Landing Analysis (TOLA) computer program are provided. The user information provides sufficient knowledge of the development and use of the option to enable the engineering user to successfully operate the modified program and understand the results. The programmer's information describes the option structure and logic enabling a programmer to make major revisions to this part of the TOLA computer program. Author

N85-27857# National Research Council of Canada, Ottawa (Ontario).

À PRELIMINARY INVESTIGATION OF HANDLING QUALITIES REQUIREMENTS FOR HELICOPTER INSTRUMENT FLIGHT DURING DECELERATING APPROACH MANEUVERS AND OVERSHOOT

S. KEKELIUK and M. MORGAN Feb. 1985 35 p refs (NRC-24173; NAE-AN-26) Avail: NTIS HC A03/MF A01

A preliminary flight investigation was carried out to highlight deficiencies of helicopters handling qualities when performing low speed instrument approaches. Steep decelerating microwave landing system approaches to a decision height of 50 feet, simultaneously decelerating to 20 knots, were performed in the NAE Airborne Simulator, a variable-stability Bell 205A helicopter. Tracking performance, in terms of height, azimuth and speed errors was of an acceptable standard, but pilot workload was extremely high, especially during the overshoot phase. Benefits of different levels of control system augmentation were not readily apparent in this high workload environment. A follow-on program is proposed where further attempts will be made to determine the effects of display and control sophistication on pilot workload during slow speed helicopter instrument procedures.

N85-27858# Dayton Univ., Ohio. Research Inst.

USAF DAMAGE TOLERANT DESIGN HANDBOOK: GUIDELINES FOR THE ANALYSIS AND DESIGN OF DAMAGE TOLERANT AIRCRAFT STRUCTURES, REVISION B Final Report, Sep. 1980 - Mar. 1984

J P. GALLAGHER, F. J. GIESSLER, and A. P. BERENS Wright-Patterson AFB, Ohio AFWAL May 1984 1329 p (Contract F33615-80-C-3229)

This handbook supports the USAF Airplane Damage Tolerance Requirements contained in MIL-A-83444. The handbook provides specific background data and justification for the detailed requirements of MIL-A-83444 and provides guidelines and state-of-the-art analysis methods to assist contractor and USAF personnel in complying with the intent of the specification and in solving cracking problems, in general, for metallic aircraft structures. The material contained in this document is general enough to be useful in the evaluation of the damage tolerance of INL-A-83444. The handbook has been structured to provide a clear and concise summary of the specification, MIL-A-83444, as well as supporting analysis methods, test techniques, and nondestructive inspection (NDI) methods are provided as state-of-the-art along with suggested and/or recommended practices, limitations, etc. For the convenience of the user, copies of appropriate USAF structural specifications are contained as an appendix to this handbook.

GRA

N85-27859# Aeronautical Research Labs., Melbourne (Australia)

FLIGHT TRIALS OF A MODIFIED GULFSTREAM COMMANDER CARRYING EXTERNAL STORES

P. A. FARRELL and A. GOLDMAN Sep. 1984 27 p

(AD-A153376; ARL/STRUC-TM-392) Avail. NTIS HC A03/MF A01 CSCL 01C

The Dept. of Aviation Australia has modified a gulfstream G.695A aircraft to carry external stores on the fuselage. A vibration test followed by a series of flight trails were conducted to satisfy some of the requirements of certification. A description of these tests together with the results is given. GRA

N85-27860# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

PARAMETER IDENTIFICATION RESULTS OF TESTS IN NONSTEADY SYMMETRIC FLIGHT WITH THE HAWKER HUNTER MK 7

J. H. BREEMAN 4 Jan. 1983 59 p refs

(Contract NIVR-1697)

(NLR-TR-83042-U; B8560426; AD-B089090L) Avail NTIS HC A04/MF A01

A flight test method for high speed aircraft was evaluated in nonsteady symmetric maneuvers with the Hawker Hunter Mk 7. The reproducibility of the estimated parameters is 1.5% for the drag model, 1% for the lift model, and 3% for the pitching moment model. However, this last result is strongly affected by the uncertainty in the center of gravity location. The results agree with findings derived from the same data after allowing for a difference in the mean aerodynamic chord used in the latter results. The results are consistent with flight tests of a Hawker Hunter Mk 12. Author (ESA)

N85-27861# National Aerospace Lab, Amsterdam (Netherlands).

NEW MATERIALS AND TECHNIQUES FOR AIRCRAFT STRUCTURES

1983 15 p In DUTCH; ENGLISH summary Sponsored by Netherlands Agency for Aerospace Programs (B8580074) Avail: NTIS HC A02/MF A01

The structural static strength and stiffness, fatigue crack propagation resistance, residual strength, stress corrosion resistance, and fracture toughness of aircraft construction materials and the techniques to produce them are discussed. Aluminum alloys (AI Zn Mg Cu, AI Cu Mg), fiber (carbon, boron, keular) composite materials, titanium alloys, high strength steels, and adhesively bonded laminated sheet structures are discussed

Author (ESA)

N85-27862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst fuer Physik der Atmosphaere.

THREE POWERED SAILPLANES AS METEOROLOGICAL INSTRUMENTATION FOR ATMOSPHERIC BOUNDARY LAYER STUDIES AT DFVLR

A. M. JOACHUM, M. E. REINHARDT, and H WILLEKE Nov. 1984 151 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-920) Original contains color illustrations

(DFVLR-FB-84-50, ISSN-0171-1342) Avail: NTIS HC A08/MF A01

Three ASK 16 powered salplanes are used as meteorological research aircraft for atmospheric boundary layer studies. The instrumentation and the data acquisition and evaluation systems as well as an error analysis are described. Data and results are presented. Author (ESA)

N85-28914# Technische Univ., Brunswick (West Germany). Inst. fuer Flugmechanik.

HELICOPTER AEROMECHANICS: INTRODUCTION AND HISTORICAL REVIEW

G. REICHERT In AGARD Helicopter Aeromech. 23 p Apr. 1985 refs

Avail NTIS HC A15/MF A01

Although the current generation of civil and military helicopters have greatly improved upon the previous generations, rotorcraft technology still has the potential for decided improvements. As high-payoff technologies aeromechanics (aerodynamics/dynamics), structures/materials, avionics/flight controls, and engine drive system technology can be identified, of which aeromechanics will be discussed in more detail. The general role of aeromechanics in military and civilian applications to rotary wing aircraft will be summarized and an overview of the state of the art will be given. In addition to direct performance improvements, there is great opportunity to improve the operating characteristics to a degree that the full performance characteristics inherent in the designs may be realized. Some current systems fail in the utilization of their full performance as a result of dynamical limitations or high vibrational levels G.L.C.

N85-28915# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

A SURVEY OF RECENT DEVELOPMENT IN HELICOPTER AERODYNAMICS

J. J. PHILIPPE, P. ROESCH, A. M DEQUIN, and A. CLER *In* AGARD Helicopter Aeromech 40 p Apr. 1985 refs Prepared in cooperation with Societe Nationale Industrielle Aerospatiale, Marignane, France

Avail: NTIS HC A15/MF A01

Various aspects of helicopter aerodynamics are addressed. The aerodynamics of isolated rotors and fuselages as well as some topics in interactional aerodynamics are dealt with. G.L.C.

N85-28917*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif

RECENT DEVELOPMENTS IN THE DYNAMICS OF ADVANCED ROTOR SYSTEMS

W. JOHNSON In AGARD Helicopter Aeromech 51 p Apr. 1985 refs

Avail: NTIS HC A15/MF A01 CSCL 01C

The problems that have been encountered in the dynamics of advanced rotor systems are described. The methods for analyzing these problems are discussed, as are past solutions of the problems. To begin, the basic dynamic problems of rotors are discussed: aeroelastic stability, rotor and airframe loads, and aircraft vibration. Next, advanced topics that are the subject of current research are described: vibration control, dynamic inflow, finite element analyses, and composite materials. Finally, the dynamics of various rotorcraft configurations are considered: hingeless rotors, bearingless rotors, ortors with circulation control, coupled rotor/engine dynamics, articulated rotors, and tilting proprotor aircraft.

N85-28920# Royal Aircraft Establishment, Bedford (England). Helicopter Aeromechanics Section.

FLIGHT TESTING FOR PERFORMANCE AND FLYING QUALITIES

G. D. PADFIELD In AGARD Helicopter Aeromech. 51 p Apr. 1985 refs

Avail: NTIS HC A15/MF A01

A systematic review of flight test techniques and test data interpretation methods for helicopter performance and flying qualities is presented. The distinction is drawn between quasi-steady and dynamic testing and within these categories both clinical and role-related techniques are discussed Performance topics covered include steady state performance in hover and forward flight, flight envelope boundaries, take-off and landing performance, and helicopter agility. Flying qualities topics begin with a treatment of static stability tests and progress to dynamic stability, control response, system identification and role-related evaluation techniques Testing appropriate to certification and development phases and research activities are addressed. The exploratory nature of flight testing is evident throughout this work and safety aspects are emphasized when required. Results from recent and past test programs are used to illustrate the forms in which flight data can be presented, and data reduction and analysis methods established and under development are reviewed

Author

N85-28936 Department of the Air Force, Washington, D.C. HEAT MANAGEMENT SYSTEM FOR AIRCRAFT Patent A. H. MAYER, inventor (to Air Force) 19 Mar. 1985 11 p Supersedes AD-D010635 (AD-D011658; US-PATENT-4,505,124;

US-PATENT-APPL-SN-534996; US-PATENT-CLASS-62-180) Avail: US Patent and Trademark Office CSCL 13A

A novel heat management system for aircraft is provided which is based on the aircraft fuel as the heat exchange medium and comprises a dedicated thermal reserve fuel tank for containing refrigerated aircraft fuel (or other expendable liquid) which is cooled by heat exchange with the primary aircraft fuel flow to the engines, a fuel line loop for conducting fuel through a plurality of heat exchangers associated with cooling loops for heat generating aircraft systems, and a central microprocessor based controller for controlling fuel flow and temperature throughout the fuel loop system and into the aircraft engine. Author (GRA)

N85-28937*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif FUTURE OF V/STOL AIRCRAFT SYSTEMS: A SURVEY OF

OPINIONS K. C. WHITE, B. A. LAMPKIN, and H. ANDREWS (Naval Air Systems Command, Washington, D C) Jun 1985 15 p refs (NASA-TM-86689; REPT-85146; NAS 1.15:86689) Avail NTIS HC A02/MF A01 CSCL 01C

The recent success of the British Harriers in the Falkland Islands conflict vividly underscored the potential of V/STOL aircraft in military operations in a difficult environment. Despite this apparent success of the Harrier, there has been a major decline of V/STOL funding in the research and development budgets of the U.S. government and industry The recent funding history of V/STOL systems is examined. Responses to a questionnaire which asked the question, Should there be an operational V/STOL aircraft other than the AV-8A and AV-8B in the military aircraft fleet of the U.S.A.? are presented and discussed. Author

N85-28938# Aeronautical Research Labs., Melbourne (Australia).

FURTHER INVESTIGATIONS TO IMPROVE THE FATIGUE LIFE OF THE MIRAGE 1110 WING MAIN SPAN

J. Y. MANN, A. S. MACHIN, and W. F. LUPSON Jan. 1985 31 p refs

(ARL-STRUC-TM-397; AR-003-984) Avail NTIS HC A03/MF A01

Wing main spars of Mirage IIIIIO aircraft have undergone a refurbishment program to extend their fatigue lives by the

installation of interference-fit steel bushes. A supplementary investigation has been carried out to assess two potential techniques for reducing the influence of empty rivet holes (namely the installation of interference-fit steel pins and adhesively-bonded aluminium rivets), and to assess the improvements in fatigue life which might be introduced by a redesign of the spar at the previously critical location. It was found that both treatments of the rivit holes resulted in a further small improvement in the life of specimens refurbished with interference-fit steel bushes at the bolt holes, and that these lives were not significantly different from that of specimens of the new design of spar in which the cross-sectional area increased and the rivet holes omitted. However, considerable improvements in life were obtained when the bolt holes in the redesigned spar specimens were either cold-expanded (a factor of 4.1) or had interference-fit steel bushes installed in them (a factor of 3.4). Author

N85-28939# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik

EXPERIMENTAL AND THEORETICAL DETERMINATION OF THE WING-INDUCED LATERAL WIND ON THE TAIL SURFACES IN OSCILLATING ROLLING MOTION. PART 1: APPLICATION OF THE MOBILE OSCILLATING DERIVATIVES (MOD) ON AN EXPERIMENTAL PART Final Report [EXPERIMENTELLE UND THEORETISCHE ERMITTLUNG DES INDUZIERTEN SEITENWINDES AM SEITENLEITWERK BEI OSZILLIERENDER ROLLBEWEGUNG. **ROLLBEWEGUNG.** TEIL 1: EXPERIMENTELLER TEIL UNTER VERWENDUNG DER MOBILEN OSZILLIERENDEN DERIVATIVWAAGE] O DETERMANN and J OSER 1 Dec 1984 92 p refs In

O DETERMANN and J OSER 1 Dec 1984 92 p refs In GERMAN 2 Vol.

(Contract BMFT-HA-514/61)

(IFD-1/84-PT-1) Avail: NTIS HC A05/MF A01

Induced oscillating lateral wind on tail surfaces was determined using a five-hole conical probe. The dynamic rolling-stability derivatives for force and moment measurement confirm the effects of the induced lateral wind The experimental values are identical to the theoretical values Author (ESA)

N85-28940# Technische Hochschule, Darmstadt (West Germany) Inst fuer Flugtechnik.

EXPERIMENTAL AND THEORETICAL DETERMINATION OF THE WING-INDUCED LATERAL WIND ON THE TAIL SURFACES IN OSCILLATING ROLLING MOTION. PART 2: THEORETICAL INVESTIGATIONS FOR CALCULATION OF THE LATERAL WIND Final Report [EXPERIMENTELLE UND THEORETISCHE ERMITTLUNG DES INDUZIERTEN SEITENWINDES AM SEITENLEITWERK BEI OSZILLIERENDER ROLLBEWEGUNG. TEIL 2: THEORETISCHE UNTERSUCHUNG ZUR BERECHNUNG DES SEITENWINDES]

J. OSER and O. DETERMANN 1 May 1984 50 p In GERMAN 2 Vol.

(Contract BMFT-HA-514/61)

(IFD-1/84-PT-2) Avail: NTIS HC A03/MF A01

The influence of geometrical parameters on ideal wing and wing-fuselage configurations was studied. The rolling lateral wind is calculated using the lifting line method for wings with different aspect ratios, sweeps and planform tapers as well as for the corresponding wing-fuselage combinations. The theoretical results give a general view of the effects of the wing and fuselage geometrical data and position on the rolling lateral wind.

Author (ESA)

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-37896#

THE COCKPIT OF THE AIRBUS A310 [DAS COCKPIT DES AIRBUS A3101

J.-P. HACH (Deutsche Lufthansa AG, Cologne, West Germany) and P. H. HELDT Luft- und Raumfahrt (ISSN 0173-6264), vol. 5, 3rd Quarter, 1984, p 67-76. In German.

The design of the cockpit of the European Airbus A310, which is fundamentally different from those of earlier commercial aircraft. is described. The design principles of the cockpit are discussed and the overhead panel, Electronic Centralized Aircraft Monitor, flight autopilot, Flight Management System flight path computer, and electronic flight instruments are described. The cockpit layout is depicted. ćр

A85-37925

COCKPIT OF THE FUTURE?

H. HOPKINS Flight International (ISSN 0015-3710), vol. 127, June 8, 1985, p. 59-61,

An evaluation is made of new perceptions that have arisen in the course of a NASA simulation study of novel transport aircraft cockpit configurations incorporating advanced display technologies and ergonomic concepts. In this study, general assumptions have been made for the case of the technological and commercial aircraft operating environment of the mid-1990s, the baseline is a two-crew member twin-engined jet aircraft, but alternative aircraft types can be simulated through software changes. The color-coded graphics displays used present flight path and speed, time-critical alert, path deviation, map, track, waypoint, time/distance to waypoint, course, wind, and weather data. Traffic information and obstacle clearance data, together with checklist and functional systems display capabilities, have also been incorporated 0 C

A85-38319

ATTITUDE DETERMINATION IN A LIMB-SCANNING BALLOON RADIOMETER

J R DRUMMOND, D. TURNER, and A. ASHTON (Toronto, University, Toronto, Canada) (COSPAR, Symposium on Scientific Ballooning - IV, 7th, Graz, Austria, June 25-July 7, 1984) Advances in Space Research (ISSN 0273-1177), vol. 5, no. 1, 1985, p. 73-76. Research supported by the Natural Sciences and Engineering Research Council of Canada and University of Toronto

The determination of the line-of-sight with reference to the atmospheric horizontal is critical to the correct interpretation of signals from an emission-sensing, limb-scanning instrument. The use of signals from a two-sided, limb-scanning instrument, the University of Toronto Balloon Radiometer, to determine the beam position relative to the atmospheric horizontal is discussed. Some preliminary results from the engineering flight of the instrument are presented. Author

A85-38363#

TERRAIN/WIRE AND WIRELIKE OBSTACLES WARNING SYSTEM FOR HELICOPTERS

Japan Society for Aeronautical and Space T. TAKENAWA Sciences, Journal (ISSN 0021-4663), vol. 32, no. 361, 1984, p. 94-96. In Japanese.

A terrain/wire and wirelike obstacle detecting system for helicopters employing a CO2 laser radar and FLIR/TV camera is proposed, and its structure and function are discussed. The CO2 laser radar provides a relatively large output power, resulting in reduced eye-hazard, and consists of a heterodyne detector for receiving and a pulse beam system for transmitting. The data collected are shown on a display panel with the aid of video signals from the FLIR or TV. Specifications of the CO2 laser radar and the construction details of the detecting system are presented. S.H.

A85-38401

ADVANCED AVIONICS MANAGEMENT SYSTEM PREVENTS PILOTS FROM BEING SWAMPED BY INFORMATION OVERLOAD

R. JOHNSTON (Allied Bendix Aerospace, Flight System Div, Teterboro, NJ) Defense Systems Review and Military Communications, vol. 3, no. 4, 1985, p. 11-14.

Pilots must not be so overwhelmed by flight instrument information as to experience distraction or stress. The organization of information demanded by this criterion has led to the recent development of an advanced Avionics Management System (AMS), which, although intended for a transport helicopter, is adaptable to a variety of other aircraft This multidisplay system combines various functions that are required for control of the cockpit and the management of mission profile and aircraft performance. The displays include an Electronic Altitude Director Indicator, an Electronic Horizontal Situation Indicator, a Color Multifunction Display, and a keyboard Primary and backup computers are incorporated in the AMS. O.C.

A85-38951

ADVANCED AIRCREW DISPLAY SYMPOSIUM, 6TH, PATUXENT RIVER, MD, MAY 15, 16, 1984, PROCEEDINGS Patuxent River, MD, U.S. Naval Air Test Center, 1984, 216 p. For

individual items see A85-38952 to A85-38961.

A systematic program for the development and evaluation of airborne color display systems is discussed along with airborne electronic color displays in the United Kingdom, color CRT in the F-15, the integration of sensor and display subsystems, and the modernization of engine displays. Attention is given to colored displays for combat aircraft, display technology and the role of human factors, and the past, present, and future of the pictorial Other topics explored are related to format program sensor-coupled vision systems, an argument for standardization in modern aircraft crew stations, and the command flight path display for the integrated pictorial presentation of the fundamental information necessary to effectively perform all normal basic flight operations. GR.

A85-38952#

A SYSTEMATIC PROGRAM FOR THE DEVELOPMENT AND EVALUATION OF AIRBORNE COLOR DISPLAY SYSTEMS

L D. SILVERSTEIN (General Physics Corp., Atlanta, GA), R. M MERRIFIELD, W. D SMITH (Boeing Commercial Airplane Co., Seattle, WA), and F. C. HOERNER (U.S. Naval Air Test Center, Patuxent River, MD) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 3-44 refs

The recent proliferation of new color display applications is partly related to a growing interest in the potential advantages of a color information display for enhancing human performance in complex man-machine systems. Another contributing factor is the availability of a rapidly evolving display technology to support advanced color display concepts. An obvious application of color display technology is connected with airborne operations. It is pointed out that piloting and airborne command/control tasks involve complex, highly-dense forms of information, entail periodic episodes of high operator workload, and are often performed under suboptimal environmental conditions. A systematic program for the development and evaluation of airborne color display systems has recently been initiated in the present paper, attention is given to the overall architecture of the program, details regarding the objectives and approach for current program activities, and a few select issues of interest for color display system design GR

A85-38953#

AIRBORNE ELECTRONIC COLOR DISPLAYS - A REVIEW OF UK ACTIVITY SINCE 1981

J. R. CALDOW (Smiths Industries Aerospace and Defence Systems Co., Arlington, VA) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 45-65. Research supported by the Department of Industry and Ministry of Defence of England.

After extended simulator studies, a color display system was installed in a research aircraft of the Royal Aircraft Establishment at Bedford, to provide an airborne assessment of the potential of such a system in transport aircraft. The present paper has the objective to outline the results of this airborne assessment and to indicate the extent of additional work which has been carried out in the United Kingdom over the last 2 1/4 years. Attention is given to background information, flight experience with color displays, general color vs monochrome impressions, problems related to scan, the format, an evaluation of colors, questions of legibility, flicker and apparent movement, eye fatigue, and additional research. G.R.

A85-38954#

COLOR CRT IN THE F-15

J. TURNER and H. WARUSZEWSKI (Sperry Corp., Sperry Flight Systems, Albuquerque, NM) IN: Advanced Aircrew Display Symposium, oth, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, US Naval Air Test Center, 1984, p. 66-80C. refs

The use of color displays in the cockpit and their capability to satisfy requirements related to the military environment has been studied by the U.S. Air Force. One of the studies conducted was requested by the F-15 System Program Office (SPO) to investigate the feasibility of using a color display in a bubble canopy fighter cockpit environment. The findings indicated that color coded symbology provided a significant reduction in the error rate and detection time. Attention is given to the F-15 color display, the programmable signal data processor (PSDP), color display details, and aspects of advanced color display. It is concluded that color CRT displays will become an accepted part of the military cockpit and in some cases the dominant feature of the crew station. The use of color displays in tactical presentations, threat displays, caution and warnings, and map displays can reduce pilot workload and error rates. GR.

A85-38955#

INTEGRATION OF SENSOR AND DISPLAY SUBSYSTEMS

D. A. BOHRER and P. C. JENKINS (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, IA) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 81-95.

The proliferation of subsystems needed to satisfy operational requirements can lead to an increasing crew workload in military aircraft, while, in connection with another trend, a reduction of the crew complement is being considered. In response to these developments, attention has been given to the use of multifunction control heads and electronic multipurpose displays to produce a more effective crew/avionics interface. In the present study, a wider view is taken of a modern aircraft as a collection of interconnected subsystems, and the integration of all subsystems is considered. It is pointed out that such an approach will produce an avionics system with excellent user characteristics. Additional advantages are related to the ability to grow in an evolutionary manner, the ability to tolerate failures and damage, and the ability to support enhanced self-diagnostic and status reporting functions. Attention is given to the evolution of the integration viewpoint, integration drivers, integration candidates, and example system solutions. G.R.

A85-38957#

DISPLAY TECHNOLOGY AND THE ROLE OF HUMAN FACTORS

S. N. ROSCOE, J. S. TATRO, and E. J. TRUJILLO (New Mexico State University, Las Cruces, NM) IN. Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 126-136. refs

While the transition from electromechanical flight instruments to multifunction electronic displays gains currently momentum, human factors engineers are not well prepared to provide quantitative information as contribution to the design process However, Tatro et al. (1983) have reported a step toward the demonstration of a holistic, multifactor experimental strategy for the design and evaluation of display and control systems. It is pointed out that vertical takeoff and landing (VTOL) aircraft have not reached their operational potential during all-weather instrument flight. The ansing problems can be partly attributed to the inherent instability of the VTOLs' current control systems, while the remainder of the difficulties is caused by inadequate flight displays. Research is being conducted with the aim to eliminate these problems, taking into account the development of a multiple regression model of helicopter and VTOL pilot performance. Attention is given to a systems approach, and a simulation facility G.R.

A85-38958#

PICTORIAL FORMAT PROGRAM - PAST, PRESENT, AND FUTURE

G. D. LIZZA, J. M. REISING (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and L. HITCHCOCK (Essex Corp., Warminster, PA) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 137-143. refs

The operational use of pictorial graphics in the F-18's stores display sparked discussion between Air Force and Navy crew station design personnel regarding the long-term potential of this type of format for conveying information to the pilot. Based on these discussions, the joint Pictorial Format Program was launched; it consists of three phases. format development, format evaluation (single-seat), and format evaluation (two-seat). The first two phases are now complete, and the third is just beginning. The results, so far, indicate that pictorial formats are, indeed, an efficient means of portraying complex information to the aircrew. Author

A85-38959#

THE COMMAND FLIGHT PATH DISPLAY - ALL WEATHER, ALL MISSIONS

G. W HOOVER (Systems Associates, Inc., San Diego, CA), S. H. SHELLEY (Intermetrics, Inc., Cambridge, MA), V. CRONAUER (Systems Associates, Inc., Arlington, VA), and S. M. FILARSKY (U.S. Naval Matenal Command, Naval Air Development Center, Warminster, PA) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 144-156. A flight test program was conducted to demonstrate

A flight test program was conducted to demonstrate enhancement of pilot performance flying zero-zero conditions using the integrated Command Flight Path Display (CFPD). The CFPD concept requires minimal training for both IFR experienced and limited expenenced pilots, compared to the training required when using conventional symbology. This enhancement is accomplished by providing attitude, altitude, direction and speed commands to the pilot in the form of an electronically generated presentation of the real world flight path which should be flown. During the flight test program, the performance of the pilots was measured subjectively through video recording of the Vertical/Head Up Display presentation. Objectively, the performance of their inadvertent diversions from a mean flight path related to the presentation displayed on the Vertical/Head Up Displays. Author

07 AIRCRAFT PROPULSION AND POWER

A85-38961#

AN ARGUMENT FOR STANDARDIZATION IN MODERN AIRCRAFT CREW STATIONS

V. DEVINO (Grumman Aerospace Corp., Bethpage, NY) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 186-195. refs

During the late 1940s and early 1950s, the armed services became increasingly aware that the lack of standardization with respect to aircrew station design was contributing to a very poor accident rate history. As a result of this development, DOD in 1951 established a panel which is now known as the Aircrew Station Standardization Panel (ASSP). The ASSP effort produced most of the crew station design standards which exist today. As the standardization effort matured, the ASSP met with decreasing frequency in the 1970s and then became dormant from June 1980 to 1983. The question arises now whether standardization is still needed. One argument against standardization is that reduced numbers and models of aircraft being procured do not warrant the effort involved in standardization. However, the author's reply to arguments against standardization is that the essential reasons for standardization are overriding and that the crew station of the future requires also standardization. GR

N85-27863# Applied Systems Inst., Inc., Washington, D.C. AVIONICS DATA BASE Final Report

J. MCGOWAN, D. J. WON, and D. VAMETTEN Jan. 1985 272 p

. (AD-A152415; FAA-APO-85-4) Avail: NTIS HC A12/MF A01 CSCL 09B

This document is a compendium of data for U.S. commercial avionics equipment produced by 61 manufacturers. It contains data for the Air Transport Association (ATA) Specification 100 categories of auto flight, communications, indicating and recording, and navigation as well as for antennas and couplers. For each piece of equipment, the following information has been collected: technical specification, price, technical standard order number, ATA Specification 100 code, and manufacturer name, address, and phone number. In addition to this report, the data is available in machine readable form compatible with the IBM personal computer with R base 4000 Data Base Management System. GRA

N85-27864# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Navigation und Flugbahnvermessung.

THE AVIONICS FLIGHT EVALUATION SYSTEM (AFES) OF DFVLR

K. HURRASS and P. SCHULZ 1985 83 p refs In GERMAN; ENGLISH summary

(DFVLR-MITT-85-01; ISSN-0176-7739) Avail: NTIS HC A05/MF A01

An Avionics Flight Evaluation System (AFES) was developed, particularly for navigation systems. A tracking radar and a laser tracker on the ground, and an inertial navigation system onboard the test aircraft measure flight trajectories. The data are combined by optimal filters. In order to be able to evaluate in real time, computers are used at different locations. All elements of this measurement system are linked together by an efficient data transfer system. Besides the reference system, AFES contains subsystems for artificial traffic loading and measuring multipath effects. Author (ESA)

N85-28941*# Charles River Analytics, Inc., Cambridge, Mass. EVALUATION OF A FAULT TOLERANT SYSTEM FOR AN INTEGRATED AVIONICS SENSOR CONFIGURATION WITH TSRV FLIGHT DATA Final Report

A. K. CAGLAYAN and P. M GODIWALA Jun. 1985 101 p refs

(Contract NAS1-17719)

(NASA-CR-172589; NAS 1.26:172589; R-85-02) Avail: NTIS HC A06/MF A01 CSCL 01D

The performance analysis results of a fault inferring nonlinear detection system (FINDS) using sensor flight data for the NASA

ATOPS B-737 aircraft in a Microwave Landing System (MLS) environment is presented. First, a statistical analysis of the flight recorded sensor data was made in order to determine the characteristics of sensor inaccuracies. Next, modifications were made to the detection and decision functions in the FINDS algorithm in order to improve false alarm and failure detection performance under real modelling errors present in the flight data. Finally, the failure detection and false alarm performance of the FINDS algorithm were analyzed by injecting bias failures into fourteen sensor outputs over six repetitive runs of the five minute flight data. In general, the detection speed, failure level estimation, and false alarm performance showed a marked improvement over the previously reported simulation runs. In agreement with earlier results, detection speed was faster for filter measurement sensors soon as MLS than for filter input sensors such as flight control accelerometers. Author

N85-28942# Applied Systems Inst., Inc., Washington, D.C. AVIONICS DATA BASE USERS MANUAL Final Report J. MCGOWAN, D. J. WON, and D. VANETTEN Jan. 1985 117 p

(Contract DTFA01-83-Y-30629)

(AD-A153810; FAA-APO-85-5) Avail: NTIS HC A06/MF A01 CSCL 01C

This manual describes the uses, structure, and operating procedures-including data retrieval, entry and special functions-for the Avionics Data Base. This data base provides detailed data for avionics currently available for both air carrier and general aviation aircraft. Specific information contained in the data base includes price, weight, dimensions, manufacture, manufacture's address and telephone number, Technical Standard Order documentation, and ATA Specification 100 data. The Avionics Data Base was created using Microrim's R:Base Series 4000 Data Base Management System on the IBM Personal Computer. It contains three files or relations as they are referred to in this document. These relations are: Avionics - the relation that contains model specifications. Manufact - the relation that contains address and telephone number for the manufacturers. TSOREF - the relation that contains the Technical Standard Order (TSO) title, location, publication date and source document(s) for each TSO. Author (GRA)

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A85-37233#

PRETWIST AND SHEAR FLEXIBILITY IN THE VIBRATIONS OF TURBINE BLADES

S. KRENK and O. GUNNESKOV (Forsogsanlaeg Riso, Roskilde, Denmark) ASME, Transactions, Journal of Applied Mechanics (ISSN 0021-8936), vol. 52, June 1985, p. 409-415. refs

A theory is developed for pretwisted beams with finite shear flexibility. The effect of pretwist is accounted for via the axial derivative of the St. Venant warping function. The shear flexibility relies on a decomposition of the shear stresses into torsion and shear contributions, and the normalized strain energy of the latter is expressed in terms of the shear flexibility tensor. An explicit approximation for the shear flexibility tensor is derived for cross sections of moderate wall thickness. A special Legendre transformation is used to obtain a consistent discretization, which is then cast in the form of a finite beam element. The accuracy of the method is illustrated by comparison with experimental results for a steam turbine blade, and the effects of pretwist and shear flexibility are discussed. Author

LIFT AND THRUST OF A LINEAR SYNCHRONOUS ENGINE WITH A SOLID-CONDUCTOR STATOR WINDING [SILY POD'EMA I TIAGI LINEINOGO SINKHRONNOGO DVIGATELIA S MASSIVNYMI PROVODNIKAMI OBMOTKI STATORA]

I. I. KURKALOV Beskontaktnye Elektricheskie Mashiny (ISSN 0320-6351), no. 23, 1984, p. 101-110. In Russian.

The characteristics of a linear synchronous engine featuring a stationary long stator which lacks ferromagnetic elements and has solid plate-shaped conductors are investigated. The lifting force and the thrust of the engine are calculated as a function of speed, acceleration, and passenger load, with allowance made for aerodynamic drag. The effect of the size of the excitation coil and of the stator conductors on the lift and thrust is analyzed, as is the effect of excitation current on the power consumption.

A85-37567

PROBABILISTIC PREDICTION OF THE FATIGUE LIFE OF THE COMPRESSOR BLADES OF GAS-TURBINE ENGINES UNDER TWO-LEVEL PROGRAMMED LOADING [VEROIATNOSTNOE PROGNOZIROVANIE USTALOSTNOI ZHIVUCHESTI KOMPRESSORNYKH LOPATOK GTD PRI DVUKHUROVNEVOM PROGRAMMNOM NAGRUZHENII]

M V. BAUMSHTEIN, A. V. PROKOPENKO, and V. N EZHOV (Akademia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), May 1985, p. 7-11. In Russian refs

An analytical-experimental approach to the probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines is proposed whereby the predictions are derived from the cyclic fracture toughness characteristics of the blade material under deterministic symmetrical two-level programmed loading. The approach involves statistical modeling of the random parameter vector of the fracture toughness characteristics. The method proposed here is verified through a direct experiment on compressor blades. V.L.

A85-37575

THE EFFECT OF STRESS RAISERS ON THE LOAD-BEARING CAPACITY OF TITANIUM-ALLOY COMPRESSOR BLADES [VLIIANIE KONTSENTRATOV NAPRIAZHENII NA NESUSHCHUIU SPOSOBNOST' KOMPRESSORNYKH LOPATOK IZ TITANOVYKH SPLAVOV]

IU S. NALIMOV, V V. OMELCHENKO, B A GRIAZNOV, and S. S. GORODETSKII (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), May 1985, p 100-105. In Russian. refs

The fatigue behavior of titanium alloy compressor blades of gas-turbine engines has been investigated experimentally as a function of the size and location of stress raisers simulating the damage sustained during service. For two specific types of compressor blades, the maximum size of defects that can be tolerated without an adverse effect on the fatigue life of the blade is determined. V.L.

A85-37582*# Queensland Univ., Brisbane (Australia). SHOCK TUNNEL MEASUREMENTS OF HEAT TRANSFER IN A MODEL SCRAMJET

R. G. MORGAN and R. J. STALKER (Queensland, University, Brisbane, Australia) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 8 p. refs

(Contract NAGW-499)

(AIAA PAPER 85-0908)

The results of heat transfer measurements to the walls of a two dimensional scramjet combustion chamber in a shock tunnel are presented. Thin film heat transfer gauges on a ceramic glass substrate were used. The range of experimental conditions covered produced boundary layers ranging from laminar to transitional, as was independently checked by flow visualization. Empincal flat plate correlations, corrected for local pressure disturbances were used to make a companison with the experimental results. In the

658

fully laminar regime the heating rates were found to give approximate agreement with the empirical estimates. In the nonlaminar tests the heating rate is found to be well below the fully turbulent levels. It is not known at present if this is a transition effect, or if the pressure corrected flat plate turbulent correlations do not apply to the configuration used. Author

A85-37682#

RADIATIVE TRANSFER IN A GAS TURBINE COMBUSTOR

M. P. MENGUC, W. G. CUMMINGS, III, and R. VISKANTA (Purdue University, West Lafayette, IN) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985 9 p. refs

(AIAA PAPER 85-1072)

A solution of the radiative transfer equation for an axisymmetric cylindrical enclosure representing a typical gas turbine combustor and containing radiatively participating gases and particles is presented. Inhomogeneities of the radiative properties and temperature distribution of the medium are allowed for, and the boundaries are assumed to be diffusely emitting and reflecting. The effects of different types of fuels and axial and radial variations of temperature and soot properties on radiative heat flux distributions are investigated. Film cooling is shown to have a marked effect on wall heat flux, especially when it quenches the soot oxidation process. A medium is shown to radiate more if its temperature is uniform than if it has a center-peaked radial temperature profile.

A85-38436

TURBOSHAFT TRUCE IN EUROPE

J. MOXON Flight International (ISSN 0015-3710), vol. 127, June 1, 1985, p. 117, 118.

An evaluation is made of the technology development status and project management efficiencies of European helicopter turboshaft manufacturing companies that have increased mutual cooperation in order to improve competitiveness with American manufacturers of comparable equipment. The three major German, French, and British turboshaft manufacturers have already joined in mutually supportive technology development efforts; current negotiations to include Italian manufacturers are rendered organizationally more complex by the existence of three Italian firms with turboshaft manufacturing capabilities. Attention is given to the design features and prospective performance characteristics of state-of-the-art European helicopter powerplants. Design commonality throughout the engine shaft output range is the ultimate goal of the present efforts. OC

A85-38956*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif

MODERNIZING ENGINE DISPLAYS

E. T. SCHNEIDER and E. K. ENEVOLDSON (NASA, Flight Research Center, Edwards, CA) IN: Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings . Patuxent River, MD, U.S. Naval Air Test Center, 1984, p. 96-125.

The introduction of electronic fuel control to modern turbine engines has a number of advantages, which are related to an increase in engine performance and to a reduction or elimination of the problems associated with high angle of attack engine operation from the surface to 50,000 feet. If the appropriate engine display devices are available to the pilot, the fuel control system can provide a great amount of information. Some of the wealth of information available from modern fuel controls are discussed in this paper. The considered electronic engine control systems in their most recent forms are known as the Full Authority Digital Engine Control (FADEC) and the Digital Electronic Engine Control (DEEC). Attention is given to some details regarding the control systems, typical engine problems, the solution of problems with the aid of displays, engine displays in normal operation, an example display format, a multipage format, flight strategies, and hardware considerations. G.R.

ADVANCES IN AEROSPACE PROPULSION; PROCEEDINGS OF THE AEROSPACE CONGRESS AND EXPOSITION, LONG BEACH, CA, OCTOBER 15-18, 1984

Congress and Exposition sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-594), 1984, 166 p. For individual items see A85-39058 to A85-39071.

(SAE SP-594)

The contributions presented deal with the design and experimental evaluation of propfan, turboprop, turboshaft, and turbojet engine components and systems. The topics include the aerodynamic performance of engine inlets, internal flow passages, internozzle region of a twin-jet nacelle, and wing-mounted turboprop configuration. Moreover, stability and control results for advanced turboprop aft-mount installations are included, as well as a discussion of technology application for added value of in-service support Finally, consideration is given to reliability assessment for gas turbine engine components, to failure mode analysis of new products, and to repair procedures for commercial aircraft jet nacelle composite structures.

A85-39065* Army Propulsion Lab., Cleveland, Ohio TEMPERATURE DISTORTION GENERATOR FOR TURBOSHAFT ENGINE TESTING

G. A. KLANN (U.S. Army, Propulsion Laboratory, Cleveland, OH), R. L BARTH, and T. J BIESIADNY (NASA, Lewis Research Center, Cleveland, OH) IN. Advances in aerospace propulsion, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 89-99 Previously announced in STAR as N85-15659 refs

(SAE PAPER 841541)

The procedures and unique hardware used to conduct an experimental investigation into the response of а small-turboshaft-engine compression system to various hot gas ingestion patterns are presented. The temperature distortion generator described herein uses gaseous hydrogen to create both steady-state and time-variant, or transient, temperature distortion at the engine inlet. The range of transient temperature ramps produced by the distortion generator during the engine tests was from less than 111 deg K/sec (200 deg R/sec) to above 611 deg K/sec (1100 deg R/sec); instantaneous temperatures to 422 deg K (760 deg R) above ambient were generated. The distortion generator was used to document the maximum inlet temperatures and temperature rise rates that the compression system could tolerate before the onset of stall for various circumferential distortions as well as the compressor system response during stall Author

A85-39067

APPLICATION OF TECHNOLOGY TO ACHIEVE VALUE - ADDED IN-SERVICE SUPPORT

L. A SCOTT (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p. 111-120.

(SAE PAPER 841566)

Repair and inspection/control programs for CF6 engines, that benefited from the application of new technology in materials, processes, methods, and management systems are reviewed. A procedure for determination of increases of reverted austenite in the Marage 250 material of fan mid shafts, due to seal deterioration, is described; the procedure utilizes field eddy current perturbations for measuring the change in surface conductivity associated with the damage. The use of IR thermography is also noted as a cost-effective inspection procedure for turbine blades. The repair programs discussed include fluoride ion cleaning/activated diffusion healing and dabber tig welding Finally, as a potential future application, a note is made of laser/fiber optic drilling. L.T.

A85-39069

RELIABILITY ASSESSMENT FROM SMALL SAMPLE INSPECTION DATA FOR GAS TURBINE ENGINE COMPONENTS

M. A. BURKETT (General Motors Corp., Allison Gas Turbine Div, Indianapolis, IN) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 135-143. (SAE PAPER 841599)

At times, a reliability analyst is faced with life data where failures are found only by inspection. Test items must be inspected at the end of a test period, and then classed as failure or non-failure. Individual failure times are not known. When each item is inspected at a common age, the binomial distribution is routinely applied in practice and in the literature. This paper uses combinatorial mathematics to apply the binomial distribution to the more complicated case where each item is inspected at an arbitrary age. Conditional probabilities are used to extend the analysis when items undergo intermediate inspections. Author

A85-39071

ENGINE SYSTEM FIELD EXPERIENCE SIMULATION PROGRAM

J F. REDMAN and R. A. MITCHELL (Garrett Turbine Engine Co., Phoenix, AZ) IN Advances in aerospace propulsion, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p 151-160. refs

(SAE PAPER 841601)

A computer simulation program has been developed to assist aerospace engineers and managers in making decisions affecting fleet reliability, maintenance strategies, and engine operating costs. This program, based on years of turbine engine experience and innovative uses of the Weibull probability distribution, accurately forecasts removals of engine components, operating and interacting as a system, under different maintenance strategies. Input variables allow the user to tailor the simulation model to fit a specific fleet, engine and maintenance plan Outputs result in a comprehensive assessment of fleet and component reliability, maintenance requirements, and operating cost. An example of a simulation referred to as the LOCI engine simulation is presented. Author

A85-39103

SELECTING DESIGN PARAMETERS FOR AN ENGINE FROM THE TOTALITY OF FLIGHT CONDITIONS [VYBOR PROEKTNYKH PARAMETROV DVIGATELIA PO SOVOKUPNOSTI I POLETNYKH REZHIMOV]

A M. BEGUN and B. G. KHUDENKO Aviatsionnaia Tekhnika (ISSN 0579-2975), no 1, 1985, p 12-17. In Russian. refs

A method is proposed whereby the design parameters of the engine of a flight vehicle are selected from the totality of flight conditions and from the criteria which directly characterize the mission planned for the flight vehicle. A computational algorithm implementing this method is developed Computations for a single-rotor turboramjet engine are presented which demonstrate the practicality and efficiency of the method. V.L.

A85-39104

AN INVESTIGATION OF THE AUTOROTATION OF GAS-TURBINE ENGINES UNDER STARTUP CONDITIONS [K VOPROSU ISSLEDOVANIIA AVTOROTATSII GAZOTURBINNOGO DVIGATELIA NA PUSKOVYKH REZHIMAKH]

V. I DAINEKO Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 17-20 In Russian. refs

The autorotation of gas-turbine engines during startup is investigated analytically for low air flow rates (0-0.2 of the nominal values) The mechanism of autorotation is identified, and analytical expressions are derived for calculating such regimes. The results obtained are found to be in good agreement with experimental data for a commercial 750-kW gas-turbine engine. VL.

A COMPARATIVE EVALUATION OF CERTAIN PROMISING GAS-TURBINE ENGINES OF FOREIGN MANUFACTURERS IN TERMS OF THEIR THRUST CHARACTERISTICS AND FUEL EFFICIENCY [SRAVNITEL'NAIA OTSENKA NEKOTORYKH PERSPEKTIVNYKH INOSTRANNYKH GTD PO IKH TIAGOVYM KHARAKTERISTIKAM I EKONOMICHNOSTI]

L. N. KAMANIN Aviatsionnala Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 24-27. In Russian. refs

Altitude/speed and thrust characteristics are presented for several gas-turbine engines of foreign manufacturers designed for supersonic cruise aircraft. The engines discussed include a compound Rolls-Royce engine consisting of the main bypass engine and several modular turboramjet engines; the Pratt & Whitney VSCE-502B vanable-cycle engine; the VCE-702 turbine bypass engine; and a dual-mode turbofan engine. V.L.

A85-39107

THE EFFECT OF THE PITCH OF AXISYMMETRIC NOZZLES ON THE EFFICIENCY OF THE NOZZLE ASSEMBLY AND OF THE TURBINE STAGE [VLIIANIE SHAGA OSESIMMETRICHNYKH SOPEL NA EFFEKTIVNOST' SOPLOVOGO APPARATA I TURBINNOI STRUPENI]

I. I KIRILLOV, K. G. RODIN, V. N. BUSURIN, G. L. RAKOV, V. A. RASSOKHIN, and L. S. GRINKRUG Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 28-32. In Russian.

The performance of nozzle assemblies and stages of small axial-flow turbines is investigated experimentally as a function of the spacing of the axisymmetric nozzles. An expression relating the efficiency of a turbine stage to the nozzle spacing is obtained. It is shown that an increase in the pitch of the nozzle exit sections by more than two rotor blade pitches does not lead to a decrease in the efficiency of the turbine stage. V.L.

A85-39112

A GENERALIZATION OF EXPERIMENTAL DATA ON HEAT TRANSFER FROM THE WORKING MEDIUM TO THE HOUSING COMPONENTS OF THE COMPRESSOR OF A GAS-TURBINE ENGINE [OBOBSHCHENIE OPYTNYKH DANNYKH PO TEPLOOTDACHE OT RABOCHEGO TELA K ELEMENTAM KORPUSA KOMPRESSORA GTD]

V. I. LOKAI, A. G. KARIMOVA, V. I. PROKOPEV, and O. L. MAKSIMOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 51-55. In Russian.

Generalized heat transfer equations are derived for the following characteristic parts of a compressor housing: the radial clearance zone above the rotor, the axial clearance zone behind the rotor, the end surfaces of the channels between the straightening vanes, and the housing surface in the radial clearance behind the straightening vanes. The expressions obtained are verified experimentally for a seven-stage compressor. V.L.

A85-39115

UNSTABLE COMBUSTION IN THE COMBUSTION CHAMBER OF A GAS-TURBINE AIRCRAFT ENGINE [NEUSTOICHIVOE GORENIE V KAMERE SGORANIIA AVIATSIONNOGO GTD]

A. V. ANDREEV and E. IU. MARCHUKOV Aviatsionnala Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 73-75. In Russian.

During the testing of a gas-turbine engine, regular vibrations were detected in the main combustion chamber. The vibrations, whose frequency was 400-500 Hz and whose amplitude did not exceed 15 kPa, were observed only during the simultaneous operation of the cascades of a dual-nozzle centrifugal injector. Here, the possible causes of this instability are investigated expenmentally-and analytically. The-results-of-the-study suggest that the unstable combustion is due to unstable mixing resulting from the self-oscillating flow of the fuel film in the second cascade of the injector.

660

A85-39118

ACCELERATED TESTING OF GAS-TURBINE AIRCRAFT ENGINES USING THE 'SOFTENING' METHOD [USKORENYE ISPYTANIIA AVIATSIONNYKH GTD S PRIMENENIEM METODA 'RAZUPROCHNENIIA']

A. S. GISHVAROV and I. KH. BADAMSHIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 79-82. In Russian.

A method for the accelerated testing of gas-turbine aircraft engines is proposed which is based on the fact that the reliability and the durability of engine components depend on their initial state achieved as a result of the fabrication process. Typically, the components of state-of-the-art gas-turbine engines are hardened by various treatments including diffusion heat treatments, plastic surface working, and application of antifriction and anticorrosion coatings. By dispensing with a hardening treatment, it is possible to modify the initial state parameter. The approach is illustrated by a specific example. V.L.

A85-39119

THE SOFTWARE PACK GRAD FOR THE ANALYSIS OF GAS-TURBINE ENGINES [PROGRAMMYI KOMPLEKS GRAD DLIA RASCHETA GAZOTURBINNYKH DVIGATELEI]

A. B. GOLLAND, E. B. MATS, S. A. MOROZOV, B. M. OSIPOV, O. I. TIMOSHENKO, A. P. TUNAKOV, and V. N. ERENBURG Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 83-85. In Russian.

The software pack GRAD has been designed specifically for the gasdynamic analysis of aircraft engines, including determination of the flow-path parameters for most gas-turbine engines (with only few constraints). The software pack consists of thirteen individual modules, each designed for solving a particular class of problems. Modules are included for the analysis of the altitude/velocity characteristics, thrust characteristics, climatic parameters, transient processes, and weight and dimensional characteristics. Also included are parameter optimization, identification, and diagnostic modules. V.L.

A85-39120

A COMPARISON OF EXPERIMENTAL CHARACTERISTICS OF POROUS AND BLADE IMPELLERS [SRAVNENIE EKSPERIMENTAL'NYKH KHARAKTERISTIK PORISTOGO I LOPASTNOGO IMPELLEROV]

IU. V. DRONOV, A. A. PANCHENKO, and V. F. PRISNIAKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 85-87. In Russian.

Experiments have been carned out to compare the performance of porous and blade impellers, which are commonly used as hydrodynamic radial sealing devices for the shafts of the pumps of aircraft engines. It is shown that the use of a porous impeller in a pump makes it possible to reduce the radial clearance to a minimum, thus improving the tightness of the seal. With a porous impeller, seal tightness is insured in all operation modes. V L.

A85-39121

AN EVALUATION OF THE EXHAUST SYSTEM CONFIGURATION FROM THE CRUISE EFFICIENCY CRITERIA OF AN ENGINE IN AN AIRCRAFT SYSTEM [OTSENKA KONFIGURATSI] VYKHODNOGO USTROISTVA PO KRITERIJAM TRANSPORTNOI EFFEKTIVNOSTI DVIGATELIA V SISTEME LETATEL'NOGO APPARATA]

O. M. ZHUKOV, V. S. KUZMICHEV, A. N. KOVARTSEV, M. A. MOROZOV, and B. D FISHBEIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 87-90. In Russian. refs

Three types of bypass engine exhaust systems, i.e., a system with separate nozzles, a system with a mixing chamber and a common nozzle, and a system with concentrically split fan flow, are evaluated in terms of engine cruise efficiency. It is shown that the efficiency of the system with split fan flow is less dependent on the degree of mixing than the efficiencies of the_other two systems. The system with concentrically split fan flow is thought to be the best compromise solution for engines with current bypass ratios of 4-5 (and for a bypass ratio of 7 in the future). V.L.

THE STRUCTURE OF THE APPLICATION SOFTWARE PACK RAFIPKS FOR THE ANALYSIS OF PHYSICAL PROCESSES IN COMBUSTION CHAMBERS [O STRUKTURE PAKETA PRIKLADNYKH PROGRAMM PO RASCHETU FIZICHESKIKH PROTSESSOV V KAMERE SGORANIIA 'RAFIPKS']

V N. IGNATEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no 1, 1985, p. 90-93. In Russian. refs

The software pack RAFIPKS includes a set of functionally related programs for the computer-aided design of combustion chambers and for the numerical modeling of the physicochemical processes occurring inside combustion chambers with the objective of design optimization. The pack consists of two base modules, one for the hydraulic design analysis and the other for the design verification based on an analysis of physicochemical processes inside the combustion chamber. The system has a user-friendly interface which makes it possible to use the software without any knowledge of a programming language and without reference to user manuals.

A85-39124

RATIONALIZING THE CHOICE OF AN ACTUATING MECHANISM FOR A JET DRIVE [OBOSNOVANIE VYBORA ISPOLNITEL'NOGO MEKHANIZMA STRUINOGO PRIVODA]

A. B. KONDRATEV and V. I. TOLMACHEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 96-98. In Russian

The paper is concerned with the problem of selecting an optimum control system for jet-type drives with controlled or uncontrolled flow. An analysis of the control efficiency is presented, and an analytical expression is obtained for determining the required momenta. The relationship makes it possible to select the type of drive and to estimate the energy performance of jet drives for a given depth of control and time of transition. V.L.

A85-39126

DETERMINATION OF THE BLADE HEIGHT OF THE LAST COMPRESSOR STAGE FOR A REFINED THERMODYNAMIC DESIGN ANALYSIS OF TURBOFAN ENGINES [OPREDELENIE VYSOTY LOPATOK POSLEDNE! STUPEN! KOMPRESSORA DLIA UTOCHNENIIA PROEKTNOGO TERMOGAZODINAMICHESKOGO RASCHETA TRDD]

E. D. STENKIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no 1, 1985, p. 101-103, In Russian.

A relationship is obtained for determining the blade height of the last compressor stage of turbofan engines, the blade height being the principal factor determining the magnitude of the relative radial clearance. In its final form, the relationship makes it possible to estimate, during a thermodynamic design analysis of turbofan engines, the magnitude of the relative radial clearance and its effect on the efficiency of the compressor. V.L

A85-39151

STARTING SYSTEMS TECHNOLOGY; PROCEEDINGS OF THE AEROSPACE CONGRESS AND EXPOSITION, LONG BEACH, CA, OCTOBER 15-18, 1984

Congress and Exposition sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE SP-598), 1984, 144 p. For individual items see A85-39152 to A85-39167.

(SAE SP-598)

Various papers are presented on the analytical aspects of starting systems technology. The subjects addressed include computer-aided start system design and verification, air turbine starter sizing for a proper bleed source match, peak transient torques in pneumatic starter engine systems, control of fuel during starting of a gas turbine, air turbine starter turbine wheel containment, lubrication systems for air turbine starters, starter-engine interface concepts, and fast start system for a 200 kW gas turbine generator set. Also considered are: F-20 air turbine cartridge start system, pressurized air start system, critical speed testing of a power take-off shaft subsystem, secondary power generation system considerations for advanced aircraft.

airplane mounted accessory gearbox design, B-1B secondary power subsystem, and electric direct current starter motors for gas turbine engines. C.D.

A85-39152

COMPUTER-AIDED START-SYSTEM DESIGN AND VERIFICATION

H. S. COLLINSWORTH (United Technologies Corp., Engineering Div., West Palm Beach, FL) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 1-14. (SAE PAPER 841508)

The start simulation is a transient representation of engine and aircraft charactenstics which are combined to construct a start system. The Computer Aided Start System (CASS) incorporates thermal effects indirectly through transient engine data. CASS is used to design start schedules and to evaluate those start schedules with known or updated aircraft installation effects. Author

A85-39153

AIR TURBINE STARTER SIZING FOR A PROPER BLEED SOURCE MATCH

W. H. ENGELMANN (Garrett Corp., Garrett Pneumatic Systems Div., Phoenix, AZ) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 15-19

(SAE PAPER 841509)

This paper presents a description of the sizing process for air turbine starters. The emphasis is on optimum system performance through proper component matching. The system includes all equipment from the pneumatic energy source, through the air delivery duct system, to and including the starter itself. While the load imposed by the engine defines the power output required at the starter, the limitations of the available bleed-air source and delivery system often dictate the starter size. All pneumatic system components must be properly matched to provide the smallest, lightest combination of components that will meet the engine starting requirements.

A85-39155

CONTROL OF FUEL DURING STARTING OF A GAS TURBINE K J. RUMFORD (Avco Corp., Avco Lycoming Div., Stratford, CT) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 29-34.

(SAE PAPER 841511)

Advances made in the past 25 years in delivering the right amount of fuel to a gas turbine engine in order to start the engine without compressor surge or turbine overheating are reviewed. The aspects discussed include. initial combustion; acceleration; scheduling of fuel vs speed; fuel ratio vs speed, and fuel vs pressure; fuel density adjustments; fuel ramping controls; N-dot starting; temperature-controlled start, and safeguards The advantages and drawbacks of the various systems involved are addressed. C.D.

A85-39156

AIR TURBINE STARTER TURBINE WHEEL CONTAINMENT

J. R GIARD (Garrett Corp., Garrett Pneumatic Systems Div., Phoenix, AZ) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 35-39.

(SAE PAPER 841546)

Turbine wheel containment on air turbine starters has been standard practice for many years. Proven methods of designing reliable containment rings combine theoretical analyses and empirical relationships derived from large-scale testing programs. The choice of design and material must consider energy absorption, piercing resistance, and the effects on the surrounding static structure due to ring expansion and movement. New concepts such as dual-alloy rings may offer improvements in weight or reliability Author

A85-39157

LUBRICATION SYSTEMS FOR AIR TURBINE STARTERS

W. E. SCHMIDT and G. G. HOUSTON (Garrett Corp., Garrett Pneumatic Systems Div., Phoenix, AZ) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 41-53. (SAE PAPER 841547)

The evolution of lubrication systems as starter speeds and motoring requirements have increased is reviewed. Problems related to lubrication, including temperature-related problems, higher overrunning speeds, limited cooling, oil level and motoring, and poor lubrication conditions are discussed. The necessity for a systems approach to lubrication selection is stressed, and several techniques of lubrication are considered, including splash lubrication, the 'holding pond' system, wet pad configuration, clutch-in-engine design, and shared engine oil systems Advanced lubricants are briefly addressed, and properties of aircraft-type gas turbine lubricants are listed. C.D.

A85-39158

STARTER-ENGINE INTERFACE CONCEPTS

G. R. TAYLOR (Garrett Corp., Garrett Pneumatic Systems Div., Phoenix, AZ) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 55-60.

(SAE PAPER 841548)

New concepts for starter-engine interfaces that can extend starter life and improve reliability when used in current commercial and military aircraft installations are discussed. The pawl-and-ratchet clutches and sprag clutches currently being used are described and compared with improved types using continuous lubrication, wet-cavity interface, nonoverrunning, and sharing of lubrication with the main engine gearbox Diagrams of these clutches are shown. C.D.

A85-39160

F-20 AIR TURBINE CARTRIDGE START SYSTEM

L. ANDERSON (Garrett Corp., Garrett Pneumatic Systems Div., Phoenix, AZ) and W. F. KELLER (Northrop Corp., Los Angeles, CA) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 69-74.

(SAE PAPER 841570)

An air turbine cartridge start system (ATCS) was developed for the F-20 fighter aircraft to provide an assisted in-flight restart capability. Normal starts are accomplished with a pneumatic ground cart. In-flight engine restarts are accomplished using a catalytically decomposed hydrazine-water mixture as the energy source, to drive an air turbine starter. The products of decomposition are primarily steam and ammonia. The starter incorporates many safety features. Author

A85-39161

PRESSURIZED AIR START SYSTEM (PASS) FOR SMALL GAS TURBINE ENGINES

J. P. ROMINEK (Garrett Corp., Garrett Pneumatic Systems Div, Phoenix, AZ) IN: Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 75-80.

(SAE PAPER 841571)

Pressurized Air-Start-System (PASS) technology was developed to offer a lighter weight alternative to conventional hydraulic or electric start systems for small gas turbine engine applications. PASS offers improved engine starting performance, notably at low ambient temperatures where high fluid viscosity values and reduced electrolyte levels can cause difficulties for hydraulic and battery-type start systems. The system consists of a pressure vessel/control manifold assembly, high pressure regulator, an air vane or air turbine starter, a recharge valve, and a turbine-driven recharge compressor. Production configurations of these components have been fabricated and are currently in use after completing performance checks, development testing, and field evaluation testing. Typical performance of the system and each of its individual components are described in this report.

A85-39162

AUXILIARY AND EMERGENCY POWER SYSTEM

B. G. KIRKMAN (Lucas Aerospace, Ltd, Power Systems Div., Hemel Hempstead, Herts., England) IN. Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p. 81-88. refs (SAE PAPER 841572)

An auxiliary and emergency power system which integrates the hydraulic and electric power requirements of an advanced aircraft with reduced stability and a fly-by-wire control system with a remotely mounted digitally controlled unit is described. The auxiliary and emergency power unit provides auxiliary/emergency electrical and hydraulic power by transmission of secondary mechanical power, generated in a turbine, through a gearbox to an auxiliary generator and an auxiliary hydraulic pump. These components are discussed The auxiliary electrical control unit, which is a full authority digital system control which incorporates the control and protection circuits for the generator, is discussed along with the choice of fuel and control of propellants for the emergency system Operational aspects of the system are addressed, as are its testing and maintainability. C.D.

A85-39163

CRITICAL SPEED TESTING OF THE GRUMMAN X-29A POWER TAKE-OFF SHAFT SUBSYSTEM

H. F. JOHNSON and W. A. MARESKO (Sundstrand Corp, Sundstrand Aviation Mechanical Div., Rockford, IL) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 89-94. (SAE PAPER 841603)

Critical speed tests were performed on the Power Take Off shaft subsystem of the Grumman X-29A advanced technology demonstration aircraft. Test speeds up to 20,000 rpm were run to insure stable operation up to the maximum installed overspeed of 17,250 rpm. The subsystem was instrumented with proximity probes and accelerometers to measure shaft displacement and vibration. This paper will show that unprocessed data from proximity probes and accelerometers does not reliably indicate the location of a critical speed, and it will outline a method for processing this type data to accurately determine the critical speed. An example of reverse precession, as well as the effects of unbalance on critical speed, will be presented.

A85-39166

B-1B SECONDARY POWER SUBSYSTEM

B. J. COVEY (Rockwell International Corp., El Segundo, CA) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 123-130.

(SAE PAPER 841607)

The B-1B secondary power subsystem is a derivative of the subsystem used in the B-1A aircraft. In the B-1B, the earlier design has been modified to add an onboard alternate cross-bleed start capability for the main propulsion engines. The normal start system also has been changed from a hydromechanical link between each APU and the two related engines to a combination of a hydromechanical link and a pneumatic-link. During this redesign, the APU starting and the APU/ADG coupling limitations revealed during the original B-1A RDT&E program also were addressed.

Development and preliminary qualification tests on the redesigned subsystem throughout the required operating environment indicate that the revised configuration meets all design objectives.

Author

A85-39167

ELECTRIC DIRECT CURRENT STARTER MOTORS FOR GAS TURBINE ENGINES

L. A. FIZER (AIResearch Manufacturing Co., Torrance, CA) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 131-137.

(SAE PAPER 841569)

The general operating requirements specific to turbine engines are described, and the resulting design features of gas turbine electric starters are presented. Engine drag characteristic, engine ignition requirements, and battery characteristics are discussed, and starter performance parameters are listed. The advantageous selection of motor size and weight, starter motor type, electromagnetic components, and electromagnetic design is considered. C.D.

A85-39203

MODEL TEST RESULTS OF THE SPLIT-FAN CROSS-DUCTED PROPULSION SYSTEM CONCEPT FOR MEDIUM SPEED V/STOL AIRCRAFT

W. E. BECK, JR., J. G CARLSON, and J. P. BAAS (Lockheed-California Co, Burbank, CA) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p. 15-22 (SAE PAPER 841495)

An experimental test program has been conducted using an 0.25-scale aircraft model that incorporates internal propulsion system flow to establish the flow transfer performance and thrust/lift/control nozzle force generation capabilities of a cross-ducted, split fan V/STOL aircraft configuration's propulsion system On the basis of the limited amount of test data analyzed to date, these model tests have demonstrated that fan air transfer between forward and aft nozzles during hover can be readily accomplished by nozzle area changes, while total lift remains approximately constant. O.C.

A85-39206

RECENT DEVELOPMENTS IN EJECTOR DESIGN FOR V/STOL AIRCRAFT

D. C WHITTLEY and F. L. GILBERTSON (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada) IN V/STOL: An update and overview, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 45-50. Research supported by the Department of National Defence of Canada.

(SAE PAPER 841498)

Two categories of ejector design have been investigated at de Havilland Aircraft of Canada: (1) Trailing edge ejector flap for augmentation of wing lift by supercirculation: primarily for STOL transport type aircraft of high aspect ratio. (2) Chordwise rectangular ejector located adjacent to the fuselage sides for vertical lift: primarily for STOVL combat type aircraft of low aspect ratio. The paper reviews the underlying physical principles of the ejector type of thrust augmentor and suggests a logical procedure for development and optimization by experimental means. Methods of data analysis are shown which provide the foundation for empirical design and some examples of performance are given for each of the two ejector categories defined above. In addition, a new form of primary nozzle is described which serves to distribute the jet and promote fast mixing in the ejector throat.

A85-39207

ESTIMATION OF HOT GAS REINGESTION FOR A VTOL AIRCRAFT AT THE CONCEPTUAL DESIGN STAGE

K. A. GREEN and J. J. ZANINE (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p 51-65. refs

(SAE PAPER 841555)

The estimation methodology presented has been embodied in a computer code for the rapid, first-order determination of inlet temperature rise due to near and far field exhaust gas reingestion in a VTOL aircraft; this code incorporates an interactive computer graphics package that displays aircraft planform configurations with superposed ground plane and undersurface stagnation lines. Ground plane wall jets can in this way be characterized, and isocontour lines of the wall jet temperature can be displayed in superimposition over the aircraft configuration The code, which is based on empirical relationships and simplified analytical approximations, was designed as a rapid evaluation tool and has shown reasonable agreement with model aircraft experimental data. O.C

A85-39209

DEVELOPMENT OF A PNEUMATIC THRUST DEFLECTOR

M. J. HARRIS and J. J. NICHOLS, JR. (David Taylor Naval Ship Research and Development Center, Bethesda, MD) IN: V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p 93-100. refs

(SAE PAPER 841558)

The flight envelope of a high performance aircraft can be expanded through an enhancement of its lifting capacity or controllability, by means of thrust deflection. Attention is presently given to the development and test results for a pneumatic thrust deflector which operates by blowing a thin sheet of air tangentially across a curved surface adjacent to a turbojet engine's exhaust stream, the angle of thrust deflection varies with jet sheet momentum and requires no mechanical movement of surfaces. Investigation of this system with a small turbojet simulator yielded thrust deflections as great as 60 deg. This thrust deflection capability may be employed for increased maneuverability, heavy lift, or STOL. O.C.

A85-39577#

ADVANCED SINGLE-ROTATION PROPFAN DRIVE SYSTEM

R. D. ANDERSON, R. E. DEVLIN, A. S. NOVICK, and D. A. WAGNER (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, July-Aug. 1985, p. 259, 260; Abridged. Previously cited in issue 17, p. 2432, Accession no. A84-36957

A85-39580*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

FLAME RADIATION AND LINER HEAT TRANSFER IN A TUBULAR-CAN COMBUSTOR

R. W. CLAUS, G. M. NEELY, and F. M. HUMENIK (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, July-Aug. 1985, p. 270-278. Previously cited in issue 07, p. 872, Accession no A84-21300. refs A85-39606*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTS IN DILUTION JET MIXING - EFFECTS OF MULTIPLE ROWS AND NON-CIRCULAR ORIFICES

J. D. HOLDEMAN (NASA, Lewis Research Center, Modeling and Verification Branch, Cleveland, OH), R. SRINIVASAN, E. B. COLEMAN, G. D. MEYERS, and C. D. WHITE (Garrett Turbine Engine Co., Phoenix, AZ) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. Previously announced in STAR as N85-25266 refs (AIAA PAPER 85-1104)

Experimental and empirical model results are presented that extend previous studies of the mixing of single-sided and opposed rows of jets in a confined duct flow to include effects of non-circular orifices and double rows of jets. Analysis of the mean temperature data obtained in this investigation showed that the effects of orifice shape and double rows are significant only in the region close to the injection plane, provided that the orifices are symmetric with respect to the main flow direction. The penetration and mixing of jets from 45-degree slanted slots is slightly less than that from equivalent-area symmetric onfices. The penetration from two-dimensional slots is similar to that from equivalent-area closely-spaced rows of holes, but the mixing is slower for the 2-D slots. Calculated mean temperature profiles downstream of lets from non-circular and double rows of orifices, made using an extension developed for a previous empirical model, are shown to be in good agreement with the measured distributions. Author

A85-39614#

PERFORMANCE OF A NEW NOSE-LIP HOT-AIR ANTI-ICING CONCEPT

H. A. ROSENTHAL and D. O. NELEPOVITZ (Rohr Industries, Inc., Chula Vista, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. (AIAA PAPER 85-1117)

A new simple anti-ice system has been developed for engine inlets. It has been designed to use turbine engine compressor bleed air that is injected tangentially into the leading edge chamber formed by the engine inlet lip and its bulkhead. The system has produced high internal heat transfer by causing the injected air to flow circumferentially at high internal velocities through the self-communicating chamber. The developmental work has consisted of basic analysis, full-scale ground tests, dry air flight tests, and icing tunnel tests. The system has been shown to be equivalent in performance to existing hot air systems but is simpler, more reliable, and lighter in weight.

A85-39620#

CANTILEVERED STATOR VANE TIP LEAKAGE STUDIES

N. G ADAMS (Garrett Turbine Engine Co, Phoenix, AZ) and H. K. HEPWORTH (Northern Arizona University, Flagstaff, AZ) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs (AIAA PAPER 85-1136)

A test program has been conducted to study the nature of the tip leakage flow associated with cantilever stator blades in axial compressor systems. A lowspeed single stage test rig with a cantilever stator vane row has been developed. The rig simulates the flows which are characteristically found in typical middle-stage axial flow compressors. The test rig is designed specifically to accommodate flow visualization techniques to study the tip leakage flow. Extensive performance testing has demonstrated the test rig does simulate typical axial compressor performance characteristics. Careful performance parameter data reduction and analysis of high speed film footage taken during rig operation provides actual tip leakage streamline velocities. The data taken includes both on and off design conditions. Author

A85-39644#

FUEL INJECTION CHARACTERIZATION AND DESIGN METHODOLOGY TO IMPROVE LEAN STABILITY

C. E. SMITH, C. B. GRAVES (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL), R. ROBACK (United Technologies Research Center, East Hartford, CT), and D. D. DALESSANDRO (U.S. Naval Air Propulsion Center, Trenton, NJ) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 7 p. (Contract N00140-83-C-8899)

(AIAA PAPER 85-1183)

Prefilming, airblast fuel injectors for gas turbine combustors have exhibited improved atomization and mixing compared to pressure atomizing injectors, resulting in lower pattern factor, less smoke, and the ability to accommodate alternate fuels. As a consequence of the improved mixing, the airblast design introduces design challenges in operability; specifically, lean blowout during rapid deceleration and altitude relight. An analytical and experimental effort was undertaken to develop design methodology to improve the operability of airblast injectors without sacrificing full power performance. Laser Doppler Velocimeter (LDV) measurements made at the injector discharge plane of the baseline injector were compared to predictions from Pratt and Whitney's computational fluid dynamics code PREACH Single injector combustion tests were conducted to systematically evaluate independent combustor front-end design variables affecting lean blowout. Variables included injector discharge airflow angle, injector flowsplit, injector scale, combustion hole pattern, combustion hole axial distance from dome, and fuel effects. Results of the investigation include a set of combustor front-end design guides for improved stability and a phenomonological understanding of combustor front-end flowfields. Author

A85-39646#

DRIVE SYSTEM DEVELOPMENT FOR PROPFAN TEST ASSESSMENT PROGRAM

A. S. NOVICK, T. H. LINDSEY (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN), and W. E. ARNDT (Lockheed-Georgia Co., Marietta, GA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 8 p.

(AIAA PAPER 85-1188)

Advanced propfan powered aircraft have the potential for large fuel savings and direct operating cost advantages. The high speed efficiency of the propfan has been verified with the aid of wind tunnel tests. A Propfan Test Assessment Program, sponsored by NASA, is being conducted by an American aerospace company. This program has the objective to assess and evaluate the technologies relevant to a large scale propfan, taking into account structural integrity, source noise, and associated cabin noise and vibration. With regard to the drive system, all efforts are made to utilize proven engine hardware. Attention is given to the engine background, aspects of drive system design, component tests, and research testing. G.R.

A85-39647#

FUTURE PROP-FANS - TRACTOR OR PUSHER

J. GODSTON and C. REYNOLDS (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. refs

(AIAA PAPER 85-1189)

The propfan shows promise to provide the next propulsion system for short to medium range aircraft. NASA-sponsored studies in the early 1970s first identified the potential of the high speed swept propeller, subsequently called the propfan. Advantages of the propfan are related to lower fuel consumption and a reduction in the direct operating costs, taking into account a comparison with comparable technology high bypass ratio turbofans A number of programs are being conducted with the aim to establish propfan propulsion system technology readiness by 1987. Potential future systems are considered, giving attention to wing or fuselage engine installation, single vs. counter rotation, and gear vs. gearless design. Propulsion system performance, weight, cost, and noise considerations are discussed. It is pointed out that tractor and pusher geared counter rotation propfan propulsion systems provide alternative configurations being studied by the industry and government agencies. G.R.

A85-39648#

THE UNDUCTED FAN ENGINE

A. R. STUART (General Electric Co., Evendale, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 5 p.

(AIAA PAPER 85-1190)

Studies conducted by an American aircraft engine company and an aircraft manufacturer are showing that the unducted fan engine is eminently suited for the efficient propulsion of high-speed subsonic commercial and military aircraft. Expenditures related to the high cost of the development of a new aircraft engine are only justified if the advantages provided by the engine in comparison to existing engines are sufficiently large. The present paper will discuss the merits of an engine which offers 30-50 percent fuel savings relative to existing turbofan engines. Attention is given to the historical trend of improvements in specific fuel consumption, the propulsive efficiency, a counter rotation schematic, low pressure turbine overall efficiency, and a three phase program designed to demonstrate and develop the technology for the considered concept. G.R.

A85-39649#

PROSPECTS AND PROBLEMS OF ADVANCED OPEN ROTORS FOR COMMERCIAL AIRCRAFT

A A. BLYTHE and P. SMITH (British Aerospace, PLC, Civil Aircraft Div., Hatfield, Herts., England) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p.

(AIAA PAPER 85-1191)

This paper reviews the open rotor propulsion scene through the eyes of the aircraft designer. After studying the options, attention is focused on the 100-120 seater Feederliner/Regional Airliner where the maximum use can be made of existing powerplant and airframe developments. Fuel savings of 25-27 percent and range increases of 45 percent are predicted. The advantages of contra-rotation and the relative merits of wing-mounted and rear-mounted powerplants are discussed, leading to an appraisal of installation problems. Emphasis is placed upon the effect of economic and commercial considerations in powerplant selection. Finally, the effect of increased aircraft size, speed and range are discussed in relation to the development of new open rotor aircraft. Economic and certification requirements point to 1995 as the earliest likely date for entry into service, preceded by one more round of turbofan powered aircraft.

A85-39654#

ENGINE DESIGN FOR MAINTENANCE AND SUPPORT

J. M. WELLBORN (General Electric Co., Aircraft Engine Business Group, Lynn, MA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. (AIAA PAPER 85-1204)

The U.S. Army's T700 turboshaft engine represents the state-of-the-art in the incorporation of design practices aimed at the minimization of maintenance and support, difficulties employing modular construction and permitting all unit and intermediate level maintenance tasks to be performed with only 10 hand tools. All line-replaceable units can be changed in less than 30 min, without disturbing other components. The T700 currently powers the H-60 series, AH-64, 214ST, and SuperCobra military helicopters.

A85-39655#

SUPPORTABILITY CONSIDERATIONS FOR ADVANCED ENGINE DEVELOPMENT

J. S. FILES (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 6 p refs (AIAA PAPER 85-1205)

The development of an advanced engine is a complex process requiring integration of new propulsion technologies and engineering applications into innovative designs to provide the weapon system (aircraft) with enhanced capabilities. In order to bring these capabilities to bear on the threat, the aircraft must be mission ready, and available in sufficient quantities. The generalized term, 'supportability' has evolved as a qualitative descriptor of the resources required to provide a mission ready weapon system, as well as the resources required to sustain it in the fight to defeat the threat. The design of an advanced engine, and critical decisions made during development determine the in-service supportability and ultimate mission readiness/fighting capability of the engine and aircraft it powers This paper describes some critical interrelationships between the engine design/development process and supportability, cites historic examples illustrating their provides recommendations importance, and for future improvement. Author

A85-39656#

USAGE MONITORING - A MILESTONE IN ENGINE LIFE MANAGEMENT

M PAQUET, P. GATLIN (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL), and S M. COTE (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. (AIAA PAPER 85-1206)

Aircraft/engine usage monitoring plays an important role in the operational phase of a weapons system. This is illustrated by the fact that usage monitoring can be used to forecast spare parts utilization and maintenance requirements, verify life limits, ensure up-to-date accelerated engine tests, such as ASMET's and AMT's, and potentially impact warranty obligations. Since each of the above areas are inter-related, engine usage monitoring/usage updates are most efficient when data is applied through a 'working system'. Both Navy MIL-E5007E and ENSIP recognize the importance of this process. Elements needed to establish a 'working system' will be described with the Pratt & Whitney J52-powered A6E/A6B aircraft used as an example.

A85-39657#

UNITED STATES AIR FORCE ENGINE DAMAGE TOLERANCE REQUIREMENTS

T. T. KING (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH), J. HURCHALLA, and D. H. NETHAWAY (United Technologies Corp., Government Products Div., West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p.

(AIAA PAPER 85-1209)

This paper summarizes the damage tolerance requirements that are applied to Air Force engine development and acquisition programs. The importance of the damage tolerance control plan and the use of reliable inspection methods during development. production, and life management is emphasized. It is highlighted that development efforts in the last five years have identified process improvements for Fluorescent Penetrant Inspection (FPI). These improvements must be implemented within industry and Air Force depots to improve reliability to detect small flaws. Case examples of damage tolerance design are presented for an improvement to an existing engine (F100-PW-220 Increased Life Core) and for a new engine (PW5000). The Increased Life Core (ILC) information shows that damage tolerance requirements were met with small or modest increases in component weight, with cost savings and reduced inspection requirements and with lower life cycle costs (LCC). The importance of early trade studies to define the optimum life (Low Cycle Fatigue-LCF) and inspection

interval requirements for a new engine design is shown for the PW5000. Data presented for both of these examples clearly illustrate that damage tolerance is achieved without adverse impact on conventional measures of ment (i.e., weight and cost).

Author

A85-39663#

TIME RESOLVED MEASUREMENTS OF A TURBINE ROTOR STATIONARY TIP CASING PRESSURE AND HEAT TRANSFER FIELD

G. R. GUENETTE, A. H. EPSTEIN (MIT, Cambridge, MA), R J. G NORTON (Rolls-Royce, Inc., Atlanta, GA), and Y. CAO (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic AIAA, SAE, ASME, and ASEE, Joint Propulsion of China) Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. Research supported by the U.S. Navy and Rolls-Royce, Inc. refs (AIAA PAPER 85-1220)

This paper presents the results of a detailed experimental investigation of the time resolved heat transfer rate and static pressure distribution on the stationary casing above the tip of a transonic high pressure turbine rotor in a short duration turbine test rig (the MIT Blowdown Turbine Facility), which reproduced all of the full scale, non-dimensional turbine operating parameters. Measurements were made as a function of rotor corrected speed and of Reynolds No The heat flux is shown to be highly unsteady with fluctuations of 80 percent across the blade spacing Approximately 45 percent of the total heat load to the shroud is from the flow under the blade tip. The time averaged heat flux to the casing drops by a factor of 5 down the blade chord and is shown to vary as Re to the (0.8) power. The pressure measurements suggested that the flow in the tip region is primarily influenced by the pressure loading across the blade. Author

A85-39664#

MILITARY ENGINE DURABILITY IMPROVEMENTS THROUGH INNOVATIVE ADVANCEMENTS IN TURBINE DESIGN AND MATERIALS

T AUXIER, G. A. BONNER, D CLEVENGER, and S. N. FINGER (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. (AIAA PAPER 85-1221)

The F100-PW-220 low bypass ratio military turbofan has in the course of extensive engine verification and accelerated mission testing exhibited turbine durability values comparable to those of cold section turbomachine components, while improving turbine efficiency. These gains are the result of advancements in active turbine cooling and materials processing during fabrication. Specific design features of consequence for reliability improvements encompass thermally matched tip segment support rings, the supply of cooling air by a tangential onboard injection system, rub-tolerant seals, and blade-to-blade dampers. The F100-PW-220 turbine rotor has demonstrated 17,000 cycles in heated spin tests. O.C.

A85-39684#

SOME RECENT U.K. PROPELLER REVIEW OF DEVELOPMENTS

R. M. BASS and D. G. M. DAVIS (Dowty Rotol, Ltd., Gloucester, AIAA, SAE, ASME, and ASEE, Joint Propulsion England) Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. refs (AIAA PAPER 85-1261)

The development of high-performance aircraft propellers in the UK is reviewed for the period 1974-1985 and illustrated with photographs, drawings, and diagrams. Topics examined include the design requirements of higher-speed aircraft, the application of modern computational techniques to the theoretical treatment of the propeller flowfield, wind-tunnel experiments, performance and acoustic testing, blade aerodynamics, and the use ofcontrarotating propellers to recover the energy lost in efflux swirl. Consideration is given to the use of composite materials to save weight and to constant-speed variable-pitch control systems.

T.K.

A85-39693#

AIRCRAFT PRELIMINARY DESIGN COMPARISON OF ADVANCED COMPOUND ENGINES WITH ADVANCED TURBINE ENGINES FOR HELICOPTER APPLICATIONS

W. L. ANDRE (U.S. Army, Research and Technology Laboratories, Moffett Field, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 5 p. (AIAA PAPER 85-1276)

Results of a preliminary design study, undertaken by the Army in view of the LHX program, of the Advanced Turbine Engine versus the Advanced Compound Engine are summarized. Mission requirements and weight and power considerations are discussed. Performance analysis indicates that at altitudes above 4000 ft the compound engine will outperform the turbine engine, whereas below 4000 ft the opposite is true. An equal-transmission comparison reveals that the two aircraft would have close gross weights for the mission; the engine weight increase for the compound engine is offset by the fuel and tankage weight reductions. An overall preference for a compound engine is indicated. L.T.

A85-39694#

DEVELOPMENT OF AN ADVANCED VANELESS INLET PARTICLE SEPARATOR FOR HELICOPTER ENGINES

B V R. VITTAL, D. L. TIPTON, and W. A. BENNETT (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 10 p. refs

(AIAA PAPER 85-1277)

Allison has designed and developed an advanced integral engine particle separator to meet the challenging operational requirements of helicopter engines of the future. The vaneless, low weight, high efficiency separator represents a significant advancement in engine tolerance to adverse operational conditions and promises new levels of engine reliability, durability, and life cycle costs. This paper presents the analytical methods developed, the design process, and the extensive experimental validation of the design. Author

A85-39695#

VARIABLE CYCLE TURBOSHAFT TECHNOLOGY FOR **ROTOR-CRAFT OF THE 90'S**

C. ROGO and E. H. BENSTEIN (Teledyne CAE, Toledo, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p. Army-sponsored research. refs

(AIAA PAPER 85-1278)

Results of an efficiency optimization study of variable-capacity turboshaft engines are applied to an advanced turboshaft engine with a turbine inlet temperature of 1447 K and 683 kW power rating. Two radial turbine geometries were tested in a cold-flow rig, the nozzle area was varied over a flow range of 62-120 percent of the design flow rate. Quantitative data are obtained on the effects of leakage and cooling injection. It is found that in a rotorcraft application the concept will provide over 14 percent SFC reduction potential at 60 percent power. Furthermore, an 11-14-percent fuel consumption decrease is expected, as compared with an equivalent-technology conventional simple-cycle engine. L.T.

A85-39696#

SECONDARY POWER UNIT OPTIONS FOR ADVANCED FIGHTER AIRCRAFT

C. RODGERS (Solar Turbines, Inc., Turbomach Div., San Diego, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. refs (AIAA PAPER 85-1280)

Future high performance fighter aircraft will demand more compact, lighter weight secondary power units capable of providing faster starts and rapid response over wider aircraft operating envelopes. Advancements in propulsion technology continue to task the design and optimization of secondary power systems to the point where an inflight power outage of a few seconds can no longer be tolerated. The first approach in pacing Advanced Tactical Fighter (ATF) secondary power demands involves continued generic improvements to conventional air-breathing gas turbine auxiliary power units, to extend starting ability and start reliability for higher altitudes, and to increase power density The second approach is the Super Integrated Power Unit which is capable of operating in both air-breathing and stored energy gas operator modes and, thus, is less sensitive to altitude effects. This paper presents the technology accomplishments as well as the future research and development paths for both of these secondary power system approaches.

A85-39699#

INTEGRATION OF VECTORING NOZZLES IN A STOL TRANSONIC TACTICAL AIRCRAFT

D. E BERNDT (Rockwell International Corp., Los Angeles, CA), R. GLIDEWELL (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), and G R. BARNES (Rolls-Royce, Inc., Atlanta, GA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 10 p (AIAA PAPER 85-1285)

Two types of single-engine STOL aircraft configurations that utilize vectorable nozzles are discussed as part of the phase II of STOL Nozzle Exhaust concept study These are the conventional single nozzle that can be deflected through 70 deg and achieves aircraft balance through blown oversized canards of through ducting fan exhaust upstream to a pitch pipe exhaust, and a three-poster configuration featuring two vectoring nozzles near the aircraft CG in addition to a conventional rear nozzle. Wind tunnel testing was carried out at Mach numbers from 0.6 to 1.5. Tests reveal higher drag levels of the side nozzle configuration, which is attributed to the jet scrubbing drag of the side nozzles on the fuselage. On a full scale it may be minimized by careful nozzle integration. It is anticipated that a 700-ft field-length aircraft can be designed to meet the same mission requirements as a conventional configuration, with a 3-4 percent penalty in the takeoff gross weight IT.

A85-39701#

ADVANCED FLOATWALL COMBUSTOR LINER TECHNOLOGY ELIMINATES TF30-P-100 TRANSITION DUCT FATIGUE CRACKING

T. L. DUBELL, J J. LETOURNEAU, and R M. KAPLAN (United Technologies Corp., Engineering Div, West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 6 p.

(AIAA PAPER 85-1288)

The TF30-P-100 engine has experienced thermal fatigue cracking of its combustor transition duct (that transitions the hot gases from the burner cans to the turbine annulus). The cracking is caused by excessive thermal gradients in a conventional sheet metal louver design. The problem can be eliminated by the application of a new technology approach. The new design is a segmented configuration which utilizes a combination of convective cooling and film cooling for enhanced heat transfer characteristics. The liner is segmented both axially and circumferentially to minimize thermal stresses and fatigue cracking. For the liner segments (panels), it utilizes high temperature turbine materials that are cast to the finished dimension. The panels are fastened to a sheet metal shell which operates at relatively low temperatures and carries the structural load. This design essentially eliminates the low cycle fatigue failure mode. This configuration has been successfully demonstrated in TF30-P-100 engine tests. One liner was used to obtain temperature and pressure measurements A second liner was successfully run in an accelerated mission test. Author

A85-39702#

COMPARISON OF ADVANCED COOLING CONCEPTS USING COLOR THERMOGRAPHY

G. MYERS, J. VAN DER GEEST, J. SANBORN, and F. DAVIS (Garrett Turbine Engine Co., Phoenix, AZ) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. refs

(AIAA PAPER 85-1289)

A variety of advanced liner-cooling concepts were proposed to meet the low-coolant-flux, high-effectiveness requirements of future high-temperature-rise gas turbine combustors. These concepts were compared at temperature levels similar to the actual liner environment. A thermographic camera and digital image analysis system were employed to acquire hot-side metal temperature distributions for each configuration over a wide range of coolant fluxes. Results indicate that cold-side convection, augmented by rectangular fins and combined with film cooling, offers the largest potential reduction in coolant flux requirements. Performance results, including hot-side temperatures and liner pressure drop measurements, are presented for several of the configurations tested and show good agreement with the measurements.

Author

A85-39703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED LINER-COOLING TECHNIQUES FOR GAS TURBINE COMBUSTORS

C. T. NORGREN and S. M. RIDDLEBAUGH (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 13 p. Previously announced in STAR as N85-21115. refs (AIAA PAPER 85-1290)

Component research for advanced small gas turbine engines is currently underway at the NASA Lewis Research Center. As part of this program, a basic reverse-flow combustor geometry was being maintained while different advanced liner wall cooling techniques were investigated. Performance and liner cooling effectiveness of the experimental combustor configuration featuring counter-flow film-cooled panels is presented and compared with two previously reported combustors featuring, splash film-cooled liner walls; and transpiration cooled liner walls (Lamilloy). Author

A85-39704#

THE INFLUENCE OF BLADE WAKES ON THE PERFORMANCE OF OUTWARDLY CURVED COMBUSTOR PRE-DIFFUSERS

S. J STEVENS and A P. WRAY (Loughborough University of Technology, Loughborough, Leics., England) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p Research supported by Rolls-Royce, Ltd.; Ministry of Defence. refs

(Contract MOD-AT/2170/065/XR)

(AIAA PAPER 85-1291)

An experimental investigation has been carried out to study the performance of a short outwardly curved pre-diffuser sited immediately downstream of an engine representative outlet guide vane blade row. The flow conditions prior to the OGVs were produced by a single stage compressor rotor. Particular emphasis has been placed on investigating the interactions that occur in such systems. Even when the OGVs were operating at off-design incidences the wakes entering the diffuser decayed rapidly and were no longer significant at diffuser exit. At off-design conditions the overall loss of the OGV/diffuser system increased, due mainly to a detenoration in OGV performance. It has been demonstrated that flaring the OGV passage reduces the radial pressure gradient at diffuser inlet and is an effective way of maintaining blade performance. Author

A85-39705#

TECHNOLOGY FOR THE DESIGN OF HIGH TEMPERATURE RISE COMBUSTORS

D. W. BAHR (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. refs (AIAA PAPER 85-1292)

The results of analytical and experimental studies to determine the design technology needs of high temperature rise (Delta T) combustors and to define candidate design concepts for meeting these needs are reviewed. These studies show that several unique design considerations and constraints apply, because a high proportion of the available airflow must be allocated to the combustion process at the high Delta T operating conditions. This airflow allocation is necessary to obtain efficient combustion and acceptable smoke emission levels at the high Delta T conditions. Important technology needs include design features to provide stable operation over very wide Delta T ranges and design concepts to mimimize liner cooling airflow requirements. Candidate design concept features for providing these needed high Delta T combustor capabilities are described. Included are advanced design concepts to provide combustion process staging capabilities, as well as advanced liner cooling and structural design concepts. The current development status of these various advanced design concepts is also assessed. Author

A85-39707#

'SMART' ENGINE COMPONENTS - A MICRO IN EVERY BLADE?

A. H. EPSTEIN (MIT, Cambridge, MA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 5 p.

(AIAA PAPER 85-1296)

The feasibility and potential benefits of closed-loop adaptive systems and subsystems of aircraft gas turbine engines are argued. The examples of application include active turbine tip clearance control, active exhaust nozzle position optimization, inlet distortion control, and active blade stall alleviation. Consideration is also given to more complex potentially advantageous configurations such as magnetic suspension bearings and piezoelectrically actuated smart structures and seals. The actuator, sensor, and processing technologies which permit the practical implementation of such systems are reviewed. Finally, data transmission and control system architecture, as well as reliability considerations, are addressed.

A85-39716#

CALCULATION OF THE FLOW IN A DUMP COMBUSTOR

E. F. BROWN (Virginia Polytechnic Institute and State University, Blacksburg, VA) and A. A. HALE (Sverdrup Technology, Inc., Arnold Air Force Station, TN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. USAF-supported research. refs

(AIAA PAPER 85-1309)

A numerical model for dump combustor calculations with the parabolized Navier-Stokes equations downstream of the separation region is presented. The model takes advantage of the lack of backflow in the separation region at the combustor entrance and the lack of feedback to upstream condition. Since an explicit solution is derived, the model furnishes a solution in one pass. When calculations were compared with data on the radial velocity and turbulence kinetic energy profiles in a combustor, a significant lack of accuracy was observed. However, the techniques did show promise in terms of lowered computation time and memory requirements.

A85-39717*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SMALL GAS TURBINE COMBUSTOR STUDY - FUEL INJECTOR PERFORMANCE IN A TRANSPIRATION-COOLED LINER

S. M. RIDDLEBAUGH and C. T. NORGREN (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs

(AIAA PAPER 85-1312)

The effect of fuel injection technique on the performance of an advanced reverse flow combustor liner constructed of Lamilloy (a multilaminate transpiration type material) was determined. Performance and emission levels are documented over a range of simulated flight conditions using simplex pressure atomizing, spill return, and splash cone airblast injectors. A parametric evaluation of the effect of increased combustor loading with each of the fuel injector types is obtained. E.A.K.

A85-39718#

APPLICATION OF 3-D AEROTHERMAL MODEL AND FLOW VISUALIZATION TECHNIQUE TO THE COMBUSTOR EXIT GAS TEMPERATURE STUDY

Y. SATO, T. TAGASHIRA, H. TOH, and T. WATANABE (Ishikawajima-Hanma Heavy Industries Co., Ltd., Research and Development Dept., Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p.

(AIAA PAPER 85-1313)

A three-dimensional numerical analysis was performed of the exit gas temperature distribution of an aircraft gas turbine combustor. The model was configured with boundary conditions for the air flow velocity in the chamber, taking into account swirlers and air holes, the fuel droplet size and the fuel spray angle. The calculations comprise a k-epsilon model for turbulence, a chemical kinetic model for heat release, Lagrangian droplet transport, and eddy breakup in reaction to turbulence. Good agreement was found, including identification of hot spots, in comparisons with experimental data with a real combustor. M.S K

A85-39739*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SUMMARY OF NONAXISYMMETRIC NOZZLE INTERNAL PERFORMANCE FROM THE NASA LANGLEY STATIC TEST FACILITY

L. D LEAVITT (NASA, Langley Research Center, Hampton, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 15 p. refs (AIAA PAPER 85-1347)

Early experimental work on multifunction nozzles (prior to 1978) concentrated on quantifying the isolated and installed performance of specific nozzle designs at vanous power settings during cruise, vectored thrust, and reverse thrust operating modes. Since 1978, however, significant effort has been expended on developing a parametric data base on nozzle internal design variables which could lead to improved internal performance and/or lower structural weight. Much of this work has been conducted in the Static Test Facility of the NASA/Langley 16-Foot Transonic Tunnel using subscale models and high pressure air to simulate jet exhaust. A review of the research effort on nonaxisymmetric multifunction nozzles along with a summary of many of the results is presented. In addition, internal performance results from subscale models tested in the Static Test Facility and from full-scale engine/nozzle Author tests are compared.

A85-39743#

APPLICATION OF SYSTEM IDENTIFICATION TECHNIQUES TO POSTSTALL COMBUSTOR DYNAMICS

S. J. PRZYBYLKO (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. (Contract F33615-84-C-2432)

(AIAA PAPER 85-1353)

In aircraft turbine engines, the occurrence of an occasional breakdown in the flow of air through the compression section of the engine is possible. These flow breakdowns are called surges or stalls. Usually the engine resumes normal operation without pilot intervention. However, it can happen that the surges are not self-recovering and result in engine flameout. In some cases pilot action is required to prevent excessive engine operating temperatures. It is pointed out that these nonrecoverable stalls are extremely dangerous and have resulted in engine destruction and loss of aircraft. After an investigation of this problem, it was eventually realized that the combustor played a large role in determining whether a particular surge was recoverable or not. In the present paper, a description is provided of computer models which have been developed to simulate engine poststall behavior.

A85-39765#

ENGINE THRUST MEASUREMENT UNCERTAINTY

J. H. ROBERTS, J. H. LEWIS, D. H. GLICKEN, R. MORIN, J. M MANCINI, and D G. HAAS (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 17 p. refs

(AIAA PAPER 85-1404)

Accurate thrust measurement for modern, high bypass ratio turbofans is best conducted by means of full scale tests in both altitude and sea level facilities satisfying three requirements: (1) instrumentation and data systems must be verified through the application of statistical measurement analysis, in which overall measurement uncertainties are evaluated by combining individual errors and then using cross-stand engine test results for comparison; (2) test facilities must accommodate the large air flow to the extent that the surrounding environment can represent conditions at altitude; finally, (3) the influence of wind momentum on thrust during sea level testing must be taken into account. In the present case, a turbulence control structure was used to eliminate thrust variations due to wind. O C.

A85-39771#

DEVELOPMENT AND EVALUATION OF AN INTEGRATED FLIGHT AND PROPULSION CONTROL SYSTEM

P. D. SHAW, K. BLUMBERG, D. JOSHI (Northrop Corp, Aircraft Div., Hawthorne, CA), R ANEX, J. H. VINCENT (Systems Control Technology, Inc., West Palm Beach, FL), and C SKIRA (USAF, Wright Aeronautical Laboratory, Wright-Patterson AFB, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 15 p. USAF-sponsored research. refs

(AIAA PAPER 85-1423)

A multivariable control methodology has been developed for functional integration of a fighter aircraft's aerodynamic controls with those of its propulsion system (inlet, engine, thrust vectoring and reversing nozzle). The technique accounts for and, where possible, takes advantage of the significant cross-couplings between flight and propulsion control systems. The design method was applied to an aircraft incorporating advanced technology features, such as variable cycle engines, variable geometry inlets, vectoring/reversing nozzles, canards, and propulsive lift. The basis of the procedure is partitioning of the system into smaller, manageable control design tasks. This procedure is outlined, the overall control structure shown, and the propulsion subsystem control approach focused upon. An example of control system performance is given for a short takeoff and landing (STOL) scenario Author

A85-39772*# McDonnell Aircraft Co., St. Louis, Mo. INTEGRATED FLIGHT/PROPULSION CONTROL - ADAPTIVE ENGINE CONTROL SYSTEM MODE

W A YONKE (McDonnell Aircraft Co., St. Louis, MO), L. A. TERRELL (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL), and L. P. MEYERS (NASA, Flight Research Center, Edwards, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. (AIAA PAPER 85-1425)

The adaptive engine control system mode (ADECS) which is developed and tested on an F-15 aircraft with PW1128 engines, using the NASA sponsored highly integrated digital electronic control program, is examined. The operation of the ADECS mode, as well as the basic control logic, the avionic architecture, and the airframe/engine interface are described. By increasing engine pressure ratio (EPR) additional thrust is obtained at intermediate power and above. To modulate the amount of EPR uptrim and to prevent engine stall, information from the flight control system is used. The performance benefits, anticipated from control integration are shown for a range of flight conditions and power settings. It is found that at higher altitudes, the ADECS mode can increase thrust as much as 12 percent, which is used for improved acceleration, improved turn rate, or sustained turn angle. M.D.

A85-39774#

DYNAMIC ENGINE BEHAVIOR DURING POST SURGE OPERATION OF A TURBOFAN ENGINE

A E. BURWELL (Arnold Engineering Development Center, Arnold Air Force Station, TN) and G T. PATTERSON (Sverdrup Technology, Inc., Arnold Air Force Station, TN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p

(AIAA PAPER 85-1430)

Analysis and evaluation were conducted on the results of four engine test programs that were conducted over a five year period at Arnold Engineering Development Center (AEDC) to investigate the phenomena of nonrecoverable stall. The testing utilized four modern turbofan engines and encompassed a range of simulated flight conditions, engine control variations, stall inducement techniques, and potential stall clearing techniques. This paper describes a typical engine test program including the facility, engine, instrumentation, and data acquisition/recording requirements It also presents the data analysis techniques employed and representative results Author

A85-39775#

MODELING POST-STALL OPERATION OF AIRCRAFT GAS TURBINE ENGINES

J. V. FRENCH (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p.

(Contract F33615-79-C-2087)

(AIAA PAPER 85-1431)

Aero and thermodynamic models of the post-stall operation of aircraft gas turbine engines are presented, including approaches and results for three systems compared to test data. Considerations of ease of model use and computational efficiency are presented. The resulting one-dimensional flow models are shown to represent the primary modes of post-stall engine operation. Author

A85-39776#

REVIEW OF EMPIRICAL AND ANALYTICAL SPECIFIC IMPULSE METHODOLOGIES

D. K. DAVIS (Hercules, Inc., Hercules Aerospace Div., Magna, UT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. refs (AIAA PAPER 85-1434)

This paper describes work which evaluated various empirical specific impulse (Isp) methodologies developed by Thiokol-Elkton, Lockheed, Hercules, Software and Engineering Associates (SEA), and Landsbaum. A new empirical method developed at Hercules using a large motor database was also included All the methods

07 AIRCRAFT PROPULSION AND POWER

were used to evaluate the Hercules motor database. The lsp values calculated by the empirical method present in the Hercules motor design optimization program were included in the methodologies comparisons. The database evaluation showed that all the methods except the SEA method gave results which had an average error less than 1 percent. The newly developed Hercules method gave the most accurate results. The results for the interim Solid Performance Program (SPP), the 1984 version of the SPP, and two modifications of each version were included to allow the comparison of analytical methods to empirical methods. The comparison between analytical and empirical methods showed that, for the motor database, the average errors for the empirical methods were comparable to those of the analytical methods. The empirical results had larger standard deviations values than the analytical methods. Author

A85-39790#

DERIVATIVE T56 ENGINE DEVELOPMENT EXPERIENCE

T. F. GEE (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. (AIAA PAPER 85-1459)

The full-scale development program for installation of the Navy T56-A-427, the series IV derivative of the T56 turboprop engine, on E-2C and C2-A aircraft is described. The program is aimed at improving the operability and durability characteristics and encompasses improvements to the reduction gearbox, combustion liners, engine control system, and compressor and turbine. Development testing of the engine was completed May 31, 1985, having accumulated 1255 h on schedule; performance goals, including the maximum power rating (4600 shp at sea level), maximum continuous rating (3180 shp at 25,000 ft), 20-percent surge margin, and constant propeller speed at 1106 rpm, were exceeded Further work is being carried out on turbine durability.

A85-39791#

THE CONCEPTION AND DEVELOPMENT OF A FAMILY OF SMALL ENGINES FOR THE 1990'S

D. LEWIS and M. J. BULLER (Rolls Royce, Ltd, Watford, Herts., England) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 8 p. refs (AIAA PAPER 85-1460)

This paper reviews the process of conceiving and evolving a strategy, design, and a development program for an aero-engine by a European team pooling their expertise and particularly their expenence. A new aircraft engine family, the RTM 322, is used to illustrate the setting of project priorities and how sometimes difficult decisions are made for strict adherence to these priorities. Significant changes in the formulation of development programs whilst incurring some increase in front-end costs should produce major rewards in terms of 'right first time' results and lowering of the risk levels. Finally advanced engineering programs to substantiate growth potential of the family are discussed. Author

A85-39794#

AXISYMMETRIC THRUST REVERSING THRUST VECTORING EXHAUST SYSTEM FOR MANEUVER AND BALANCED FIELD LENGTH AIRCRAFT

J. A COHN, D. J. DUSA, C. D. WAGENKNECHT, and J. P. WOLF (General Electric Co., Cincinnati, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 14 p. refs

(AIAA PAPER 85-1466)

A genenc axisymmetric multifunctional exhaust system, one of the candidate thrust reversing and thrust vectoring systems, is described, with a review of the projected STOL maneuver requirements. Several nozzle configurations are presented for J-79 nozzles, initially used in the F4, Phantom, Hustler, and F16 Falcon; the J93 nozzle for the XB70; and the F110 and F404 nozzles for F16 Falcon and F18 Hornet. The effects of interference of the engine efflux in the reverse thrust mode with aircraft surfaces are discussed. Experimental data are presented for a 1/8 scale quadrant of a thrust reverser; it is concluded that full-scale reverse thrust capability of 65-75 percent is substantiated. L.T.

A85-39798#

NONCONTACT ENGINE BLADE VIBRATION MEASUREMENTS AND ANALYSIS

W. B. WATKINS, W. W. ROBINSON (United Technologies Corp., Engineering Div., West Palm Beach, FL), and R. M. CHI (United Technologies Research Center, East Hartford, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 9 p. refs

(AIAA PAPER 85-1473)

A noncontact vibration measurement method for rotating turbine blades is presented. Blade passage through a focused light beam guided and received by optic fibers triggers signals for comparisons with reference signals tuned to the expected intervals. The data permit calculation of the angular positions of the blades and, therefore, the displacements. The all-blade vibrational spectrum is extracted by treating the data as a Fourier spectrum. Blades, however, can vibrate in frequency, time and phase-to-phase modes, and require the recording of time intervals between vibrations to detect any approach to a fundamental mode. M.S.K.

N85-27865 Department of the Air Force, Washington, D.C. SEGMENTED ZONED FUEL INJECTION SYSTEM FOR USE WITH A COMBUSTOR Patent

G W. MOORE and R. G. CARROLL, inventors (to Air Force) 19 Feb. 1985 6 p

(AD-D011640; US-PATENT-4,499,735,

US-PATENT-APPL-SN-578304; US-PATENT-CLASS-60-739)

Avail US Patent and Trademark Office CSCL 21E

A segmented, zoned fuel injection system for use within the entrance area of a combustor is described. The fuel injection system has a plurality of spray bars formed as part of closely-spaced apart segments. The spray bars are zoned to permit additional control of profile and flow rate of fuel injected into the combustor. This design permits radial profile control within the combustor, maintains higher efficiency at low fuel flows and easy replacement and/or maintenance of the components thereof.

GRA

N85-27866 Department of the Air Force, Washington, D.C. SPACER STRUCTURE Patent

G. WEBB, inventor (to Air Force) 19 Feb. 1985 7 p Supersedes AD-D008756

(AD-D011641; US-PATENT-4,500,255,

US-PATENT-APPL-SN-256880; US-PATENT-CLASS-415-189) Avail: US Patent and Trademark Office CSCL 21E

A structure useable as a spacer is described. In a preferred embodiment, the spacer is ideally suited (one of a plurality of identical spacers) for use as a spacer between every two adjacent stator vanes of a stator vane ring of a multiplestage fan of a gas turbofan engine The spacer is in the form of a rectangular solid and comprises a metal face skin member having a curved aerodynamically configurated outer surface with a centrally-located longitudinally-positioned concavity which functions as a rib, and a backing pad member that is made of a molded polyethelene material with integral peripheral edge lip seals that are coated with a polyurethane material, and that is joined by its outer surface to the inner surface of the face skin member, with the backing pad member having an embeddded rib skin stiffner positioned under, along, and in contact with the concavity in the face skin member. In the adaptation as a fan stator vane spacer, each spacer is releasably attached by novel means to the fan stator vane ring in the space on the ring between every two adjavent fan stator vanes, and is positioned in the force-to-aft fan air flow such that the fan air flows over the curved aerodynamically configured outer surface of the face skin member in the direction of the longitudinally-positioned concavity. In this_adaptation, the spacer proides peripheral sealing, ice impact resistance, and face skin stability, and prevents or at least minimizes fan air flow short circuits around vane ends and beneath the spacer. GRA

N85-27867*# Oklahoma State Univ., Stillwater. School of Mechanics and Aerospace Engineering

PREDICTIONS AND MEASUREMENTS OF ISOTHERMAL FLOWFIELDS IN AXISYMMETRIC COMBUSTOR GEOMETRIES Ph.D. Thesis. Final Report

D. L. RHODES and D. G. LILLEY May 1985 169 p refs (Contract NAG3-74)

(NASA-CR-174916, NAS 1.26:174916) Avail: NTIS HC A08/MF A01 CSCL 21E

Numerical predictions, flow visualization experiments and time-mean velocity measurements were obtained for six basic nonreacting flowfields (with inlet swirl vane angles of 0 (swirler removed), 45 and 70 degrees and sidewall expansion angles of 90 and 45 degrees) in an idealized axisymmetric combustor geometry. A flowfield prediction computer program was developed which solves appropriate finite difference equations including a conventional two equation k-epsilon eddy viscosity turbulence model. The wall functions employed were derived from previous swirling flow measurements, and the stairstep approximation was employed to represent the sloping wall at the inlet to the test chamber. Recirculation region boundaries have been sketched from the entire flow visualization photograph collection. Tufts, smoke, and neutrally buoyant helium filled soap bubbles were employed as flow tracers. A five hole pitot probe was utilized to measure the axial, radial, and swirl time mean velocity components.

Author

N85-27868*# Ohio State Univ, Columbus. Dept. of Engineering Mechanics.

A STUDY OF INTERNAL AND DISTRIBUTED DAMPING FOR VIBRATING TURBOMACHINER BLADES Final Report, 15 Apr. 1983 - 15 Apr. 1985

A W. LEISSA Jun. 1985 24 p refs

(Contract NAG3-424)

(NASA-CR-175901; NAS 1 26:175901) Avail: NTIS HC A02/MF A01 CSCL 21E

Internal and distributed damping as possible methods for reducing the vibration response of turbomachine blades and theoretical methods for analyzing damped vibration were studied. It is demonstrated how the Ritz-Galerkin methods may be used to straightforwardly to analyze forced vibrations with damping. This is done directly without requiring the free vibration eigenfunctions. The Galerkin method is an effective technique for these types of problems. The Ritz method has the further advantage of not needing to satisfy the force type boundary conditions, which is particularly important for plates and shells. But proper functionals representing the forcing and damping terms must be developed, and this is done. Two types of damping--viscous and material (hysteretic) are considered Both distributed and concentrated exciting forces are treated. Numerical results are obtained for cantilevered beams and rectangular plates. Studies showing the rates of convergence of the solutions are made. In the case of the cantilever beam, approximate solutions from the present methods are compared with the exact solutions. R.J.F.

Princeton Univ, N J Dept. of Mechanical and N85-27869*# Aerospace Engineering.

THE ROLE OF SURFACE GENERATED RADICALS IN CATALYTIC COMBUSTION Final Report

D. A. SANTAVICCA, Y. STEIN, and B. S. H. ROYCE Jun. 1985 24 p refs

(Contract NAG3-353)

Avail: NTIS HC A02/MF A01 CSCL 21B

Experiments were conducted to better understand the role of catalytic surface reactions in determining the ignition characteristics of practical catalytic combustors Hydrocarbon concentrations. carbon monoxide and carbon dioxide concentrations, hydroxyl radical concentrations, and gas temperature were measured at the exit of a platinum coated, stacked plate, catalytic combustor during the ignition of lean propane-air mixtures. The substrate temperature profile was also measured during the ignition transient Ignition was initiated by suddenly turning on the fuel and the time to reach steady state was of the order of 10 minutes. The gas phase reaction, showed no pronounced effect due to the catalytic surface reactions, except the absence of a hydroxyl radical overshoot It is found that the transient ignition measurements are valuable in understanding the steady state performance characteristics E.A.K.

N85-27870*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FUTURE FUNDAMENTAL COMBUSTION RESEARCH FOR **AEROPROPULSION SYSTEMS**

E J. MULARZ 1985 8 p refs Presented at the 21st Joint Propulsion Conf., Monterey, Calif.; sponsored by AIAA, SAE, ASME and ASEE

(NASA-TM-87049; E-2612; NAS 1.15:87049, AIAA-85-1398; USAAVSCOM-TR-85-C-11) Avail: NTIS HC A02/MF A01 CSCL 21E

Physical fluid mechanics, heat transfer, and chemical kinetic processes which occur in the combustion chamber of aeropropulsion systems were investigated. With the component requirements becoming more severe for future engines, the current design methodology needs the new tools to obtain the optimum configuration in a reasonable design and development cycle. Research efforts in the last few years were encouraging but to achieve these benefits research is required into the fundamental aerothermodynamic processes of combustion. It is recommended that research continues in the areas of flame stabilization, combustor aerodynamics, heat transfer, multiphase flow and atomization, turbulent reacting flows, and chemical kinetics Associated with each of these engineering sciences is the need for research into computational methods to accurately describe and predict these complex physical processes. Research needs in each of these areas are highlighted. E A K

N85-27871# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering.

INVESTIGATION OF HEAT TRANSFER TO A TURBINE BLADE CASCADE USING A SHOCK TUBE M.S. Thesis J. E GOCHENAUR Dec. 1984 107 p

(AD-A153090: AFIT/GAE/AA/84D-6) Avail: NTIS HC A06/MF A01 CSCL 21E

In order to increase the turbine inlet temperatures at which gas turbine engines operate it is important to understand the heat transfer mechanisms which govern turbine blade heating. This study used a shock tube to generate high temperature gas flows which were allowed to pass through a turbine blade cascade. A Germanium surface thermocouple was used to provide temperature historics at five locations on a turbine blade for a range of flow temperature to blade temperature ratios. Heat transfer rates were determined from these temperature histories using a finite differencing scheme to approximate the heat equation It was found that the rate of heat transfer along the pressure side of the blade decreased with chordwise position from a maximum value at the leading edge. On the blade suction side, heat transfer rates were found to be considerably greater at the 1/4 and 1/2 chord positions than at the leading edge. GRA

National N85-27872# Aerospace Lab., Amsterdam (Netherlands).

FAN NOISE SUPPRESSION IN TURBOFAN ENGINES

13 p In DUTCH, ENGLISH summary 1983 Sponsored by Netherlands Agency for Aerospace Programs

(B8580076) Avail: NTIS HC A02/MF A01

The optimum impedance of the sound absorbing materials of the intake and exhaust ducts of turbofan engines is investigated. To detect the circumferential modes, measurements were performed in a mode simulator in which spiraling sound waves can be generated or suppressed using a ring of loudspeakers in the wall. A computer program to calculate the sound absorbtion of sound absorbing material lined ducts together with the sound radiated on the ground was developed. The acoustic impedance of a Helmholtz-resonator type liner is determined using a two-microphone technique in which the amplitude and phase inside and on the resonator are measured. Author (ESA) N85-27873# National Aerospace Lab., Amsterdam (Netherlands).

TESTING OF MATERIALS AND COATINGS FOR JET ENGINE COMPONENTS UNDER SIMULATED OPERATIONAL CONDITIONS

1983 14 p In DUTCH; ENGLISH summary Sponsored by Netherlands Agency for Aerospace Programs Original contains color illustrations

(B8580073) Avail: NTIS HC A02/MF A01

Two installations were built to test turbine blades, vanes, and compressor components under simulated polluted-air operational conditions. A burner rig controlled by a process computer was constructed to test the thermal fatigue of turbine blades and vanes at high temperatures. A compressor, and a combustion and mixing chamber were constructed to simulate the conditions under which the compressor components operate. Results show that most materials need a special coating when used in the Western European atmosphere. Author (ESA)

N85-27874# SIGRI Electrogradhit G.m b.H., Meitingen (West Germany).

REACTION-BONDED AND FIBER-REINFORCED SIC STATIC AND DYNAMIC GAS TURBINE COMPONENTS Final Report, Jun. 1983

W. HEIDER, H. BOEDER, and H. FERBER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1984 90 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie.

(BMFT-FB-T-84-302; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19.50

The development, manufacturing, and testing of static gas turbine components in reaction sintered silicon impregnated silicon carbide (SiSiC) and the application of carbon fiber reinforced silicon carbide (CSiC) in dynamically loaded components were studied for the development of a ceramic gas turbine for high process temperatures. The SiSiC can be applied for static high temperature turbine components and CSiC with a long oxidation stability for components production loaded dynamically Line of complex-shaped turbine components is based on the improvement of the injection molding technique and on the production of combustion chambers and of a turbine entrance spiral.

Author (ESA)

N85-28147# Joint Publications Research Service, Arlington, Va. VIBRATIONS OF ROTORS CONNECTED THROUGH COUPLINGS WITH BACKLASH Abstract Only

E. L. POZNYAK and G. P. MAYOROV In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 19-20 15 May 1985 Transl. into ENGLISH from Mashinostr. (Moscow), no. 5, Sep -Oct. 1984 p 36-42

Avail: NTIS HC A06/MF A01

Couplings with backlash for turbine sets, while suitable for compensation of manufacturing and assembly imprecision, cause vibration of the rotors they connect - especially when the shifts of those rotors are not perfectly aligned. Such couplings are either of the fixed type without friction or of the flexible type with very significant friction, flange couplings and end sleeves belonging in the first group while those in the second group have a sleeve and claw, a sleeve with slit, or a sleeve with teeth. A qualitative performance and vibration analysis for the various types of couplings is based on corresponding force and motion diagrams. A computer-aided quantitative analysis for coupled rotors in an SKV 150 MW - 3000 rpm turbine set (total length 12 m, total mass 30 tons, pitch circle of toothed sleeve coupling 14 cm in diameter) confirms the theoretical prediction that the force distribution becomes more uniform with a decreasing relative magnitude of unbalance force as the load is increased. Experimental data indicate, however, that the mechanism of vibration buildup is much more complex, being not only different for vertical and horizontal vibrations but also leading to instability. Author

N85-28148# Joint Publications Research Service, Arlington, Va. PRECISION DIE FORGING OF BLADES OR GAS TURBINES Abstract Only

E. G. SHASTIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 27 15 May 1985 Transl. into ENGLISH from Energomashinostr. (Moscow), no. 8, Aug. 1984 p 20-22 Avail: NTIS HC A06/MF A01

Precision die forging of blades for supersonic gas turbines and compressors is continuously competing with precision die casting, such blades being made of either heat-resistant alloy steels or titanium alloys. One problem in die forging is preheating the blanks and heat treatment without building up a weak surface layer thicker than the allowance for subsequent machining, this layer being either depleted of carbon and alloying elements (steels) or saturated with oxygen and hydrogen (titanium alloys). This problem has been solved by forging in a protective atmosphere or under vacuum. Two other problems are ensuring the necessary deformation of materials with low plasticity within a narrow temperature range and ensuring adequate mechanical strength and stability of the dies. These two problems, solved earlier by sequential forging and by hardening the platen, are now solved by utilizing the superplasticity effect in alloys with certain structural characteristics during deformation along certain temperature strain-rate rate curves. Author

N85-28149# Joint Publications Research Service, Arlington, Va. STRESSED-STRAINED STATE OF TIGHTENING BUCKLES IN SECTIONAL RUNNERS OF GAS TURBINES Abstract Only

I. K. BAKUMENKO and N. A. KULAKOVSKAYA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 27-28 15 May 1985 Transl. into ENGLISH from Energomashinostr (Moscow), no. 9, Sep. 1984 p 7-10 Avail: NTIS HC A06/MF A01

The mechanical state of the 10 tightening buckles in sectional runners of GTN-16 gas turbine-generator sets at high operating temperatures and speeds, after balancing, is analyzed on the basis of the total force and moment balance. The Poisson effect for rotating disks and a 2 5 to 4-times nominal safety margin under vanable load are taken into account. Rotational and thermal stresses as well as contact strsses are included, in addition to plain flexural and torsional stresses. A safety factor for tightness is defined for the joints, which can be higher or lower depending on the balance of forces on a joint. The calculations have been programmed in FORTRAN-4 for an M-222 computer. Calculations have been checked by experiments, the object being to design tightening buckles with more stable joints so as to reduce vibrations.

N85-28943 Department of the Air Force, Washington, D.C. STRUTLESS DIFFUSER FOR GAS TURBINE ENGINE Patent G H. DUNCAN, III and D. L. COOPER, inventors (to Air Force) 12 Mar. 1985 5 p Supersedes AD-D010244 (AD-D011662, US-PATENT-4,503,668; US-PATENT-APPL-SN-484390; US-PATENT-CLASS-60-39.32) Avail: US Patent and Trademark Office CSCL 21E

This patent discloses an improved diffuser for a gas turbine engine which is mounted between a compressor section and a burner section. The diffuser eliminates struts by using the exit guide vanes of the compressor for support. The vanes are fixedly mounted to an inner case wall and to a double outer wall. A cantilevered case wall being one of the double outer walls can flex both radially and axially to relieve thermal stress in the vanes. Additionally, probes can be mounted in access ports formed in the double outer wall. Compressor leakage gas is prevented from entering voids in the double outer wall by a seal seated between the cantilevered case wall and the other case wall. GRA N85-28944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. ADVANCED SECONDARY POWER SYSTEM FOR TRANSPORT

ADVANCED SECUNDART POWER SYSTEM FOR TRANSPORT

A. C. HOFFMAN, I. G. HANSEN, R. F. BEACH, R. M. PLENCNER, R. P. DENGLER, K. S. JEFFERIES, and R. J. FRYE May 1985 38 p refs

(NASA-TP-2463, E-2434, NAS 1.60:2463) Avail: NTIS HC A03/MF A01 CSCL 21E

A concept for an advanced aircraft power system was identified that uses 20-kHz, 440-V, sin-wave power distribution. This system was integrated with an electrically powered flight control system and with other aircraft systems requiring secondary power. The resulting all-electric secondary power configuration reduced the empty weight of a modern 200-passenger, twin-engine transport by 10 percent and the mission fuel by 9 percent. Author

N85-28945*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DEAN: A PROGRAM FOR DYNAMIC ENGINE ANALYSIS

G. G. SADLER and K. J. MELCHER 1985 18 p refs Proposed for presentation at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME Prepared in cooperation with Army Research and Technology Labs.

(NASA-TM-87033; E-2588; NAS 1.15:87033;

USAVSCOM-TR-85-C-10) Avail: NTIS HC A02/MF A01 CSCL 21E

The Dynamic Engine Analysis program, DEAN, is a FORTRAN code implemented on the IBM/370 mainframe at NASA Lewis Research Center for digital simulation of turbofan engine dynamics. DEAN is an interactive program which allows the user to simulate engine subsystems as well as a full engine systems with relative ease. The nonlinear first order ordinary differential equations which define the engine model may be solved by one of four integration schemes, a second order Runge-Kutta, a fourth order Runge-Kutta, an Adams Predictor-Corrector, or Gear's method for still systems. The numerical data generated by the model equations are displayed at specified intervals between which the user may choose to modify various parameters affecting the model equations and transient execution. Following the transient run, versatile graphics capabilities allow close examination of the data. DEAN's modeling procedure and capabilities are demonstrated by generating a model of simple compressor rig. Author

N85-28946# Universal Energy Systems, Inc., Dayton, Ohio. MULTI-DUCTED INLET COMBUSTOR RESEARCH AND DEVELOPMENT Final Report, 31 Aug. 1981 - 31 Aug. 1984 G. D. STREBY Wright-Patterson AFB, Ohio AFWAL Mar. 1985 26 p refs

(Contract F33615-81-C-2074; SB5448-81-C-0518)

(AD-A153753; AFWAL-TR-85-2004) Avail: NTIS HC A03/MF A01 CSCL 21E

Hydrodynamic simulations were conducted of dual inlet side dump combustor configurations to obtain flow visualization and residence time data using the Water Tunnel test rig facility of the Ramjet Technology Branch AFWAL/PORT Wright-Patterson AFB, Ohio. Tests were conducted for inlet duct angles of 30, 45, and 60 degrees for variations in the combustor dome plate height from 0.0 to 6.0 inches, for total combustor fluid flow rates of 200, 300 and 400 gallons per minute, for nozzle area to combustor area ratios of 0.20, 0.29 and 0.39, and for combustor lengths of 20.13, 39 0 and 53.25 inches. The inlet duct Reynolds Numbers for each total flow rate tested were 125,640 for 200 gallons per minute, 188,400 for 300 gallons per minute, and 251,300 for 400 gallons per minute. Also reported on are specialized research efforts concluded to support advanced combustor studies. GRA N85-28947# Air Force Wnght Aeronautical Labs., Wright-Patterson AFB, Ohio. Aerodynamics and Airframe Branch. IMPROVED STATISTICAL ANALYSIS METHOD FOR PREDICTION OF MAXIMUM INLET DISTORTION Final Report, 1 Jan. 1983 - 31 Mar. 1984

D. SEDLOCK Mar. 1985 116 p refs

(AD-A153767; AFWAL-TR-84-3085) Avail: NTIS HC A06/MF A01 CSCL 12A

This report presents the results of an investigation to develop an analytical method which predicts the maximum pressure distortion level and provides a synthesized pressure distortion map at the entrance to the turbine engine compression system. The method uses inlet total pressure statistical properties and a random number process to predict the most probable maximum pressure distortion and pressure distortion map. The validity of the method is demonstrated by comparing predicted maximum distortion levels and pressure contour maps with measured peak distortion levels and pressure contour maps obtained from analog screening of inlet pressure data. GRA

N85-28948# Tennessee Univ., Tullahoma.

COMPRESSOR AND TURBINE MODELS - NUMERICAL STABILITY AND OTHER ASPECTS Final Report, 1 May 1982 -1 May 1984

K. C. REDDY and S. N NAYANI AEDC Apr. 1985 70 p (Contract F40600-82-C-0003)

(AD-A153811, AEDC-TR-85-5) Avail: NTIS HC A04/MF A01 CSCL 12A

This report deals with the mathematical-numerical models used at AEDC for the simulation of aircraft engine compressors and turbines. Numerical stability problems encountered in a one-dimensional compressor model (COMP2SP) have been eliminated with appropriate changes in the algorithm. A multidimensional finite volume code (ATAC), which simulates the operation of a turbine, has been analyzed, and the source of numerical oscillations in that code has been isolated. Subsequently, proper changes to the ATAC code have been made at AEDC and numerical oscillations have been eliminated. Stage characteristics based on the total pressure loss coefficient and the deviation angle as functions of incidence angle have been found to be less sensitive to errors in interpolation for intermediate speeds than the pressure and temperature coefficients as functions of the flow coefficient. Multidimensional compressor model equations suitable for simulating the circumferentially distorted flows have been developed. Characteristics and compatibility equations are derived for the imposition of inflow and outflow boundary condition.

GRA

80

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A85-37195#

DESIGN OF DIGITAL FLIGHT CONTROL SYSTEMS FOR HELICOPTERS

B. PORTER (Salford, University, Salford, England) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 146-152. refs

In this paper, general results from the singular perturbation analysis of the transfer function matrices of discrete-time tracking systems are used to design a fast-sampling error-actuated digital controller and associated transducers for the automatic control of the longitudinal motions of the CH-47 helicopter. It is demonstrated that tight non-interacting robust control of the vertical velocity an pitch attitude of the helicopter is readily achievable by the implementation of an appropriate fast-sampling digital controller

08 AIRCRAFT STABILITY AND CONTROL

which generates practically acceptable gang-collective and differential-collective rotor control inputs. Author

A85-38168# PERTURBED MOTION OF AIRPLANE AND SAFE STORE SEPARATION

S. C. RAISINGHANI and S RAO (Indian Institute of Technology, Kanpur, India) Defence Science Journal (ISSN 0011-748X), vol. 34, July 1984, p. 221-234. refs

A method is presented to predict the perturbed motion of an airplane following stores jettisoning. The mass, moment of inertia, forces, and moments acting on the airplane are suitably split into contributions from the stores and the rest of the airplane parts. The separation of stores is assumed to result in a step change of mass, moment of inertia, forces, and moments contributed by stores. The resulting set of perturbed state equations of motion are solved for two illustrative airplane-stores combination. A criterion is evolved to qualitatively indicate locations for safe store separation. It is suggested that the present method be used to predict airplane perturbed motion following stores separation for a given airplane-store combination and results be used in conjunction with store trajectory analysis for finally declaring a store location as safe or unsafe.

A85-38357#

AN EVADING PATH AGAINST 3 D OBSTACLES

K. KATO and H. SOGA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no 360, 1984, p. 59-66. In Japanese, with abstract in English.

A quasi-optimum flight path is determined in order to evade three-dimensional obstacles. The procedure consists in solving two linear complementary problems, and is an extension of Funk's terrain-following control into three-dimensional space. The formulation includes upper as well as lower bounds for flight-admissible space and gives a near minimum-distance path following terrain or obstacles. Author

A85-38364#

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) OF HELICOPTER USING AN OPTICAL CONTROL ALGORITHM T. TAKISHIMA, T. SATO, M. TAKAHAMA, and T. OTSUKI Japan Society for Aeronautical and Space Sciences, Journal (ISSN

0021-4663), vol. 32, no. 361, 1984, p. 96-101. In Japanese.

An automatic flight control system for single-rotor helicopters using an optical algorithm to obtain a stabilized autoapproach is developed. The mathematical analysis of the optimal control system using a kinematic equation of the airframe is carried out. The system was tested with the Sikorsky S-61 helicopter, and it was shown that it was resistant to the gain variation and had a low vibrational fluctuation in the autoapproach profile. Block diagrams are included. S.H.

A85-38369#

DEVELOPMENT OF THE BK 117 HELICOPTER

T. MASUE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol 32, no. 362, 1984, p. 142-148. In Japanese. refs

The structural specifications of the BK 117 helicopter and the technical problems encountered in its development are described. The BK 117 is a joint_venture of Japan and Federal Republic of Germany and since its first flight in 1977, no accident or emergency landing have been recorded. The BK 117 has been commercialized as a multipurpose helicopter, and type certification has been issued by U.S., FRG, and Japan. S.H.

A85-38794#

AN EXPERIMENTAL DETERMINATION OF THE LONGITUDINAL STABILITY PROPERTIES OF THE LTA 20-1 AIRSHIP

J. D. LOWE, A S. KING, W. D. MCKINNEY, and D. R. UFFEN (Toronto, University, Toronto, Canada) IN: Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 115-123.

(AIAA PAPER 85-0879)

A dynamically-scaled, radio-controlled flying model of the LTA 20-1, which is a spherically shaped heavy lift airship, has been used to experimentally assess the longitudinal stability properties of the vehicle. Test results have confirmed analytical stability predictions. In general, it has been found that a horizontal tail is required to provide adequate damping properties in cruise flight. Author

A85-38795#

DYNAMIC CHARACTERISTICS OF THE STARS AEROSTAT

J. A. KRAUSMAN, S P. JONES, and B. D. SUNKARA (TCOM, Columbia, MD) IN Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1985, p. 124-129. refs

(AIAA PAPER 85-0880)

The STARS is a asmall tethered aerostat with inverted-Y fins and a large windscreen. In a previous study, a mathematical model and various dynamic characteristics of the aerostat were reported The present paper updates and extends the dynamic analysis including the correction of a minor error in the previously reported work. The principal effect of the lattgr is in the lateral fin interference factors with no change in the longitudinal coefficients Additional studies of the STARS include calculation of the turbulence transfer functions and power density functions from which RMS displacements are calculated. Author

A85-38970#

THE WIND TUNNEL INVESTIGATION FOR OBTAINING ROLLING MOMENT WITH SMALL ASYMMETRY

X. HUANG and H. CAI (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 69-73. In Chinese, with abstract in English.

A wind tunnel experimental method, which is used for obtaining the rolling moment with small asymmetry, has been developed. The experimental Mach numbers are 4, 5, 6 The angle of attacks range from -2 deg to 6 deg, and the Reynolds number, about 5 million. The experiment results and repeatance error are given in the paper. The experiment investigation shows that the tolerance in machining can cause as large as a 0.0001 coefficient of the rolling moment. It is even somewhat larger than that of the nosetip. Author

A85-38974#

DISCUSSIONS ON THE REGULAR BEHAVIOR OF THE LONGITUDINAL DYNAMIC RESPONSE OF AIRCRAFT DURING VARIABLE SWEEP FLIGHTS

D LIU (China Aerodynamic Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 93-96. In Chinese, with abstract in English. refs

The regular behavior of the aircraft dynamic response and its relation to the aerodynamics of the aircraft during variable sweep and accelerated flights are discussed in this paper, and the mechanism for the regular behavior of the aircraft response is also analyzed. It is pointed out that the decrease of the incidence, flight-path angle, and the flight altitude at initial time during the variable sweep and accelerated flight is the foundational characteristic of the aircraft response, and that the aerodynamic center moving backward, and therefore the increase of the static stability, is the foundational cause for it. It is also pointed out that the dynamic response at the initial time can be predicted using the varying rate, at the time when sweep angle begins to vary, of the static stability to the sweep angle.

A85-39059* National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

STABILITY AND CONTROL RESULTS FOR ADVANCED TURBOPROP AFT-MOUNT INSTALLATIONS

P L. COE, JR., Z. T. APPLIN, and L. J. WILLIAMS (NASA, Langley Research Center, Hampton, VA) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 19-26. refs (SAE PAPER 841479)

An experimental investigation was recently conducted in the NASA-Langley Research Center 4- by 7-Meter Tunnel to explore the effects of aft-mounted advanced turboprop installations on the low-speed stability and control characteristics of a representative transport aircraft configuration. For the conditions investigated, the experimental results indicate that the longitudinal and directional stability of the configuration was not adversely affected by aft-pylon-mounted single-rotation tractor or counter-rotation pusher propeller installations. The results indicate that for the single-rotation tractor configuration the propeller induced aerodynamics are dominated by the interaction of the propeller slipsteam with the pylon, and that the propeller contribution to the stability characteristics for the counter-rotating pusher configuration is dominated by propeller normal forces The longitudinal and directional control effectiveness, engine-out characteristics, and ground effects are also presented. Author

A85-39567*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STATE VARIABLES SLOW AND FAST FOR THREE-DIMENSIONAL FLIGHT DYNAMICS

M. ARDEMA (NASA, Ames Research Center, Moffett Field, CA) and N. RAJAN (Stanford University, Stanford, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol 8, July-Aug 1985, p. 532-535.

The identification of a new fast variable for three-dimensional flight dynamics is discussed. It is shown that the variable gives a value of the flightpath angle which is consistent with the velocity-altitude state equations and that the accuracy of single-perturbation analyses is increased by decreasing the magnitude of boundary-layer corrections. The values of the flightpath angle along the three-dimensional energy-state extremal are found to be lower by approximately an order of magnitude than those along the two-dimensional energy-state solution

M.D.

N85-27875# Air Force Wright Aeronautical Labs. Wright-Patterson AFB, Ohio.

USE OF QUATERNIONS IN FLIGHT MECHANICS Final Technical Report, Jul. 1982 - Sep. 1983

W L. HANKEY, L. E. MILLER, and S. J. SCHERR Mar. 1984 48 p

(Contract AF PROJ. 2307)

(AD-A152616; AFWAL-TR-84-3045) Avail. NTIS HC A03/MF A01 CSCL 12A

In analyzing aircraft spin and other flight maneuvers with large rotation rates based upon first principles, the non-linear aerodynamic equations (Navier-Stokes) must be coupled with the rigid-body dynamic equations of motion. In both systems of equations it is desirable to use a body axes system to describe the forces and moments, and utilize a surface-oriented coordinate system for obtaining the flowfield grid. To solve this system of equations it is necessary to describe the position of the aircraft with respect to a fixed inertial coordinate system. The classic method is to use the Euler angles to define the aircraft orientation. However, singularities and ambiguities exist when the elevation angle is plus or minus ninety degrees. This difficulty has been overcome in the field of inertial guidance by the use of quaternions to describe the aircraft position in space. It is the purpose of this report to investigate this technique for numerically solving aircraft spin problems. Two problems are addressed, the first is a nonsymmetric body and the second is a symmetric configuration The rotational dynamics and the solution for the guaternions and Euler angles are determined for both problems. Hamilton (circa 1840) was the first to point out that the three Euler angles are inadequate to uniquely define the orientation of a body in space and that four variables are required to resolve the predicament. Hence he invented the quaternion which is a scalar plus a vector, totalling four elements. GRA

N85-27876# Naval Postgraduate School, Monterey, Calif. ANALYSIS OF CONTROL SYSTEM FROM A VIEWPOINT OF DESIRED POLE PLACEMENT AND DESIRED DEGREE OF **ROBUSTNESS M.S. Thesis**

J. CHANG Dec. 1984 83 p

(AD-A152627) Avail NTIS HC A05/MF A01 CSCL 12A A design method for solving the problem of robustness to cross-coupling perturbations in multivariable control systems for the X22A V/STOL aircraft is presented in this thesis. The method uses numerical optimization procedures to manipulate the system feedback gains as direct design variables. The manipulation is accomplished in a manner that produces desired performance by pole placement and robustness by modification of the minimum singular values of the system return difference matrix. Channels affected by cross-coupling perturbation may be recognized by the character of their transfer function Bode plots. The mechanism used by the pole placement and robustness routine in obtaining a robust design is evident from the gain changes associated with the transfer function diagram and the zero shifts shown on pole-zero plots. The pole placement and robustness routine uses gain equalization and zero assignment to modify the characteristics of the system in the areas of low singular values, producing a robust desian. GRA

Air Force Inst. of Tech., Wright-Patterson AFB, N85-27877# Ohio. School of Engineering

DESIGN OF ROBUST CONTROLLERS FOR A MULTIPLE INPUT-MULTIPLE OUTPUT CONTROL SYSTEM WITH UNCERTAIN PARAMETERS APPLICATION TO THE LATERAL AND LONGITUDINAL MODES OF THE KC-135 TRANSPORT **AIRCRAFT M.S. Thesis**

H H RUSSELL Dec 1984 380 p

(AD-A153100; AFIT/GE/ENG/84D-72) Avail: NTIS HC A17/MF A01 CSCL 01D

A multiple input-multiple output flight control design on the KC-135 aircraft is completed using Quantitative Feedback Theory (QFT). The three degrees-of-freedom model for the lateral mode is reduced to a two degrees-of-freedom model. From this model a robust controller is developed to perform two maneuvers over a wide range of the aircraft flight envelope. The three degrees-of-freedom for the longitudinal mode is then used to develop a robust controller to perform one maneuver. The first and second body bending modes are then added to remove the rigid bosy constraint and a robust control is developed for the non-rigid aircraft. The robust controllers developed for the lateral and longitudinal modes are simulated over a large range of the aircraft's flight envelope. The conclusion drawn from the research is that this method is very effective in designing multiple input-multiple output systems with plant uncertainty. GRA

N85-27878# McDonnell Aircraft Co, St. Louis, Mo CONTROLLER REQUIREMENTS FOR UNCOUPLED AIRCRAFT MOTION, VOLUME 1 Final Report, Aug. 1981 - Apr. 1984

Wright-Patterson AFB, Ohio Sep. K. D. CITURS AFWAL 1984 198 p

(Contract F33615-81-C-3605)

(AD-A153173; AFWAL-TR-84-3060-VOL-1) Avail: NTIS HC A09/MF A01 CSCL 01A

Use of uncoupled, six-degree-of-freedom (6-DOF) motion is rapidly becoming state-of-the-art in terms of necessary flight control laws and aerodynamic capability. The next generation of aircraft may use uncoupled, 6-DOF control capability in conjunction with other new technologies. In order for future applications of 6-DOF control to be successful, the pilot must be able to command motion and acceleration magnitudes with sufficiently good system response characteristics to accomplish particular missions or tasks. This

08 AIRCRAFT STABILITY AND CONTROL

study sought to develop design criteria and gather appropriate substantiating data for cockpit control devices for 6-DOF motion which will assure compatibility among the pilot, control device(s) and aircraft response and thus allow efficient implementation of the 6-DOF control capability. Phase 1 consisted of defining existing data on the design of cockpit controllers for 6-DOF motion. Application of 6-DOF aircraft motion to aircraft mission requirements was examined. A set of tentative criteria was formulated and test plans developed to gather data necessary to validate and expand the tentative criteria. A simulation was conducted using the motion based simulator at Wright-Patterson AFB. Results of the simulation were combined with the results of the literature survey to form a set of design guidelines. Volume 1 presents the results of the literature survey, summarizes the simulation effort and presents the design criteria. GRA

N85-27879# McDonnell Aircraft Co., St. Louis, Mo. CONTROLLER REQUIREMENTS FOR UNCOUPLED AIRCRAFT MOTION, VOLUME 2 Final Report, Aug. 1981 - Apr. 1984 K. D. CITURS 1984 558 p Wright-Patterson AFB, Ohio AFWAL Sep.

(Contract F33615-81-C-3605)

(AD-A153300; AFWAL-TR-84-3060-VOL-2) Avail: NTIS HC A24/MF A01 CSCL 01D

Use of uncoupled, six-degree-of-freedom (6-DOF) motion is rapidly becoming state-of-the-art in terms of necessary flight control laws and aerodynamic capability. The next generation of aircraft may use uncoupled, 6-DOF control capability in conjunction with other new technologies such as Integrated Flight-Fire Control (IFFC). In order for future applications of 6-DOF control to be successful, the pilot must be able to command motion and acceleration magnitude with sufficiently good system response characteristics to accomplish particular missions or tasks. This study sought to develop design criteria and gather appropriate substantiating data for cockpit control devices for 6-DOF motion which will assure compatibility among the pilot, control device(s) and aircraft response and thus allow efficient implementation of the 6-DOF control capability. Phase 1 consisted of defining existing data on the design of of cockpit controllers for 6-DOF. Application of 6-DOF aircraft motion to aircraft mission requirements was examined A set of tentative criteria was formulated and test plans developed to gather data necessary to validate and expand the tentative criteria. A simulation was conducted using the motion-based simulator at Wright-Patterson AFB. Results of the simulation were combined with results of the literature survey to form a set of design guidelines. Volume 1 (AD-A153300) presents the results of the literature survey. Volume 2 is a detailed discussion of the simulation and analysis of the data. GRA

N85-27880# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flaechenflugzeuge.

IN-FLIGHT INVESTIGATION OF THE INFLUENCE OF PITCH DAMPING AND PITCH CONTROL EFFECTIVENESS ON LANDING APPROACH FLYING QUALITIES OF STATICALLY UNSTABLE TRANSPORT AIRCRAFT

K. WILHELM and D. SCHAFRANEK Feb. 1984 66 p refs (DFVLR-FB-84-12; AD-B085878L) Avail: NTIS HC A04/MF A01: DFVLR, Cologne DM 26

A in-flight simulator was used to investigate the flying qualities of statically unstable transport aircraft. The numerical values of pitch damping and pitch control effectiveness were varied in combination with a constant amount of instability. Over 70 landing approaches were flown by 3 pilots evaluating 5 configurations. Pilot ratings on the basis of the Cooper-Harper scale and a special effort rating scale and statistical values of measured performance data are presented. Decreasing the pitch damping in combination with an unchanged amount of instability leads to unacceptable flying qualities due to extreme difficulties with pitch attitude tracking. High values of pitch control effectiveness make the aircraft oversensitive and are not accepted by the pilots. An increase in turbulence intensity aggravates the influence of pitch damping

reduction and control effectiveness increase on the flying Author (ESA) qualities.

N85-27881# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flaechenflugzeuge.

IDENTIFICATION OF GUST INPUT AND GUST RESPONSE **CHARACTERISTICS FROM DO 28 TNT FLIGHT TEST DATA** D ROHLF Nov. 1984 59 p refs In GERMAN; ENGLISH Report will also be announced as translation summary (ESA-TT-919)

(DFVLR-FB-84-48; ISSN-0171-1342) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 21

A method to determine gust reponse characteristics and simultaneously estimate the discrete gust input from flight test data using system identification techniques is presented. The method is restricted to longitudinal motion of aircraft with separated wing and tail surfaces at low Mach numbers. The applicability of the method is demonstrated by analyzing free flight catapult tests and dynamic wind tunnel tests with models of the Do 28 TNT aircraft. A good fit of the measured and identified time histories is achieved by considering the dynamic terms which are important for angles of attack varying rapidly due to gusts. Author (ESA)

Deutsche Forschungs- und Versuchsanstalt fuer N85-27882# Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flaechenflugzeuge.

PROPOSALS FOR THE DETERMINATION OF NECESSARY ELEVATOR HANDLING CHARACTERISTICS OF SAILPLANES IN HIGH SPEED RANGE

G STICH and D. SCHMERWITZ Dec. 1984 38 p refs In GERMAN; ENGLISH summary

(DFVLR-FB-84-52) Avail: NTIS HC A03/MF A01; DFVLR,

Cologne, DM 14.50

For high performance salplanes with relaxed longitudinal static stability or slight instability in high speed range, pitch controllability using the elevator (stick deflection per load factor) is demonstrated by measurements in steady turns. A flight test program with a sailplane proves the theoretical investigations. A proposal for a simple procedure which allows the determination of pitch controllability in high speed range in the case of relaxed longitudinal static stability or slight instability is presented. Author (ESA)

N85-27883# Advisory Group for Aerospace Research and Development, Neully-Sur-Seine (France).

ACTIVE CONTROL SYSTEMS: REVIEW, EVALUATION AND PROJECTIONS

Loughton, England Mar. 1985 392 p refs In ENGLISH and FRENCH Symp held in Toronto, 15-18 Oct. 1984

(AGARD-CP-384; ISBN-92-835-0375-9) Avail: NTIS HC A17/MF A01

Numerous topics relative to digital flight control systems are discussed. Active control technology applications, optimization of systems architecture for both reliability and costs control cam design, handling qualities, and the operational demonstration of systems reliability are among the topics covered.

N85-27884# Centre d'Etudes et de Recherches, Toulouse (France).

ACTIVE CONTROL TECHNOLOGY (ACT): PAST, PRESENT AND FUTURE

M. J. PELEGRIN In AGARD Active Control Systems: Rev., Evaluation and Projections 30 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

The past, present and future developments in the field of active control technology are surveyed. The improvement of aircraft performance, the reduction of operating costs, and the reduction of workloads are seen as benefits derived from active control technology. R.J.F.

N85-27885# General Electric Co, Binghamton, NY. THE STATE-OF-THE-ART AND FUTURE OF FLIGHT CONTROL SYSTEMS

In AGARD Active Control Systems: Rev., Evaluation and Projections 4 p Mar. 1985

Avail: NTIS HC A17/MF A01

The evolution of flight control systems from non-electronic primary controls with electronic secondary augmentation systems to modern electronic Primary Fly-By-Wire systems is traced. Current system configurations are related to their origins in both aircraft and electronics technology. The future of flight control technology is discussed in view of the payoff which is expected from the increased integration of the various aircraft control functions. The integration of the aerodynamic and propulsive control systems provides a new level of control which will make the aircraft dramatically more maneuverable. The coupling of the integrated flight control system with the avionics system will permit advanced guidance and attack modes which will combine to increase the lethality of the combat system. The system will reconfigure its control laws to allow continuation of the mission or at least controlled flight in the face of battle damage if sufficient control power, lift, and propulsion remain. System architecture will be such as to support advanced maintainability features which will provide vastly improved system availability and persistance. RJ.F.

N85-27886*# Systems Technology, Inc., Hawthorne, Calif. A PERSPECTIVE ON SUPERAUGMENTED FLIGHT CONTROL ADVANTAGES AND PROBLEMS

D MCRUER, D JOHNSTON, and T MYERS *In* AGARD Active Control Systems: Rev., Evaluation and Projections 20 p Mar. 1985 refs

(Contract NAS2-11388)

Àvail: NTIS HC A17/MF A01 CSCL 01C

Superaugmented aircraft are an important subclass of actively controlled, higly-augmented aircraft. The aircraft without augmentation is unstable, and the control system not only redresses the stability and control imbalance but also provides effective vehicle dynamics which may differ in kind from those associated with conventional aircraft. The properties of highly unstable aircraft and typical superaugmented control systems used to remedy their dynamic deficiencies are explored generically. The following topics are considered: basic flight control system architectures suitable to reduce or completely alleviate the unstable aircraft characteristics; the primary dynamic characteristics and regulatory properties of typical superaugmented aircraft control systems, including governing factors in the linear system, dominant mode characteristics, and fundamental stability margin properties; and flying qualities features for superaugmented aircraft with rate command/attitude hold. extended bandwidth, and attitude command configurations. RJF.

N85-27887# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

ASPECTS OF APPLICATION OF ACT SYSTEMS FOR PILOT WORKLOAD ALLEVIATION

K. WILHELM and B. GMELIN *In* AGARD Active Control Systems: Rev., Evaluation and Projections 20 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

An essential element in the construction of future civil and military aircraft will be the inclusion of Active Control Technology (ACT) in the design process. This will be true for fixed-wing aircraft as well as for rotary-wing aircraft. The implementation of ACT makes possible improvements in flight performance and handling qualities. In particular, ACT can lead to alleviation of pilot workload in performing a specific task. This can be achieved by reducing undesirable motions and effects and adjusting the aircraft dynamics to a certain flight task and to the pilot. The above-mentioned problem areas concerning the implementation of ACT are discussed. Piloting problems with conventional systems and the influence of ACT systems on flying qualities and pilot workload are covered Results from wind tunnel testing and flight testing using a BO 105 type helicopter and the HFB 320 in-flight simulator are given. R.J.F

N85-27888# General Dynamics Corp., Fort Worth, Tex. APPLICATION OF AFTI/F-16 TASK-TAILORED CONTROL MODES IN ADVANCED MULTIROLE FIGHTERS

R D. TOLES, D R. MCMONAGLE (Air Force, Edwards AFB, Calif.), D. C. ANDERSON, and J. H. WATSON *In* AGARD Active Control Systems: Rev., Evaluation and Projections 11 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

The next generation of multirole fighter aircraft will benefit from recent advances in flight control technology. The advent of digital fly-by-wire flight control capability for vehicles with relaxed static stability, as recently demonstrated by the AFTI/F-16, means a much higher level of performance is now attainable in handling qualities and weapon delivery effectiveness. Specifically, digital implementation of control laws permits the designer to attain a higher level of man/machine capability and performance, even at the flight envelope extremities. Multiple, separate task-tailored modes can be designed and employed to perform tasks with distinctly different flight dynamics requirements, achieving better performance than any single, multipurpose mode. Recently developed design concepts which support the above assertions are discussed. These concepts were employed on the AFTI/F-16 aircraft which dramatically demonstrated the benefits of digital flight control and task-tailored modes. R.I.F.

N85-27889# Grumman Aircraft Engineering Corp., Bethpage, N.

X-29 DIGITAL FLIGHT CONTROL SYSTEM DESIGN

A. WHITAKER and J. CHIN /n AGARD Active Control Systems: Rev., Evaluation and Projections 13 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

The X-29 Technology Demonstrator is a Forward Swept Wing Aircraft with primary longitudinal control provided by a large canard. The wing body is balanced to be neutrally stable for minimum drag. The canard is sized for high maneuverability resulting in a configuration which is 35% unstable. This configuration with its high aerodynamic efficiency became practical through the application of Active Control System Technology in the design of the Digital Flight Control System. The design concept for the X-29 flight control system was to utilize the available state-of-the-art and existing hardware to fly a very unusual aircraft. The purpose was to achieve an Advanced Application of Control Configured Vehicle with minimum cost and risk in the hardware development. As a result, the system architecture is very conservative using demonstrated techniques. The Normal Longitudinal Control Law, on the other hand, is based on Modern Control Theory. The unique features of the aircraft configuration, the control system architecture, and control surface arrangement are discussed. The hardware selected for implementation is described. The control law development is outlined to include the constraints which result from the 35% static instability. B.IE

N85-27890# Royal Aircraft Establishment, Bedford (England). Flight Systems Dept.

THE EVOLUTION OF ACS FOR HELICOPTERS: CONCEPTUAL SIMULATION STUDIES TO PRELIMINARY DESIGN

J. S. WINTER, G D. PADFIELD, and S. L. BUCKINGHAM *In* AGARD Active Control Systems: Rev , Evaluation and Projections 14 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

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In the development of suitable control algorithms for future active control technology battlefield helicopters, handling qualities appropriate to a wide range of tasks will need to be identified and incorporated into the design process before detailed control laws may be defined. Work in identifying appropriate characteristics through piloted simulation studies of a conceptual model of the controlled helicopter, subsequent control law studies and the use of computer aided design and analysis of the sensitivity of the controlled vehicle are discussed R J.F.

N85-27891# Smiths Industries Ltd., Bishops Cleeve (England). ACT APPLIED TO HELICOPTER FLIGHT CONTROL

W. R. RICHARDS In AGARD Active Control Systems: Rev., Evaluation and Projections 12 p Mar. 1985 refs Avail NTIS HC A17/MF A01

Benefits of ACT applied to helicopters are potentially significant resulting in a considerable challenge to avionic equipment suppliers. The impact of mechanical link removal and replacement by electrical/optical signalling is discussed. ACT control systems configurations suitable for installation in helicopters in the 1988 and 1992 time scales with anticipation of continued component technological development are identified. New control laws are discussed based on requirements for higher bandwidth controllers, and non-interaction of control axes. Author

N85-27892# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div. SOME FLIGHT TEST RESULTS WITH REDUNDANT DIGITAL

FLIGHT CONTROL SYSTEMS

U. KORTE In AGARD Active Control Systems: Rev., Evaluation and Projections 14 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

Under contract of the German MOD a quadruredundant, full authority digital Flight Control System has been developed by MBB for use in naturally unstable aircraft and flight tested in a single seater F-104 G which has been modified as a CCV demonstrator aircraft. From Dec. 1977 to Nov. 1981 the new FCS was tested in 118 flights in five different configurations of the aircraft. 22 of the flights were made in unstable configurations with instabilities up to 22 % MAC. In a follow-on program from Aug. 1982 to April 1984 a simple digital Backup-Controller (Software) and an integrated digital Autopilot were developed and successfully flight tested. Total number of flights with the digital FBW-system was 176. Some of the experiences and results are presented which were made with the operational FBW-system and the backup-software. Author

N85-27893# British Aerospace Public Ltd Co., Lancashire (England). Aircraft Group.

AN UPDATE OF EXPERIENCE ON THE FLY BY WIRE JAGUAR EQUIPPED WITH A FULL-TIME DIGITAL FLIGHT CONTROL SYSTEM

E. DALEY In AGARD Active Control Systems: Rev., Evaluation and Projections 15 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

An overview of the Fly By Wire Jaguar Demonstrator Program which was recently successfully completed with the flight trials of a highly unstable configuration of 10% negative maneuver margin. The aircraft is unique, being equipped from the outset with a quadruplex digital flight control system, with no form of electrical or mechanical backup system. The U.K. demonstrator program was sponsored by MoD, with the aim of the design, development and demonstration of a safe, practical, full time fly by wire flight control system for a combat aircraft. The primary aim was achieved in 1981 with the first flight of the aircraft, and further objectives of the flight demonstration of the aircraft in a highly unstable configuration in pitch, and with a Stall Departure/Spin Prevention system, was successfully completed. The flight control system, its flight certification and all phases of its flight trials is briefly described. Author

N85-27894# British Aerospace Aircraft Group, Brough (England). Aircraft Group.

ACT FLIGHT RESEARCH EXPERIENCE

D. J. WALKER and R M. HORNER (RAE, Farnborough) In AGARD Active Control Systems: Rev., Evaluation and Projections Mar. 1985 7 p

Avail: NTIS HC A17/MF A01

Hunter XE 531 was the subject of a 15 year ACT program. The initial years involved the design, implementation and flight testing of a full authority quadruplex FCS flight control system. Using the aircraft as an experimental facility, a joint program emerged with British Aerospace, concentrating on handling aspects,

N85-27895# McDonnell Aircraft Co., St. Louis, Mo. OPERATIONAL AND DEVELOPMENTAL EXPERIENCE WITH THE F/A-18A DIGITAL FLIGHT CONTROL SYSTEM

ending with the loss of the aircraft through engine failure on take-off

Author

W. A. MORAN In AGARD Active Control Systems: Rev., Evaluation and Projections 13 p Mar. 1985 Avail: NTIS HC A17/MF A01

The control system of the F/A-184 Hornet is a four channel fly by wire system using digital processors. During the development of the F/A-18, more than 75 control law variations were flown. Many of these variations were made necessary by flexible aerodynamic characteristics which sometimes defied prediction and by evolving structural loads requirements, as well as by the usual refinements in control laws resulting from flight experience. The digital flight control computer provided the ability to make these changes with relative ease. It also provided the flexibility to solve problems which on past generation aircraft might have been treated either with placards or with expensive structural modifications. The control system and the testing of the system is described in detail. Author

N85-27896# Naval Air Test Center, Patuxent River, Md. Strike Aircraft Test Directorate.

FLIGHT TESTING AND DEVELOPMENT OF THE F/A-18A DIGITAL FLIGHT CONTROL SYSTEM

R. A. BURTON, B. T. KNEELAND, U H. RABIN (Systems Control Technology, Inc., Palo Alto, Calif.), and R. S. HANSEN (Systems Control Technology, Inc., Palo Alto, Calif.) In AGARD Active Control Systems: Rev, Evaluation and Projections 18 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

The improvement in the F/A-18 handling qualities from level 3 to level 1 for several mission tasks is documented. A new approach to the problem of extracting equivalent system models are handling qualities characteristics for fully augmented aircraft is introduced. This approach identified equivalent aerodynamic parameters and time delays of the flight control system and instrumentation system. This approach makes use of a mature and efficient integrated system identification procedure which uses several algorithms including a maximum likelihood method. This advanced equivalent system analysis method and the use of closed loop pilot mission related task testing are used to evaluate the F/A-18 digital FCS during its development. This is in contrast to classical open loop test techiques such as droplet inputs which gave little insight into the FCS and airframe interface. The correlation between equivalent time delays and the pilot handling qualities rating's obtained from closed loop mission task demonstrate that the equivalent system methodology can successfully be used to document the handling qualities of a highly augmented aircraft. In addition, the flexibility of the F/A-18 digital FCS allow for the correction of handling qualities and structural problems in a manner that has not previously been possible. Author

N85-27897# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany)

OLGA: AN OPEN LOOP GUST ALLEVIATION SYSTEM

H. BOEHRET, B. KRAG (DFVLR, Brunswick), and J. SKUDRIDAKIS (DFVLR, Wesseling, West Germany) In AGARD Active Control Systems: Rev., Evaluation and Projections 16 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

Aircraft with a modern wing of high aerodynamic efficiency and low wing loading are sensitive to gusts and, therefore, only offer limited passenger comfort in turbulent weather. The OLGA (Open Loop Alleviation) system was developed in cooperation with the DFVLR to improve the passenger ride comfort for such types of aircraft. The open loop principle was chosen because investigations showed this to be superior to a feed back type system. The gust angle of attack, calculated from sensor signals determines the performance of the system. Symmetric alleron

deflection and the elevator are used for the compensation of the gust induced lift and pitching moment. Both control surfaces are operated by electromechanical actuators. After theoretical design work, the open loop principle was the subject of intensive wind tunnel investigation using a remotely controlled wind tunnel model of the Do 28 TNT experimental aircraft. After realizing the hardware, the system was implemented and flight tested in the real Do 28 TNT airplane. The flight test results and its comparison with those obtained from the hardware simulation and the wind tunnel investigations are discussed. Author

N85-27898*# Lockheed-California Co., Burbank.

DEMONSTRATION OF RELAXED STATIC STABILITY ON A COMMERCIAL TRANSPORT

J. J. RISING, W. J. DAVIS, and C. S. WILLEY In AGARD Active Control Systems Rev., Evaluation and Projections 18 p Mar. 1985 refs

(Contract NAS1-15326)

Avail: NTIS HC A17/MF A01 CSCL 01C

The application of relaxed static stability was studied under a program to determine ways of improving the energy efficiency in current and future transport aircraft. Pitch active control systems (PACs) were developed for application in the near term to current aircraft and in the next generation to advanced aircrft of the future. Analyses identified potential drag benefits of: (1) 2% for current transport aircraft with neutral stability; and (2) as much as 17% for next generation aircraft with high aspect ratio supercritical wings which must operate 10 to 15% statistically unstable to achieve optimum performance. Flight test evaluations of the near-term PACs were conducted to a 3% mean aerodynamic chord (MAC) negative static margin on a Lockheed L-1011 aircraft. The advanced PACs was demonstrated to a 20% MAC negative static margin on a piloted visual motion simulator at the NASA Langley Research Center. Test results for both systems showed flying qualities characteristics as good as current conventional aircraft. MG

Messerschmitt-Boelkow-Blohm G.m b H., Hamburg N85-27899#

(West Germany). Transport Aircraft Div. REALISATION OF RELAXED STATIC STABILITY ON A COMMERCIAL TRANSPORT

In AGARD Active Control Systems. Rev., U. P. GRAEBER Evaluation and Projection 11 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

The requirements of some airlines to increase the fuel capacity of a given transport aircraft led to a combined solution of an additional tank and the application of relaxed static stability. Some steps that led to the final solution are reviewed and some of its problems and benefits are shown Author

N85-27901# London Univ. (England).

THE AERODYNAMICS OF CONTROL

A. D. YOUNG In AGARD Active Control Systems: Rev, Evaluation and Projections 17 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

Traditional forms of control, novel forms developed to deal with flight conditions where the traditional forms lose effectiveness, and direct force controls are reviewed. Dynamic effects, missile controls and computational methods for predicting the aerodynamic characteristics of controls (or motivators) are briefly discussed. Finally, comments are offered on major areas calling for future research. Author

N85-27902*# National Aeronautics and Space Administration. Langlev Research Center, Hampton, Va.

ACTIVE CONTROL LANDING GEAR FOR GROUND LOAD ALLEVIATION

J. R. MCGEHEE and D. L. MORRIS (AFWAL) In AGARD Active Control Systems: Rev., Evaluation and Projections 12 p Mar. 1985 refs

Avail NTIS HC A17/MF A01 CSCL 01C

Results of analytical and experimental investigations of a series-hydraulic active control landing gear show that such a gear is feasible when using existing hardware and is very effective in

08 AIRCRAFT STABILITY AND CONTROL

reducing loads, relative to those generated by a conventional (passive year) gear, transmitted to the airframe during ground operations. Analytical results obtained from an active gear, flexible aircraft, take-off and landing analysis are in good agreement with experimental data and indicate that the analysis is a valid tool for study and initial design of series-hydraulic active control landing gears. An analytical study of a series-hydraulic active control main landing gear on an operational supersonic airplane shows that the active gear has the potential for improving the dynamic response of the aircraft and significantly reducing structural fatigue damage during ground operations. M.G.

N85-27903# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

WING BUFFETING ACTIVE CONTROL TESTING ON A TRANSPORT AIRCRAFT CONFIGURATION IN A LARGE SONIC WINDTUNNEL

R. DESTUYNDER In AGARD Active Control Systems: Rev., Evaluation and Projections 10 p Mar. 1985 refs In FRENCH; ENGLISH summary

Avail: NTIS HC A17/MF A01

A large half-model, duplicating the structural characteristics of a typical civil transport aircraft, was developed to study the unsteady response of active flaperons in the ONERA/S1 Modane Sonic Tunnel. The buffeting envelope results at large angles of attack or large Mach numbers were analyzed and the structural response to the buffeting phenomena was damped by introducing unsteady aerodynamic forces generated by the active flaperons Thus a multicontrol system, operating on the various eigen modes of the wing structure was applied Significant reduction of the consequences of this buffeting, both structural strain (fatigue) and airframe motion (comfort), were obtained, which could be translated into an effective widening of the usable flight envelope. Author

N85-27905# National Aerospace Lab., Amsterdam (Netherlands).

HOW TO HANDLE FAILURES IN ADVANCED FLIGHT CONTROL SYSTEMS OF FUTURE TRANSPORT AIRCRAFT

M. F G. VANGOOL In AGARD Active Control Systems: Rev., Evaluation and Projections 11 p Mar 1985 refs

Avail: NTIS HC A17/MF A01

Indications exist that future transport aircraft will be designed according to active control technology concepts, using fly-by-wire flight control systems. Some philosophical considerations on the treatment of failures in these advanced flight control systems are given both from the industry and from the certification authorities point of view. It is concluded that early cooperation of parties involved is of utmost importance. Some results of an exploratory simulator investigation directed at the pilot appreciation of degradation in the aircraft handling qualities after failures in the primary flight control system are included. One of the problems encountered was large variability of the pilot ratings. The existing handling qualities criteria can be shown to have difficulty in explaining the pilot rating trend Author

Avions Marcel Dassault-Breguet Aviation, N85-27906# Saint-Cloud (France). Div. des Etudes Avancees.

THE INTERACTIVE GENERATION OF SPECIFICATIONS FOR AN ONBOARD SOFTWARE SERIES (GISELE) [GENERATION INTERACTIVE DE SPECIFICATIONS D'ENSEMBLE LOGICIEL EMBARQUE (GISELE)]

J. CHOPLIN and D. BEURRIER In AGARD Active Control Systems: Rev., Evaluation and Projections 11 p Mar 1985 refs In FRENCH

Avail: NTIS HC A17/MF A01

GISELE is a software tool designed to be used for establishing software specifications for onboard systems which require a very high level of security. This interactive tool permits the design and editing of specifications in an appropriate language as well as the design of a very complete group of tests under the specifications. In addition, GISELE provides an aid to management and modification of specifications, and contributes a method for the

08 AIRCRAFT STABILITY AND CONTROL

means for the design and preparation of tests of the software constructed from these specifications. Transl. by A.R.H.

N85-27907# Societe Nationale Industrielle Aerospatiale, Toulouse (France).

CERTIFYING COMPLEX DIGITAL SYSTEMS ON CIVIL AVIATION AIRCRAFT [CERTIFICATION DES SYSTEMES DIGITAUX COMPLEXES A BORD D'AVIONS CIVILS]

In AGARD Active Control Systems: P. TOULOUSE Rev, Evaluation and Projections 12 p Mar. 1985 In FRENCH Avail: NTIS HC A17/MF A01

The certification of equipment using digital techniques creates a delay with regards to demonstrating the security level because the software which controls these systems is subject to a new category of definition errors which are not present in analog systems. The demonstration of an acceptable level of security is applied in a qualitative manner considering together a total analysis equipment faults, a process of verifying the software in relation to the criticality of the function provided by the equipment using the software, and, if necessary, by architectural precautions which provide freedom from the consequences of eventual latent software errors or of not easily predicted failure modes of equipment This effort should be reflected in documentation acknowledged as acceptable by all parties to the certification. Transl by A R H.

N85-27908# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

THE FLIGHT CONTROL SYSTEM FOR THE EXPERIMENTAL **AIRCRAFT PROGRAMME (EAP) DEMONSTRATION AIRCRAFT** H. J. KAUL, F. SELLA (Aeritalia, Turin), and M J. WALKER (British Aerospace P L.C., Preston, England) In AGARD Active Control Systems: Rev., Evaluation and Projections 16 p Mar. 1985 refs

Avail: NTIS HC A17/MF A01

The EAP is designed to be a highly maneuverable combat aircraft with a primary role of air superiority and a secondary role of ground attack. The performance capability is optimized by making the aircraft both longitudinally and directionally aerodynamically unstable in parts of the flight envelope. This requires artificial stabilization which is provided by the flight control system (FCS). The control laws also include control of angle of attack to prevent departure and spin, and features to safeguard the structure, to give a carefree maneuvering capability The FCS is a full time fly by wire system based upon quadruplex digital computing and duo-duplex primary actuation, requiring no facility for reversion to back up or mechanical control. The system includes an extensive preflight test capability which checks that the system is fully operational prior to flight. It is designed to have a very high level of integrity; the design aim is to achieve a safety critical failure rate of less than 10 x 10 to the -6 power per flight hour. Author

N85-27909# Boeing Military Airplane Development, Seattle, Wash.

AUTOMATIC FLIGHT CONTROL MODES FOR THE AFTI/F-111 **MISSION ADAPTIVE WING AIRCRAFT**

M. R. EVANS, R. J. HYNES, D. C. NORMAN, and R. E. THOMASSON In AGARD Active Control Systems: Rev., Evaluation and Projections 13 p Mar. 1985

Avail: NTIS HC A17/MF A01

The advanced fighter technology integration F-111 mission adaptive wing (AFTI/F-111 MAW) is a joint Air Force and NASA Program that involves equipping an experimental F-111 aircraft with a variable camber wing and control modes that utilize the capabilities of this advanced technology wing. These new control modes are both manual and automatic modes that use variable camber to increase the performance of the aircraft. The automatic modes that have been added are: (1) maneuver camber control (MCC) - varies the camber to maximize lift/drag (L/D); (2) cruise camber control (CCC) - varies the camber to maximize horizontal velocity using an online optimization technique; (3) maneuver load control (MLC) - directly controls wing root bending moment once a threshold has been exceeded; and (4) maneuver enhancement and gust alleviation (ME/GA) - generates variable camber and

horizontal tail commands to increase the maneuver response of the aircraft to pilot inputs and reduce the gust induced normal acceleration. These modes were integrated with the existing F-111 command augmentation system in a dual digital fail safe control system configuration for flight testing. Author

N85-27910# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

THE STOL AND MANEUVER TECHNOLOGY PROGRAM INTEGRATED CONTROL SYSTEM DEVELOPMENT

D J. MOORHOUSE and D. R. SELEGAN In AGARD Active Control Systems: Rev., Evaluation and Projections 10 p Mar 1985 refs

Avail: NTIS HC A17/MF A01

A technology demonstration program was initiated to flight validate and mature near-term technologies applicable to adding STOL capability to a supersonic fighter, with a goal of also enhancing combat mission performance using the same technologies. A key technology is the development of a control system to integrate flight, propulsion, braking and steering controls. The STOL and Maneuver Technology Demonstration Program is defined with emphasis on the control system development. Many design options are available for such a system and criteria are not well defined. The expected benefits and problems of the control system development, the design options, the status of control system and flying qualities design criteria and the specific approach taken in defining program requirements are discussed. Finally, the expected contribution to future aircraft designs is examined.

Author

N85-27911# Westland Aircraft Ltd., Yeovil (England). Systems Technology.

THE EVOLUTION OF ACTIVE CONTROL TECHNOLOGY SYSTEMS FOR THE 1990'S HELICOPTER

G. C. F. WYATT In AGARD Active Control Systems. Rev., Evaluation and Projections 11 p Mar. 1985 refs Avail: NTIS HC A17/MF A01

The primary flight control system requirements for both military and civil helicopters operating in the 1990's are reviewed and a rationale for system architectures which maximize the common features of military and civil active control systems is proposed While the need for caution is recognized if system performance is not to be compromised through an unbalanced application of the methodology, substantial cost and weight savings are predicted. The particularly demanding problems of the avoidance of common mode system faults in a civil application are addressed and a solution to these problems is proposed. Author

N85-28918# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik

MISSION REQUIREMENTS AND HANDLING QUALITIES

B. L. GMELIN and H J. PAUSDER In AGARD Helicopter Aeromech. 37 p Apr. 1985 refs Avail: NTIS HC A15/MF A01

With the appearance of new missions for helicopters and with the development of a new generation of rotary-wing aircraft it has become obvious at the latest that future activities in the field of handling qualities must include the mission characteristics as well as the influences of the different subsystems implemented in the helicopter system. Therefore, mission analyses and consideration of system elements influencing mission performance are the basis for this work. The missions under consideration emphasize military missions but refer to civil missions, too. The system elements influencing mission performance include the basic helicopter, the pilot, the information system, the control system, interfaces, etc. GLC

N85-28949*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PILOTED SIMULATION OF AN ALGORITHM FOR ONBOARD CONTROL OF TIME-OPTIMAL INTERCEPT

D. B. PRICE, A. J. CALISE (Drexel Univ.), and D D. MOERDER (Information and Control Systems, Inc., Hampton, Va.) Jun. 1985 48 p refs

(NASA-TP-2445; L-15896; NAS 1.60:2445) Avail: NTIS HC A03/MF A01 CSCL 01C

A piloted simulation of algorithms for onboard computation of trajectories for time-optimal intercept of a moving target by an F-8 aircraft is described. The algorithms, use singular perturbation techniques, generate commands in the cockpit. By centering the horizontal and vertical needles, the pilot files an approximation to a time-optimal intercept trajectory Example simulations are shown and statistical data on the pilot's performance when presented with different display and computation modes are described.

E.A.K.

N85-28950# National Aerospace Lab., Tokyo (Japan). GUST LOAD ALLEVIATION OF A CANTILEVERED RECTANGULAR ELASTIC WING. WIND TUNNEL EXPERIMENT AND ANALYSIS

1984 37 p refs In JAPANESE; ENGLISH summary (NAK-TR-86; ISSN-0089-4010) Avail: NTIS HC A03/MF A01

An experimental and theoretical study on gust load alleviation (GLA) of a cantilevered rectangular elastic wing with an active aileron was described. The beneficial effects predicted by the theoretical analysis were verified in a low subsonic wind tunnel. The root mean square value of the wing motion to random gust decreased by 45-50% when the GLA system was turned on The aileron was actuated according to the first order control law. The law used was obtained by modifying an optimal control law of seventh order which was originally formulated with the aid of an LQG approach. In the mathematical wing model, only the first bending mode and aileron motions were taken into account because the frequencies of the second and higher modes of the wing were much higher than the frequency spectrum contained in the gust generated. The unsteady aerodynamic prediction incorporated in the GLA system was corrected by test data for steady flow so that the response due to the alleron motion was estimated with good accuracy. F.A.K.

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities, and engine test blocks.

A85-37491#

EUROPEAN TRANSONIC WIND TUNNEL

W. SCHMIDT Dornier Post (English Edition) (ISSN 0012-5563), no. 1, 1985, p. 40-42.

In virtue of energy-related cost reduction criteria, a low temperature gas flow concept has been chosen for the design development of the projected European transonic wind tunnel (ETW) facility. An attempt is presently made to ascertain whether, in wind tunnels using nitrogen that has been cooled close to ite liquefaction point, flow simulation distortions could be generated by the influence of real gas effects, local condensation, and heat transfer problems. Attention is accordingly given to ETW aircraft models' material property requirements and requisite degree of geometric accuracy, as well as the tunnel's diffuser throat design. O.C.

A85-37622#

MEASUREMENT OF WING-LEADING-EDGE HEATING RATES ON WIND TUNNEL MODELS USING THE THIN-FILM TECHNIQUE

G D. WANNENWETSCH, L. A. TICATCH, C. T. KIDD, and R. L. ARTERBURY (Calspan Corp., Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985 12 p. USAF-sponsored research.

(AIAA PAPER 85-0972)

A test program was performed at AEDC in Hypersonic Wind Tunnel B (Mach 8) to demonstrate the feasibility of measuring wing-leading-edge heating in a continuous-flow facility with thin-film resistance thermometers applied to a glass-ceramic substrate This program was designed to demonstrate (1) the feasibility of fabricating the thin-film/glass-ceramic combination, (2) the survivability of the thin films, and (3) the accuracy of the heating measurements made with the thin-film/glass-ceramic devices. Following the demonstration test phase, an improved design for construction of an instrumented leading edge was developed. Details of the fabrication, calibration, and testing of the thin-film devices are discussed in this paper.

A85-37644#

DEVELOPMENTS IN AEROTHERMAL TEST TECHNIQUES AT THE AEDC SUPERSONIC-HYPERSONIC WIND TUNNELS

R. K. MATTHEWS, K. W. NUTT, G. D. WANNENWETSCH, C. T. KIDD (Calspan Corp., Arnold Air Force Station, TN), and A. H. BOUDREAU (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 10 p. refs

(AIAA PAPER 85-1003)

A description of the aerothermodynamic test techniques and instrumentation available for use in the Arnold Engineering Development Center supersonic-hypersonic wind tunnels is presented. The techniques include the measurement of convective heating on model leading edges, continuous sweep heat-transfer measurements, Schmidt-Boelter heat-transfer gages, measurements on roughened surfaces, online infrared analysis, and material sample testing in transient environments. Consideration is given to the application and limitations of each technique. It is shown that a precisely defined test objective coupled with comprehensive pretest planning are essential for a successful test program. M.D.

A85-37949

KOREA'S AIR TRANSPORT - PLANNED EXPANSION

Airport Forum (ISSN 0002-2802), vol 14, April 1985, p. 61, 63, 65-67, 69, 71.

The current status and planned expansion of the airport system in the Republic of Korea (ROK) are surveyed and illustrated with photographs, maps, and drawings. The growth of the ROK economy is described; the role of the Korea International Airports Authority in administering the three largest airports (Seoul-Kimpo, Pusan-Kimhae, and Cheju) is indicated, and the new international terminal and parallel runway under construction at Kimpo to accommodate the increased traffic expected for the 1986 Asian and 1988 Olympic Games are characterized. Consideration is given to the KE maintenance facilities at Kimhae, plans for a new major airport at Cheongju by 1992, the six local airports, the centralized control exercised by the Hanjin Group, and the efforts of the ROK to obtain reciprocal air-transport agreements with neighboring states such as China. T.K.

A85-38962#

AN INTEGRAL METHOD OF WALL INTERFERENCE CORRECTION FOR LOW SPEED WIND TUNNEL

C. ZHOU (Shenyang Aeronautics and Aerodynamics Research Institute, Shenyang, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 1-9. In Chinese, with abstract in English.

The analytical solution of Poisson's equation, derived from the definition of vortex, has been applied to the calculations of interference velocities due to the presence of wind tunnel walls. This approach, called the Integral Method, allows an accurate evaluation of wall interference for separated or more complicated flows without the need for considering any features of the model. All the information necessary for obtaining the wall correction is not sensitive to normal data-scatter, and the computations are fast enough for on-line data processing.

A85-38968#

INVESTIGATION ON REDUCING THE FLOW NOISE OF THE 0.6 M X 0.6 M TRISONIC WIND TUNNEL

Q. YUN (China Aerodynamic Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 51-60. In Chinese, with abstract in English. refs

The 0.6 m x 0.6 m trisonic wind tunnel (FL-23) is of an intermittent blow-down type. The flow noise produced by the pressure regulating valve was very high. A significant reduction of the tunnel's flow noise has been achieved and the noise level is now among the lowest both at home and abroad, after the noise-reducing device set between the pressure regulating valve and the settling chamber was added. This paper describes the noise-reducing device and shows the flow noise characteristics before and after it was set. The flow noise characteristics are also compared with those of wind tunnels at home and abroad

Author

A85-38975#

A NEW TECHNIQUE TO BREAK DIAPHRAGMS ELECTRICALLY IN A DOUBLE-TUBE SHORT DURATION JET SIMULATION FACILITY

Y. WANG (China Aerodynamic Research and Development Center, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 97-100. In Chinese, with abstract in English.

A new technique to break a diaphragm electrically in a double-tube short-duration jet simulation facility is presented in this paper. This facility is used to simulate the jet of an oxyhydrogen engine and obtain plume data at higher altitude. The diaphragm is combined, i.e., a crossed electric fuse is held between two layers (polyester film). The test result showed that this technique is available and much better than the general technique. It can meet the requirements (rapid rupture of the diaphragms and synchronization of the rupture) and has the unique advantages: it may be used high pressure pure oxygen and hydrogen condition, avoiding the combustion and explosion, and a good-looking and repeatable petal of the diaphragm may be obtained. The present technique is suitable for other facilities, too.

A85-39243#

FROM MEASUREMENT UNCERTAINTY TO MEASUREMENT COMMUNICATIONS, CREDIBILITY, AND COST CONTROL IN PROPULSION GROUND TEST FACILITIES

R E SMITH, JR. and S. WEHOFER (Sverdrup Technology, Inc., Aeropropulsion Program Dept., Arnold Air Force Station, TN) ASME, Transactions, Journal of Fluids Engineering (ISSN 0098-2202), vol. 107, June 1985, p. 165-172. refs

An overview of an engine test facility measurement evaluation program is given, and the utilization of the measurement uncertainty results are discussed. The engine thrust measurement process is described, starting with the definition of measurement uncertainty. Procedures for identifying and quantifying measurement error sources are discussed, including a brief description of a propulsion test cell and engine thrust measurement system. The measurement validation process, which uses unlinked measurement self-consistency checks to preclude gross error omissions, is discussed. Results and findings which evolve from the measurement uncertainty assessment are reviewed, and the principal organizational requirements for implementing a measurement uncertainty evaluation program are addressed.

C.D

A85-39274

EFFICIENCIES OF MULTIPLE-INPUT TECHNIQUES FOR AIRCRAFT GROUND VIBRATION TESTING

D L. HUNT (SDRC, Inc., Milford, OH), S. R. HURLEY, and I. B. SACHS (Lockheed-California Co., Burbank, CA) IN: Structural dynamics testing and analysis; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 . Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 9-16. refs

(SAE PAPER 841575)

The recent advances in multiple-input techniques for experimental modal analysis have given the test engineer alternatives for performing aircraft ground vibration tests (GVT). Multiple-input random excitation and polyreference analysis are two of the methods that are being used instead of the traditional sine dwell approach. The efficiency and advantages of these new methods are examined and examples of this application to recent aircraft GVT's are described. Author

A85-39706#

THE DEVELOPMENT OF A HARDWARE-IN-THE-LOOP ENGINE SIMULATION FACILITY

S. W. K. CHAN and J. R. DAVIDSON (Douglas Aircraft Co, Long Beach, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. (AIAA PAPER 85-1293)

A generic hardware-in-the-loop engine simulation facility which is developed, based on a set of design specifications resulting from an independent research and development effort, in anticipation of rapid advances in the area of digital electronic engine controls and the need to study and verify the interaction between the airplane and engine, is described. The facility has a microprocessor-based programmable interface between the digital electronic engine control and computer simulation, which can generate and accept the analog and digital signals required by the engine control, as well as control a pneumatic system that provides simulated engine and environmental pressure inputs to the engine control. It is shown that the facility provides the airframer the capability to study engine management techniques, system integration, and verification/validation methodologies. M.D.

A85-39773#

HIGH SPEED COMPRESSOR RIG AS A STALL RECOVERY RESEARCH TOOL

C. J. SMALL and J. T. LEWIS (Unitet Technonlogies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Montérey, CA, July 8-10, 1985. 11 p.

(Contract F33615-79-C-2087)

(AIAA PAPER 85-1428)

An experimental investigation of post-stall phenomena exhibited by high speed axial flow compressors is presented. The test vehicle selected for this experimentation is a three-stage compressor rig which is representative of highly loaded, state of the art, military high pressure compressors. The rig and dedicated test facility were specifically designed for efficient parametric post-stall testing and provided data not available from any other source. Unconventional test procedures were implemented to control compressor boundary conditions and acquire detailed post-stall compressor data isolated from the unavoidable system effects encountered during engine testing. Data obtained have provided invaluable fundamental knowledge for the formulation of steady-state and dynamic post-stall compressor models. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

N85-27912 Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.

ADAPTIVE WALL WIND TUNNELS AND WALL INTERFERENCE CORRECTION METHODS

H HORNUNG, ed. and E. STANEWSKY, ed. 1984 42 p refs Presented at European Mech. Colloq. No. 187, Goettingen, West Germany, 15-17 Oct. 1984

(DFVLR-IB-222-84-A-37) Avail Issuing Activity

Wind tunnel tests involving adaptive wind tunnel walls, partially open wind tunnel walls, and side wall interference were discussed. Transonic, cryogenic, and supersonic wind tunnels were described. Author (ESA)

N85-27913 Duits-Nederlandse Windtunnel, Noordoostpolder (Netherlands).

CONSTRUCTION 1976-1980: DESIGN, MANUFACTURING, CALIBRATION OF THE GERMAN-DUTCH WIND TUNNEL (DNW)

M SEIDEL, ed. 1982 137 p refs Original contains color illustrations

Avail: Issuing Activity

A low speed wind tunnel was built. It has 3 closed, interchangeable test sections with cross sectional sizes of 9.5 m x 9.5 m, 8 m x 6 m and 6 m x 6 m with maximum continuous wind speeds of at least 55, 100 and 130 m/sec respectively in the presence of a typical model, an open test section for aeroacoustic measurements (8 m x 6 m, 80 m/sec); and an air exchange system for the rapid removal of hot or contaminated gases, e.g., during tests with engine simulators or full scale engines. It has a continuous drive power of 11.5 MW plus 10% design margin to cover prediction risks. Intermittent use of overload capacity was anticipated to provide short duration maximum speeds up to 62 and 145 m/sec for the 9.5 m x 9.5 m and the 6 m x 6 m respectively. In empty test sections, relative deviation of static and dynamic pressure across the center section is + or - 0.3%, local deviation of flow direction: + or - 0.1 deg; local temperature deviation = + or \cdot 0.5 C; turbulence: 0 1 to 0 2%. Author (ESA)

N85-27914*# National Aeronautics and Space Administration, Washington, D. C.

TEST DEVICES FOR AERONAUTICAL RESEARCH AND TECHNOLOGY

Apr. 1985 65 p Transl. into ENGLISH from "Versuchsanlagen fuer Luftfahrtforschung und Luftfahrttechnologie" Cologne, Dec. 1981 p A2-1-A2-11, B1.1-1-B1.1-3, B2.1-1-B2.1-2, B4.1-1-B4.1-10, B4.2-1-B4.2-5, and B4.3-1-B4 3-3 Transl. by The Corporate Word, Inc., Pittsburgh Original document prepared by DFVLR, Cologne (Contract NASW-4006)

(NASA-TM-77651; NAS 1 15:77651) Avail: NTIS HC A04/MF A01 CSCL 14B

The objectives of the DFVLR in six areas are described: (1) transportation and communication systems; (2) aircraft, space technology, (4) remote sensing, (5) energy and propulsion technology; and (6) research and development A detailed description of testing devices and other facilities required to carry out the research program is given Author

N85-27915*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECT OF SUPERCONDUCTING SOLENOID MODEL CORES ON SPANWISE IRON MAGNET ROLL CONTROL

C. P. BRITCHER Jun 1985 25 p refs

(Contract NSG-7523)

(NASA-TM-86378; L-15924; NAS 1.15:86378) Avail: NTIS HC A02/MF A01 CSCL 14B

Compared with conventional ferromagnetic fuselage cores, superconducting solenoid cores appear to offer significant reductions in the projected cost of a large wind tunnel magnetic suspension and balance system. The provision of sufficient magnetic roll torque capability has been a long-standing problem with all magnetic suspension and balance systems; and the spanwise iron magnet scheme appears to be the most powerful system available. This scheme utilizes iron cores which are installed in the wings of the model. It was anticipated that the magnetization of these cores, and hence the roll torque generated, would be affected by the powerful external magnetic field of the superconducting solenoid. A preliminary study has been made of the effect of the superconducting solenoid fuselage model core concept on the spanwise iron magnet roll torque generation schemes. Computed data for one representative configuration indicate that reductions in available roll torque occur over a range of applied magnetic field levels. These results indicate that a 30-percent increase in roll electromagnet capacity over that previously determined will be required for a representative 8-foot wind tunnel magnetic suspension and balance system design.

Author

N85-27916*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

BACKGROUND NOISE MEASUREMENTS FROM JET EXIT VANES DESIGNED TO REDUCED FLOW PULSATIONS IN AN OPEN-JET WIND TUNNEL

D. R. HOAD (Army Research and Technology Labs., Hampton, Va.) and R M. MARTIN Jun. 1985 48 p $\,$ refs

(Contract DA PROJ. 1L1-63309-AH-76)

(NASA-TM-86383; L-15923; NAS 1.15:86383;

AVSCOM-TM-85-B-1) Avail: NTIS HC A03/MF A01 CSCL 14B

Many open jet wind tunnels experience pulsations of the flow which are typically characterized by periodic low frequency velocity and pressure variations One method of reducing these fluctuations is to install vanes around the perimeter of the jet exit to protrude into the flow. Although these vanes were shown to be effective in reducing the fluctuation content, they can also increase the test section background noise level. The results of an experimental acoustic program in the Langley 4- by 7-Meter Tunnel is presented which evaluates the effect on tunnel background noise of such modifications to the jet exit nozzle. Noise levels for the baseline tunnel configuration are compared with those for three jet exit nozzle modifications, including an enhanced noise reduction configuration that minimizes the effect of the vanes on the background noise. Although the noise levels for this modified vane configuration were comparable to baseline tunnel background noise levels in this facility, installation of these modified vanes in an acoustic tunnel may be of concern because the noise levels for the vanes could be well above background noise levels in a quiet facility. Author

N85-27917# Mitre Corp., McLean, Va. Metrek Div. AIRPORT AND AIRWAY SYSTEM COST ALLOCATION MODEL. VOLUME 7: USER'S MANUAL

J C. SCALEA Sep. 1977 66 p

(Contract DOT-FA69NS-162)

(AD-A152877; MTR-7610-VÓL-7) Avail. NTIS HC A04/MF A01 CSCL 01E

This volume constitutes the user's manual for the computer program written to automate the calculations involved in the allocation of costs to the various airport and airway system users. It includes a very brief summary of the allocation methodology which is developed in detail in previous volumes. The program itself is interactive in nature and this manual contains a summary of the commands and input data formats required by the user for successful program execution. A sample terminal session is included as well as a program listing and a sample of the output. GRA N85-27920# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abt. Elastomechanik und Aeroelastische Stabilitaet.

THE GUST SIMULATION APPARATUS OF THE 3M X 3M LOW SPEED WIND TUNNEL OF THE DFVLR IN GOETTINGEN, WEST GERMANY

R. FREYMANN Jun. 1984 38 p refs In GERMAN; ENGLISH summary

(DFVLR-FB-85-04; ISSN-0171-1342) Avail NTIS HC A03/MF A01; DFVLR, Cologne DM 14.50

A gust simulation apparatus was fitted into a 3m x 3m low speed wind tunnel to increase the range of test possibilities. The design of the gust generating system and of the test method used for determination of the gust flow behind the gust generator is described. Graphical representations of experimentally determined gust flow distributions in the wind tunnel measuring section are shown. Author (ESA)

N85-27921# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Prozessortechnik

DATA PROCESSING ON THE ROTOR TEST STAND AT DFVLR IN BRUNSWICK: MICROPROGRAMMABLE INTERFACES AND ARRAY PROCESSOR AS KEY COMPONENTS IN A PDP 11 REAL TIME DATA ACQUISITION AND PROCESSING SYSTEM R. SEIFERT Jan. 1985 116 p refs in GERMAN; ENGLISH summary

(DFVLR-MITT-85-03; ISSN-0176-7739) Avail NTIS HC A06/MF A01; DFVLR, Cologne DM 40 50

The construction and operation of data acquisition and processing systems on rotor test stands for studies of higher harmonic control of helicopter rotors in wind tunnels is discussed. The processing system consists of 3 MININET-coupled PDP 11 computers supported by microprogrammable PCM interfaces and by an array processor. The implementation of these components under the RSX 11 M operating system for the treatment of real time requirements, the structure of the software system, and the associated programming and testing aids are presented.

Author (ESA)

N85-28919# Messerschmitt-Boelkow-Blohm G.m.b.H, Munich (West Germany).

THE ROLE OF SIMULATION

H. HUBER and P. KRAUSPE In AGARD Helicopter Aeromech. 35 p Apr. 1985 refs

Avail: NTIS HC A15/MF A01

The development of helicopter flight simulation has undoubtedly made considerable progress in the past decade. Due to the helicopter specific flight regime, which is essentially characterized by low altitude flying (NOE), low to moderate speeds, and distinct stability and control behavior, the simulation of rotorcraft sets high standards to the simulation quality. An overview about the various simulation techniques and their specific application during research and development work is presented. First, the details and capabilities of the round-based simulation are discussed. Stringent requirements for real-time simulation result in the use of comprehensive math models, representing the aerodynamic and dynamic complexities of rotary-wing aircraft. In addition, great effort has to be made to simulate the environmental scenario, such as visual and motional cues. Advances are especially made on the field of generating and displaying visual imagery. The technique of computer generated images (CGI) and the progress achieved, e g., in the field-of-view and resolution, is demonstrated. G.L.C.

N85-28952# National Aerospace Lab., Tokyo (Japan). FLOW QUALITY OF NATIONAL AEROSPACE LABORATORY TWO-DIMENSIONAL TRANSONIC WIND TUNNEL. PART 3: FLOW TURBULENCE LEVEL AND MEASURING METHOD Y. O. M. SATO, H. KANDA, S. SAKAKIBARA, H. MIWA, and S.

BABA 1984 29 p refs In JAPANESE; ENGLISH summary (NAL-TR-842-PT-3; ISSN-0389-4010) Avail: NTIS HC A03/MF A01_

The flow turbulence level of the NAL two dimensional transonic wind tunnel was measured with a constant temperature hot wire anemometer using a hot film probe. The fluctuation of the mass flow is within a range of 0.3%-0.45% with Mach numbers of 0.2 to 0.8 and unit Reynolds numbers of 1.8×10 to the 5th to 5.5 x 10 to the 5th (1/cm). The fluctuation of the total temperature was one seventh to one tenth of the mass flow fluctuation. A plain sound wave was assumed, and the noise data was measured simultaneously with the turbulence and compared with this turbulence. An attempt was made to separate the velocity fluctuation and the density fluctuation in the mass flow. The future development of this complex method is discussed.

N85-28953# National Aerospace Lab., Tokyo (Japan). ON POWER EFFECIENT OPERATION OF THE 2M X 2M TRANSONIC WIND TUNNEL AT THE NATIONAL AEROSPACE LABORATORY

M SHIRAI, S NAKAMURA, M SUZUKI, A. KOIKE, K SUZUKI, and N KAMIYA 1984 25 p refs in JAPANESE; ENGLISH summary

(NAL-TR-847; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

In the conventional test procedure using the 2m x 2m transonic wind tunnel, an auxiliary power unit is operated synergistically for Mach numbers near and above unity to establish the desired Mach number at the test section by suction through the perforated test section walls. The extent to which the test Mach number can be increased without the use of the auxiliary power unit was investigated. It is found that a Mach number of 1.06 is attained by adequately adjusting several geometric parameters such as diverging angle of the side walls of the test section, opening width of the diffuser flaps, width of the second throat and the flexible nozzle setting. Electric power of 7800kW can be served at Mach number 1 by using this procedure compared with the conventional procedure in which an auxiliary fan is used Mach number distributions at the test section are found to be little influenced by these adjustments E.A.K.

N85-28954# Center for Naval Analyses, Alexandria, Va. Naval Planning Manpower and Logistics Div.

THE USE OF FLIGHT SIMULATORS IN MEASURING AND IMPROVING TRAINING EFFECTIVENESS

A. J. MARCUS and L. E. CURRAN Jan. 1985 25 p

(Contract N00014-83-C-0725)

(AD-A153817; CNA-PP-432) Avail. NTIS HC A02/MF A01 CSCL 051

This paper studies the value of the aircraft simulators as measures of training readiness. Simulator evaluations are analyzed for reserves enlisted crewmen on Navy patrol aircraft. Part-time reservists are found to have very little skill loss over time and perform as well as their full-time counterparts. Experience in the simulator produces substantial increases in subsequent flights appear to be useful measures of readiness and valuable training expenience. GRA N85-28955# Rijksluchtvaartdienst, The Hague (Netherlands). OWEMA REPORT: A PROJECT STUDY CONCERNING THE POSSIBILITIES AND THE DESIRABILITY OF A EAST-WEST RUNWAY FOR MAASTRICHT AIRPORT (NETHERLANDS) AS EURO-REGIONAL AIR FREIGHT CENTER [OWEMA-RAPPORT: EEN PROJECTSTUDIE OMTRENT DE MOGELIJKHEDEN EN DE WENSELIJKHEID VAN EEN VOOR MAASTRICHT OOST-WESTBAN AIRPORT ALS EUREGIONAAL VRACHTCENTRUM]

Mar. 1984 157 p refs In DUTCH

(B8476490: ISBN-90-346-02478) Avail: NTIS HC A08/MF A01

A planned runway for an airport in the southeast Netherlands is discussed. Transportation developments, the financial and exploitation possibilities, as well as the regional and environmental consequences are considered. The project is supported

Author (ESA)

10

ASTRONAUTICS

Includes astronautics (general), astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking, spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A85-37599#

PITOT PRESSURE AND HEAT TRANSFER MEASUREMENTS IN HYDRAZINE THRUSTER PLUMES

H. LEGGE and G. DETTLEFF (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer experimentelle Stroemungsmechanik, Goettingen, West Germany) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985 9 p. Sponsorship: European Space Research and Technology Centre. refs

(Contract ESTEC-5194/82/NL/PB) (AIAA PAPER 85-0934)

The results of heat-transfer and Pitot pressure measurements obtained in the plumes from MBB/ERNO 0.5, 2, and 5-N hydrazine-monopropellant thruster nozzles during standard pulsed and steady-state performance tests are reported and compared with the predictions of theoretical models, summarizing the reports of Legge and Dettleff (1984) and Dettleff and Legge (1985). The data are presented in graphs and shown to be in good general agreement with the freezing-surface models proposed by Legge and Boettcher (1982). Shock disturbances are detected in the near-plume flow fields of the contoured (2-N and 5-N) nozzles, with stagnation temperatures 900-1350 K, molecular weights 11-14.5, and mean effective specific-heat ratio kappa = 1.4 + or- 0.03 in the region of expansion from the stagnation chamber to the continuum plume flow. T.K

A85-38545#

INTEGRATION OF THE B-52G OFFENSIVE AVIONICS SYSTEM (OAS) WITH THE GLOBAL POSITIONING SYSTEM (GPS)

A. L. FOOTE (Logicon, Inc., Dayton, OH) and S. C. PLUNTZE (USAF, Space Div., Los Angeles, CA) IN. Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 201-209.

Integration of the B-52G OAS with the GPS has been accomplished by modification of existing OAS software. GPS derived position and velocity data are used to enhance the quality of the OAS inertial and dead reckoning navigation systems. The engineering design and the software development process used to implement this design are presented Author

A85-38546*#

SIMULATION AND ANALYSIS OF DIFFERENTIAL GPS

R. P. DENARO (TAU Corp., Los Gatos, CA) IN Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 225-234. NASA-sponsored research. refs

NASA is conducting a research program to evaluate differential Global Positioning System (GPS) concepts for civil helicopter navigation. It is pointed out that the civil helicopter community will probably be an early user of GPS because of the unique mission operations in areas where precise navigation aids are not available. However, many of these applications involve accuracy requirements which cannot be satisfied by conventional GPS. Such applications include remote area search and rescue, offshore oil platform approach, remote area precision landing, and other precise navigation operations. Differential GPS provides a promising approach for meeting very demanding accuracy requirements. The considered procedure eliminates some of the common bias errors experienced by conventional GPS. This is done by making use of a second GPS receiver A simulation process is developed as a tool for analyzing various scenarios of GPS-referenced civil aircraft navigation. G.R.

A85-38608

DEVELOPMENT AND TESTING OF THE RPS-1000 PARACHUTE SYSTEM FOR THE MMR-06-DART METEOROLOGICAL ROCKET SYSTEM [RAZRABOTKA I ISPYTANIIA PARASHIUTNOI SISTEMY RPS-1000 DLIA METEOROLOGICHESKOI RAKETNOI SISTEMY MMR-06-DART

M. GERNANDT, K. DRESCHER (Lindenberg, Aerologisches Observatorium, Lindenberg, East Germany), and IA. M. PSUI (Instytut Meteorologii i Gospodarki Wodnej, Warsaw, Poland) IN: Studies of the upper earth atmosphere Leningrad. Gidrometeoizdat, 1984, p. 39-47. In Russian.

The mechanical construction and technical characteristics are described for the RPS-1000 parachute system made by Polish and GDR engineers for operation in the MMR-06-DART unified meteorological rocket network. Flight test results are presented which demonstrate that the parachute system satisfies the requirement that a sonde descent velocity less than the speed of sound be provided. B.J.

A85-38610

SOLUTION OF CERTAIN TECHNICAL PROBLEMS CONNECTED WITH THE DEVELOPMENT OF THE MMR-06M METEOROLOGICAL ROCKET [RESHENIE NEKOTORYKH TEKHNICHESKIKH ZADACH, SVIAZANNYKH S RAZRABOTKOI **METEOROLOGICHESKOI RAKETY MMR-06M**]

V. N. ALIN, IU. K. VASILEV, and V I. TATARENKO (Tsentral'naia Aerologicheskaia Observatoriia, Dolgoprudny, USSR) IN: Studies of the upper earth atmosphere . Leningrad, Gidrometeoizdat, 1984, p. 50-54. In Russian. refs

The main technical solutions utilized in the development of the payload body of the MMR-06M meteorological rocket are outlined, with particular attention given to the choice of temperature and wind measurement schemes, the parachute system, and the aerodynamic design. The main technical characteristics of the rocket are described, and diagrams of the rocket and the payload body are presented. B.J.

A85-38775

THE IDEAS OF K.E. TSIOLKOVSKII AND PRESENT-DAY SCIENTIFIC PROBLEMS [IDEI K.E. TSIOLKOVSKOGO I SOVREMENNYE NAUCHNYE PROBLEMY]

B. M. KEDROV, ED. Moscow, Izdatel'stvo Nauka, 1984, 240 p. In Russian. No individual items are abstracted in this volume.

A selection of papers from the Tsiolkovskii Scientific Lectures XI-XII (1976-1977) is presented. Attention is given to Tsiolkovskii's ideas and to their development in present-day research in fields such as rocket and space technology, space-flight mechanics, space medicine and biology, aviation, and scientific prediction.

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials, and propellants and fuels.

A85-37201#

EVALUATION OF NOZZLE THROAT MATERIALS FOR RAMJET ENGINES

S. SHANI, J. BARTA, I. GREENBERG, R JOSEPH, and A. PERETZ (Rafael Armament Development Authority, Haifa, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 205-212 refs

Silica phenolic, sintered zirconia and zirconia-coated graphites were evaluated as ramjet nozzle-throat materials at simulated ramjet configuration and operation conditions. The test nozzles were mounted to a ramjet combustor, which burns JP-4/air/oxygen mixture. Appropriate fabrication processes for all throat inserts tested have been developed. The limits for acceptable throat erosion of silica phenolic inserts were determined in terms of combinations of total pressure and temperature and burning duration: 0.6 MPa, 2150 K and 100 sec, 0.3 MPa, 2500 K and 100 sec; 0.3 MPa, 2250 K and 200 sec, respectively. These results were obtained for a fabric orientation angle of 80 deg to the nozzle centerline, which provided the highest erosion resistance Throat inserts made of sintered zirconia and zirconia-coated graphite (with Mo intermediate layer) sustained successfully (no integrity damage and no erosion) total temperature of 2450 K at 0.6 MPa for 100 sec. The results of this study point out that the ceramics tested may be used successfully at nozzle throats, subjected to severe internal environment conditions, such as those encountered in high-performance ramjet engines. Author

A85-37339

THE PROBLEMS ARISING IN TESTING OF CARBON-BASED MATERIALS FOR STRUCTURAL COMPONENTS OF AIRFRAMES [PROBLEMY ISPYTANII UGLERODNYKH MATERIALOV DLIA ELEMENTOV KONSTRUKTSII LETATEL'NYKH APPARATOV]

N. A. ANFIMOV and IU. V. CHUDETSKII IN Hydroaeromechanics and space research. Moscow, Izdatel'stvo Nauka, 1985, p. 151-157. In Russian. refs

The processes associated with mass transfer of carbon-based composites in supersonic and hypersonic flows are identified, and the governing chemical reactions are described. The procedures currently used for model testing of graphite and composite specimens are reviewed, and some suggestions are made concerning the sequence of testing. It is pointed out that the approach described allows the range of enthalpies and pressures, required for testing, to be narrowed considerably. L.T.

A85-37380

REPAIR PROCEDURES FOR COMPOSITE SINEWAVE SUBSTRUCTURE

J. D. LABOR (Northrop Corp., Hawthorne, CA) IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 119-128.

Repair procedures are described for substructure fabricated with integrally-formed caps and sinewave webs made of graphite/epoxy matenal. Both a mechanically-attached metal repair and a bonded composite repair were developed, installed on full-size elements, and tested to demonstrate acceptable strength. Author

A85-37381

IMPROVED RESINS FOR WET LAYUP REPAIR OF ADVANCED COMPOSITE STRUCTURE

J. R. SCOTT and C. K. MASHIBA (Boeing Co., Materials Technology Group, Seattle, WA) IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 129-135.

Increased usage of advanced composites on 767 and 757 Boeing aircraft has necessitated development of more cost-effective repair techniques for field-based repairs. Airlines have recognized the advantages of low temperature curing wet layup repair techniques, but Boeing did not authorize its use for structural repairs due to insufficient strength of typical resins in hot, wet environments. By surveying the resin manufacturers and extensively testing a wide range of resins, Boeing was able to recommend the use of two resins for interim and permanent repair of Kevlar and graphite composite structure. One resin is curable at room temperature to 1500 F, and the other curable at 200 F to 350 F. Implementation of these resins for composite repair has resulted in a significant reduction in material and processing costs, as well as aircraft downtime This paper will describe the development program conducted and review evaluation procedures and test results. It will describe changes made to the Boeing Structural Repair Manuals (SRM's) resulting from this study. Author

A85-37407

AN OVERVIEW OF STRUCTURAL REPAIR ADHESIVES

S. QUICK (Dexter Corp., Hysol Div., Pittsburg, CA) IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 671-685.

Attention is given to aircraft metallic structure and composite structure repair methods employing ambient and/or low curing temperature paste adhesive systems. Paste adhesives are considered in light of the sophistication of repair facility equipment and personnel, the service temperature of the area to be repaired, and desired adhesive physical characteristics. The adhesive systems in current use are low viscosity liquid epoxies and aromatic amines. O.C.

A85-37415*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE SUBSTITUTION OF NICKEL FOR COBALT IN HOT ISOSTATICALLY PRESSED POWDER METALLURGY UDIMET 700 ALLOYS

F. H. HARF (NASA, Lewis Research Center, Cleveland, OH) Metallurgical Transactions A - Physical Metallurgy and Matenals Science (ISSN 0360-2133), vol. 16A, June 1985, p. 993-1003. refs

Nickel was substituted in various proportions for cobalt in a series of five hot-isostatically-pressed powder metallurgy alloys based on the UDIMET 700 composition. These alloys were given 5-step heat treatments appropriate for use in turbine engine disks. The resultant microstructures displayed three distinct sizes of gamma-prime particles in a gamma matrix. The higher cobalt-content alloys contained larger amounts of the finest gamma-prime particles, and had the lowest gamma-gamma-prime lattice mismatch. While all alloys had approximately the same tensile properties at 25 and 650 gamma C, the rupture lives at 650 and 760 C peaked in the alloys with cobalt contents between 12.7 and 4.3 pct. Minimum creep rates increased as cobalt contents were lowered, suggesting their correlation with the gamma-prime particle size distribution and the gamma-gamma-prime mismatch. It was also found that, on overaging at temperatures higher than suitable for turbine disk use, the high cobalt-content alloys were prone to sigma phase formation. Author

A85-37484* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. FIBERS FOR STRUCTURALLY RELIABLE METAL AND

FIBERS FOR STRUCTURALLY RELIABLE METAL AND CERAMIC COMPOSITES

J. A DICARLO (NASA, Lewis Research Center, Ceramics Systems Branch, Cleveland, OH) Journal of Metals (ISSN 0148-6608), vol. 37, June 1985, p. 44-49. refs In their current state of development, commercially available

In their current state of development, commercially available reinforcing fibers fail to meet the requirements formulated for metal or ceramic matrix composites of sufficient strength and toughness. Attention is presently given to criteria for high strength and toughness in metal and ceramic matrix composites, as well as the approach adopted in fiber evaluation as a result of studies at the NASA Lewis Research Center. Two areas of special interest have been strength improvement in large diameter boron fibers for tough, impact-resistant boron/aluminum composites, and the evaluation of SiC fibers as reinforcement in tough ceramic-matrix composites with service temperatures of the order of 1400 C.

O.C.

A85-37495

A METHOD FOR THE EVALUATION OF THE BOUNDARY LUBRICATING PROPERTIES OF AVIATION TURBINE FUELS

J. W HADLEY (Shell Research, Ltd., Thornton Research Centre, Chester, England) Wear (ISSN 0043-1648), vol. 101, Feb. 1, 1985, p. 219-253. Research supported by the Ministry of Defense of England. refs

In the late 1960s and early 1970s, a lubrication-related malfunction of aviation fuel systems was observed. Thus, it was found, for instance, that some types of aircraft axial piston pumps occasionally suffered premature lubricity failures when operated on particular Jet A-1 fuels The problems were allegedly related to the poor boundary lubricating properties of some fuels then in use. For an investigation and solution of these problems, a suitable test method for evaluating aviation fuel lubricity was needed. Available mechanical lubricity test methods were found to be unsuited for the particular problems involved, and a new test procedure had to be developed. The basis for this development was provided by the Amsler machine which was found to give promising results. However, further improvements were found to be necessary to give satisfactory performance over a wide range of fuels. The various stages of the development are discussed. G.R.

A85-38748

LOW TEMPERATURE CREEP AND FRACTURE OF NEAR ALPHA TITANIUM ALLOYS

W J EVANS (Royal Aircraft Establishment, Farnborough, Hants., England) IN: Creep and fracture of engineering materials and structures; Proceedings of the Second International Conference, Swansea, Wales, April 1-6, 1984 Part 1. Swansea, Wales, Pineridge Press, 1984, p 395-406. refs

Creep at low temperatures has been recognized for some considerable time. In general, however, other than the nuisance value it posed for component tolerancing it was considered to be unimportant. The introduction of the near alpha titanium alloys changed this belief since it was found that under certain conditions low temperature creep could lead to the premature failure of components. The paper uses creep and dwell data obtained on the titanium alloy IMI685 to illustrate how microstructure and stress affect deformation and failure behavior at room temperature. On this basis, a general purpose model of the phenomenon is constructed and related to available data on the near alpha alloy IMI829. Finally, a Weibull analysis of the data is used to account for the behavior of a model component, thereby removing uncertainties about the inservice integrity of these materials

A85-38749

THE INFLUENCE OF MICROSTRUCTURE ON THE TEMPERATURE-DEPENDENT FLOW PROPERTIES OF TI-6AL-4V

C. G. SHELTON (Cambridge University, Cambridge, England) and B. RALPH (Cardiff, University College, Cardiff, Wales) IN: Creep and fracture of engineering materials and structures; Proceedings of the Second International Conference, Swansea, Wales, April 1-6, 1984. Part 1 . Swansea, Wales, Pineridge Press, 1984, p. 407-418. Research supported by Inco, Ltd. and Science and Engineering Research Council. refs

Two different microstructures in a commercial Ti-6AI-4V alloy have been generated by forging at two temperatures, 1073 and 1243 K. Subtle differences in the phase populations and the initial dislocation substructure have been detected by microscopy. The mechanical properties over a wide range of temperature (293-973 K) and strain rate (0.0003/s-28/s) have been measured and the microstructures again investigated. Author

A85-38874

DISSIPATIVE PROPERTIES OF INHOMOGENEOUS MATERIALS AND SYSTEMS [DISSIPATIVNYE SVOISTVA NEODNORODNYKH MATERIALOV I SISTEM]

A P. IAKOVLEV Kiev, Izdatel'stvo Naukova Dumka, 1985, 248 p. In Russian. refs

Results of experimental studies of the dissipative properties of laminates, fiber composites, and materials with local inclusions are reviewed. Particular attention is given to the effect of component characteristics and service-related factors (e.g., the type and volume fraction of components, the shape and size of inclusions, the cyclic deformation amplitude, and temperature) on the dissipative properties of inhomogeneous materials, such as nodular cast iron Engineering methods are presented for determining the vibration decrement of layered rods, rods with single- and two-layer coatings, and undirectional fiber composites.

A85-39101

THE 'SOLUTION-LARGE MOLECULES' METHOD FOR CALCULATING THE EQUILIBRIUM COMPOSITION OF HETEROGENEOUS SYSTEMS [METOD 'RASTVOR - BOL'SHIE MOLEKULY' DLIA RASCHETA RAVNOVESNOGO SOSTAVA GETEROGENNYKH SISTEM]

V. E. ALEMASOV, Z KH. GRUZDEVA, A. A. DREGALIN, and A. F. DREGALIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 6-9. In Russian.

A refined method for calculating the equilibrium composition of heterogeneous systems is presented which combines the advantages of the large-molecule method and of the model of an ideal solution of condensed phases. It is shown that the new method provides better convergence and requires less computational effort than either of the above approaches. Results are presented for the combustion products of O2 + BeH2 fuel.

V.L.

A85-39175

THE BONDING OF MATERIALS FOR PROPULSION SYSTEMS [LE COLLAGE DES MATERIAUX POUR PROPULSEURS]

E. H. SUBRENAT (Societe Europeenne de Propulsion, Paris, France) (L'Atelier de Construction de Tarbes and l'Association pour le Developpement de l'Information Scientifique et Technique dans le Bassin de l'Adour, Colloque sur la Mecanique et la Metallurgie, 5th, Tarbes, France, Mar. 14-16, 1984) Materiaux et Techniques (ISSN 0032-6895), vol. 73, Apr.-May 1985, p. 179-187. In French.

The various types of adhesives, their properties and applications in joining components, and techniques used in their development to the point of acceptance in aircraft are surveyed. The bonding agents are selected on the basis of the parts to be joined, e.g., a thick joint with a large surface area or a thin joint with a small surface area, in situ, setting, for carbon composites, etc. Epoxies are the most commonly used adhesives, with different products requiring various treatment times and temperatures for polymerization and different surface preparation. The resulting bonds are characterized by the flexibility, stability at specific temperatures, resistance to shearing and pulling, and fatigue life The rheological properties are determined by the viscosity, thixotropy, lifetime on the shelf and the curing duration. Industrial procedures employed for bonding Al alloys, stainless steel and Ti are discussed. M.S.K.

A85-39228

FRACTURE BEHAVIOR OF GLASS-CLOTH/POLYESTER COMPOSITE LAMINATE AT LOW TEMPERATURE

D XU, R. LIU, J. XIA, J. ZHAO (University of Science and Technology of China, Hefei, People's Republic of China), and W. SHEN (Huazhong University of Science and Technology, Wuhan, People's Republic of China) Journal of Reinforced Plastics and Composites (ISSN 0731-6844), vol. 4, April 1985, p. 205-211.

By means of experimental technique, the fracture toughness, fracture mechanism, and strength limit of glass-cloth/polyester composite laminate (GPCL) at low temperature (77 K) are studied. The strength limit of GPCL is found to be 39.34 kg/sq mm at 300 K and 59.41 kg/sq mm at 77 K, thus indicating that the value of the strength limit at low temperature is 1.5 times as large as the value at ambient temperature. To reveal the properties of GPCL, the fracture toughness and fracture phenomenon of net matrix material and matrix with some bunches of glass fiber are also examined.

A85-39284* Garrett Turbine Engine Co., Phoenix, Ariz. PROGRESS IN THE UTILIZATION OF AN OXIDE-DISPERSION-STRENGTHENED ALLOY FOR SMALL ENGINE TURBINE BLADES

T. G. BEATTY and P. P. MILLAN (Garrett Turbine Engine Co., Phoenix, AZ) IN: Advanced aerospace materials technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 1-9. refs

(Contract NAS3-20073)

(SAE PAPER 841512)

The conventional means of improving gas turbine engine performance typically involves increasing the turbine inlet temperature; however, at these higher operational temperatures the high pressure turbine blades require air-cooling to maintain durability. Air-cooling imposes design, material, and economic constraints not only on the turbine blades but also on engine performance. The use of uncooled turbine blades at increased operating temperatures can offer significantly improved performance in small gas turbine engines. A program to demonstrate uncooled MA6000 high pressure turbine blades in a GTEC TFE731 turbofan engine is being conducted. The project goals include demonstration of the advantages of using uncooled MA6000 turbine blades as compared with cast directionally solidified MAR-M 247 blades.

A85-39291

MATERIAL EVALUATION OF SECOND-GENERATION COMPOSITES FOR TRANSPORT WING APPLICATION

J. HARPER-TERVET and G. HULL (Lockheed-California Co., Burbank, CA) IN: Advanced aerospace materials technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 93-101. refs (SAE PAPER 841520)

Second generation, or toughened, epoxy resin systems are under consideration for use on a large composite primary structural part such as a wing. A method of evaluating the properties of these materials, while at the same time considering design, structural and manufacturing requirements has been developed. Processability requirements for toughened epoxy resin systems have been established. Cost efficient manufacturing methods, such as pultrusion, have been investigated and found to be a feasible production method for composite structure. The use of pultrusion as a fabrication method for partially staged parts to be co-cured at a later date is being evaluated. A85-39339* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FEASIBILITY STUDY OF THE WELDING OF SIC

T. J. MOORE (NASA, Lewis Research Center, Cleveland, OH) American Ceramic Society, Communications (ISSN 0002-7820), vol. 68, June 1985, p C-151 to C-153. refs

In a brief study of the feasibility of welding sintered alpha-SiC, solid-state welding and brazing were investigated. Joint quality was determined solely by microstructural examination Hot-pressure welding was shown to be feasible at 1950 C. Diffusion welding and brazing were also successful under hot isostatic pressure at 1950 C when boride, carbide, and silicide interlayers were used. Furnace brazing was accomplished at 1750 C when a TiSi2 interlayer was introduced Author

A85-39492

FRACTURE TOUGHNESS OF ADHESIVELY BONDED JOINTS

F. FLASHNER, S KENIG, I. G. ZEWI, and H. DODIUK (Ministry of Defence, Haifa, Israel) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 21, no. 5, 1985, p. 997-1004. refs

Using uniaxial loading of Mode I type and biaxial loading of combined Mode I and Mode II, the fracture toughness of an epoxy film adhesive is investigated under conditions of both ambient as well as elevated temperature and high humidity Experimental results show that the resistance to crack growth decreases by a calibration of temperature and humidity for both uniaxial and biaxial loading and that increased temperature alone is not harmful up to 70 C for crack growth. In comparison to uniaxial mode loading, the most pronounced effect on the critical energy release rate parameter is shown by mixed mode loading, and the combined effect of biaxial load, temperature, and water results in a drastic decrease in fracture toughness of the film adhesive. M.D.

A85-39598

ASSESSMENT OF DAMAGE TOLERANCE IN COMPOSITES

E DEMUTS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), R. S. WHITEHEAD, and R. B DEO (Northrop Corp., Aircraft Div., Hawthorne, CA) (USAF, U.S. Army, Westland Helicopters, Ltd., et al., International Conference on Structural Impact and Crashworthiness, Impenal College of Science and Technology, London, England, July 16-20, 1984) Composite Structures (ISSN 0263-8223), vol. 4, no. 1, 1985, p 45-58. USAF-sponsored research. refs

Tolerance of carbon epoxy coupons to processing and normal service damage is examined experimentally for built-up panels representing multispar and multinb wing designs. It is found that low-velocity impact damage is more severe than damage in holes, delaminations, or porosity, and leads to losses in compression strength from 58 to 73 percent. It is shown that the complexity provided by built-up three-spar panels significantly enhances their static compression strength as compared to the corresponding coupon strength. Fatigue strength, on the other hand, can be considerably improved by stitching.

A85-39600

DAMAGE TOLERANCE OF COMPOSITE CYLINDERS

M. J. GRAVES (Boeing Military Airplane Co., Seattle, WA; MIT, Cambridge, MA) and P. A. LAGACE (MIT, Cambridge, MA) (Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 12-15, 1983) Composite Structures (ISSN 0263-8223), vol. 4, no. 1, 1985, p. 75-91. refs

(Contract F33615-77-C-5155)

The fracture of pressurized graphite/epoxy cylinders was investigated and their damage tolerance assessed. The cylinders were 610 mm long and 305 mm in diameter and were fabricated from Hercules A370-5H/3501-6 prepreg fabric in quasi-isotropic four-ply configurations: (0, 45)s and (45, 0)s. The cylinders were slit in the longitudinal direction and the critical notch sizes for three pressure levels were determined. Experiments on coupons of similar construction loaded in tension were previously conducted. The critical flaw sizes for the cylinders-were-well predicted from the flat coupon data corrected for the effects of curvature in addition, circumferentially wrapped undirectional plies of Hercules AS1/3501-6 tape of various stacking sequences were used as selective reinforcement on several (0, 45)s cylinders. These reinforcing plies did change the path of damage but did not prevent catastrophic failure. Author

A85-39640#

COMBUSTION STUDIES OF METALLIZED FUELS FOR SOLID FUEL RAMJETS

A. GANY (Technion - Israel Institute of Technology, Haifa, Israel) and D. W. NETZER (U.S. Naval Postgraduate School, Monterey, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 8 p. Research supported by the U.S. National Research Council. refs

(Contract N60530-85-WR-30011)

(AIAA PAPER 85-1177)

Combustion phenomena of highly metallized, boron containing, solid fuels in solid fuel ramjets (SFRJ) were studied by means of high speed photography using a windowed two-dimensional SFRJ combustor. The experiments indicated the existence of a gas phase diffusion flame of the volatile fuel ingredients within the boundary layer above the fuel surface. It was also revealed that material is often emitted from the surface in the form of large pieces and segments. Flow impingement on the surface may cause surface heating and glowing by chemical reactions, which promote the high speed ejection of hot particles and the disintegration and emittance of large glowing segments and pieces from the fuel surface layer to the gas stream. Author

A85-39645#

BORON SLURRY FUEL ATOMIZATION EVALUATION

J. J. LIPINSKI, E. B. COLEMAN, and B. R. HEATH (Garrett Turbine Engine Co., Phoenix, AZ) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. refs

(Contract F33615-82-C-0123)

(AIAA PAPER 85-1184)

The atomization of boron slurry fuel was studied experimentally by spraying it into a coflowing low-velocity airstream at atmospheric pressure. The object of the testing was to determine if a spray could be produced of a quality that would promote high combustion efficiency in a boron-slurry-fueled gas turbine combustor. Testing was conducted with two slurry formulations and three different atomizer configurations. Laser diffraction was used to characterize the spray droplet size distribution. A plain-jet airblast atomizer was found to produce a uniform spray while exhibiting no plugging problems. Measured droplet average diameters for this atomizer were found to be close to the size expected for the liquid component of the fuel alone, as predicted by fuel atomizer correlations found in the literature. The width of the size distribution. however, was somewhat greater than is typical of liquid fuel sprays produced by conventional gas turbine atomizers. Author

A85-39662*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH-TEMPERATURE EROSION OF PLASMA-SPRAYED, YTTRIA-STABILIZED ZIRCONIA IN A SIMULATED TURBINE ENVIRONMENT

R. F. HANDSCHUH (NASA, Lewis Research Center; U.S. Army Propulsion Laboratory, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 13 p. Previously announced in STAR as N85-13045. refs (AIAA PAPER 85-1219)

A series of rig calibration and high temperature tests simulating gas path seal erosion in turbine engines were performed at three impingement angles and at three downstream locations. Plasma sprayed, yttria stabilized zirconia specimens were tested. Steady state erosion curves presented for 19 test specimens indicate a brittle type of material erosion despite scanning electron microscopy evidence of plastic deformation. Steady state erosion results were not sensitive to downstream location but were sensitive to impingement angle. At different downstream locations specimen surface temperature varied from 1250 to 1600 C (2280 to 2900 F) and particle velocity varied from 260 to 320 m/s (850 to 1050 ft/s). The mass ratio of combustion products to erosive grit material was typically 240. Author

A85-39676#

COMBUSTION INSTABILITY SUSTAINED BY UNSTEADY VORTEX COMBUSTION

E. E. ZUKOSKI (California Institute of Technology, Pasadena, CA) and D. A. SMITH AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985 10 p. refs (Contract AF-AFOSR-80-0286)

(AIAA PAPER 85-1248)

The determination of an internal feedback mechanism which leads to combustion instability inside a small scale laboratory combustor is presented in this paper. During combustion instability, the experimental findings show that a large vortical structure is formed at an acoustic resonant mode of the system. The subsequent unsteady burning, within the vortex as it is convected downstream, feeds energy into the acoustic field and sustains the large resonant oscillations. These vortices are formed when the acoustic velocity fluctuation at the flameholder is a large fraction of the mean flow velocity. The propagation of these vortices is not a strong function of the mean flow speed and appears to be dependent upon the frequency of the instability. Continued existence of large vortical structures which characterize unstable operation depends upon the fuel-air ratio, system acoustics, and fuel type. (Author)

A85-39727#

PROPELLANT OPTIONS FOR LONG DURATION, HIGH ALTITUDE UNMANNED AIRCRAFT

J. E. BORETZ (TRW Inc., Applied Technology Div., Redondo Beach, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 5 p. refs (AIAA PAPER 85-1326)

Two of the main objectives in the development of high-performance unmanned aircraft are related to the achievement of long duration flight and an operation at high altitudes. The characteristics of typical propulsion devices for achieving the considered performance objectives are shown along with the properties of fuels and gases. It is found that the determination and optimization of a specific engine combustion process involves a complex combination of propellant characteristics, fuel injector characteristics, and combustion chamber design features However, an initial figure of ment can be established by examining some of the fuel properties which will impact remotely piloted vehicle (RPV) endurance and altitude. G.R.

A85-39744#

THE EFFECT OF COATINGS ON THE THERMOMECHANICAL FATIGUE LIFE OF A SINGLE CRYSTAL TURBINE BLADE MATERIAL

K. R BAIN (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. Research supported by General Motors Corp.

(AIAA PAPER 85-1366)

The effect of a protective coating on the cyclic fatigue life of an advanced single crystal turbine blade alloy under thermomechanical fatigue cycling investigated. was Thermomechanical fatigue cycling combines both mechanical strain controlled cycling and temperature cycling to better simulate the actual temperature/strain environment in a modern gas turbine engine. The application of a coating for increased corrosion and/or oxidation protection may result in a reduction in the number of strain/temperature cycles to initiate a critical crack which leads to failure. The effect of a coating in TMF was to reduce the TMF lives of the alloy, but a cross-over occurred between the two coatings. The overlay coating resulted in longer lives at the higher strain ranges while the aluminide coating performed better at lower strain ranges. Author

11 CHEMISTRY AND MATERIALS

A85-39763#

COMBUSTION TECHNOLOGY - A NAVY PERSPECTIVE

A. J. CIFONE and E. L. KRUEGER (U.S. Navy, Naval Air Propulsion AIAA, SAE, ASME, and ASEE, Joint Center, Trenton, NJ) Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. (AIAA PAPER 85-1400)

Navy combustor and augmentor trends are examined and related technology levels are assessed. Specific R & D needs such as advanced materials, improved liner cooling schemes, high Mach number diffuser design, fuel injector design methodologies, high-temperature augmentor performance and operability, fuel compatibility, and improved usable analytical techniques, are discussed. Consideration is given to the need to pursue specific combustion system technology features and their ramifications.

MD.

A85-39913#

STATE OF THE ART AND RESEARCH NEEDS OF PULSATING COMBUSTION

B. T. ZINN (Georgia Institute of Technology, Atlanta, GA) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 7 p Research supported by the Gas Research Institute. refs

(ASME PAPER 84-WA/NCA-19)

A review of the historical background of pulsating combustion engines is presented, reflecting on the principles of operation of the guarter wave, Helmholtz, and Rije-type combustors. The advantages of pulsating combustion are outlined, including the effects of pulses on convective heat transfer at the walls of the engine and faster oxidation rates. The discussion also covers the effects of acoustic oscillation on the production of nitrogen oxides, carbon monoxide, hydrocarbons, sulfur dioxide, and soot during the combustion. In addition, thermal efficiency of such engines is examined. Finally, a summary of the state-of-the-art of the field and of its future needs is given. L.T.

N85-27975 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge. INTEGRAL PROFILE METHOD FOR PRODUCTION OF CARBON [FERTIGUNG INTEGRAL FIBER SHEETS PROFILVERSTAERKTER CFK-SCHALEN] J. KLENNER Nov 1984 29 p In GERMAN (MBB/LFA34/CFK/PUB/006) Avail: Issuing Activity

Carbon-fiber subassembly structural resistance and applicability are demonstrated by static and dynamic tests. The production techniques and quality control process for economical line production are presented. Carbon fiber use in aircraft primary structures is recommended for weight reduction Author (ESA)

N85-27976 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

HEAT RESISTANT CARBON FIBER REINFORCED PLASTICS HARDENING EQUIPMENT (CFRP) [TEMPERATURBESTAENDIGE

G]

K. LEDWA and J. KLENNER Nov. 1984 19 p In GERMAN (MBB/LFA33/CFK/PUB/007) Avail: Issuing Activity

Hardening equipment made of CFRP for aircraft structures was tested. Five systems were chosen after a survey of laminating and surface resins. Tests of these systems lead to a production concept for a heat resistant CFRP hardening apparatus for cylindrical integral profile-stiffened fuselage side shells. The production concept is described. The test results meet expectations with respect to quality as well as to costs and throughput time Temperature resistance, dimensional stability, and surface finishing are excellent; the measured shrinkage is 0.5%. Author (ESA)

N85-27992# Naval Postgraduate School, Monterey, Calif. AN INVESTIGATION INTO THE SOOT PRODUCTION **PROCESSES IN A GAS TURBINE ENGINE M.S. Thesis** A. L. LOHMAN Sep. 1984 52 p (AD-A152710) Avail: NTIS HC A04/MF A01 CSCL 21B

This thesis details an investigation into the nature of soot production in a gas turbine combustor. The goal was to obtain axial temperature profiles and soot size distributions inside an Allison T63-A-5A combustor. The present temperature probe and gas sampling apparatus were able to acquire data. Results from these initial tests suggested some preliminary conclusions. First of all, flatter temperature profiles were possibly indicative of fuels with lower aromatic content. Also, soot size along the centerline of the combustor did not appear to change appreciably. Soot itself seemed to be composed of 0.1 micron spherical particles prone to agglomeration. Relatively large, puff-like structures observed on sample collection filters were apparently artifacts of the sampling technique. Several methods of improving the GRA apparatus were suggested

N85-28109*# General Motors Corp., Indianapolis, Ind. Gas Turbine Div.

CERAMIC APPLICATIONS IN TURBINE ENGINES Final Report H. E. HELMS, P. W. HEITMAN, L. C LINDGREN, and S. R. THRASHER Oct. 1984 268 p refs (Contract DEN3-17; DE-Al01-77CS-51040)

NASA-CR-174715; DOE/NASA/0017-6; NAS 1.26:174715;

EDR-11442) Avail: NTIS HC A12/MF A01 CSCL 11B

The application of ceramic components to demonstrate improved cycle efficiency by raising the operating temperature of the existing Allison IGI 404 vehicular gas turbine engine is discussed. This effort was called the Ceramic Applications in Turbine Engines (CATE) program and has successfully demonstrated ceramic components. Among these components are two design configurations featuring stationary and rotating caramic components in the IGT 404 engine. A complete discussion of all phases of the program, design, materials development, fabrication of ceramic components, and testing-including rig, engine, and vehicle demonstation test are presented. During the CATE program, a ceramic technology base was established that is now being applied to automotive and other gas turbine engine programs. This technology base is outlined and also provides a description of the CATE program accomplishments. Author

N85-28127*# Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.

JET FUEL INSTABILITY MECHANISMS Final Technical Report, 1 Aug. 1981 - 31 Mar. 1985 S R. DANIEL 31 Mar. 1985 104 p

refs

(Contract NAG3-197) (NASA-CR-175856; NAS 1.26 175856) Avail. NTIS HC A06/MF A01 CSCL 21D

The mechanisms of the formation of fuel-insoluble deposits were studied in several real fuels and in a model fuel consisting of tetralin in dodecane solution. The influence of addition to the fuels of small concentrations of various compounds on the quantities of deposits formed and on the formation and disappearance of oxygenated species in solution was assessed. The effect of temperature on deposit formation was also investigated over the range of 308-453 K. G.L.C.

N85-28129# Boeing Military Airplane Development, Seattle, Wash.

FUEL FREEZE POINT INVESTIGATIONS Final Report, Sep. 1982 - Mar. 1984

L. A. DESMARAIS and F. F. TOLLE Wright-Patterson AFB, Ohio AFWAL Jul. 1984 286 p

(Contract F33615-82-C-2262)

(AD-A152801; D180-28285-1; AFWAL-TR-84-2049) Avail: NTIS HC A13/MF A01 CSCL 21D

The objective of this program was to conduct a detailed assessment of the low temperature environment to which USAF aircraft are exposed for the purpose of defining a maximum acceptable fuel freeze point and also to define any operational changes required with the use of a high freeze point fuel. A previous study of B-52, C-141, and KC-135 operational missions indicated that the -58 C freeze point specification was too conservative Based on recommendations resulting from the previous program. several improvements in the method of analysis were made, such as: expansion of the atmospheric temperature data base, the addition of ground temperature analysis, the addition of fuel freezing analysis to the one-dimensional fuel temperature computer program, and the examination of heat transfer in external fuel tanks, such as pylon or tip tanks The B-52, C-141, and KC-135 mission were analyzed again, along with the operational missions of two tactical airplanes, the A-10 and F-15; -50C was determined to be the maximum allowable freeze point for a general purpose USAF aviation turbine fuel. Higher freeze points can be tolerated if the probability of operational interference is acceptably low or if operational changes can be made. Study of atmospheric temperatures encountered for the missions of the five study aircraft indicates that a maximum freeze point of -48 C would not likely create any operational difficulties in Northern Europe GRA

N85-29045 Department of the Air Force, Washington, D.C. LAMINATED THERMOPLASTIC RADOME Patent

E. E. GREENE, inventor (to Air Force) 19 Mar 1985 7 p Supersedes AD-D009637

(AD-D011664; US-PATENT-4,506.269:

US-PATENT-APPL-SN-382070; US-PATENT-CLASS-343-872) Avail: US Patent and Trademark Office CSCL 17I

This patent discloses an improved rain resistance radome C-sandwich wall which is constructed of thermoplastic polycarbonate material The cores are either posts or tubes and are bonded to the skins with polyurethane. The percentage of core material to air is adjusted by electrical tuning to make the optimum dielectric value for use in the gigahertz radar frequency range. GRÁ

N85-29052# Oak Ridge National Lab., Tenn. CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT Semiannual Progress Report, Apr. - Sep. 1984 M C. MATTHEWS Feb. 1985 117 p refs (Contract DE-AC05-84CR-21400)

(DE85-008755; ORNL/TM-9497) Avail: NTIS HC A06/MF A01

Significant accomplishments in fabricating ceramic components for the DOE, NASA, and DOD advanced heat engine programs have provided evidence that the operation of ceramic parts in high-temperature engine environments is feasible. An assessment of needs was completed, and a five-year project plan was developed with extensive input from private industry in order to develop the industrial technology base required for reliable ceramics for application in advanced automotive heat engines. The project approach includes determining the mechanisms controlling reliability, improving processes for fabricating existing ceramics, developing new materials with increased reliability, and testing these materials in simulated engine environments to confirm reliability Although this is a generic materials project, focus is on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. DOE

N85-29053# Oak Ridge National Lab., Tenn.

CERAMIC COATINGS FOR HEAT ENGINE MATERIALS: STATUS AND FUTURE NEEDS

W. J. LACKEY, D. P. STINTON, G. A. CERNY, I. L. FEHRENBACHER, and A C SCHAFFHAUSER Dec. 1984 116 p refs

(Contract DE-AC05-84OR-21400)

(DE85-008759, ORNL/TM-8959) Avail: NTIS HC A06/MF A01

The status and potential for application of ceramic coatings to diesel and turbine engine components was assessed. Properties are tabulated for numerous materials from the oxide, carbide, nitride, and boride families. Several coating deposition processes are described and compared, including plasma spraying, electron beam evaporation, sputtering, chemical vapor deposition, sol-gel,

ion, and laser techniques. Zirconia thermal-barrier coatings were emphasized, but coatings for wear and erosion resistance. lubrication, chemical protection, seals, and interfaces were also addressed Coating characterization methods, particularly those for measuring adherence and defects, are reviewed, it was concluded that the use of coatings will expand in the future, permitting higher performance and more reliable heat engines. DOE

N85-29054# Oak Ridge National Lab, Tenn. Metals and Ceramics Div

CERAMIC COATINGS FOR HEAT ENGINE MATERIALS

W. J. LACKEY and D. P. STINTON 1984 4 p refs Presented at the Automotive Technol. Develop. Contractors' Coord. Meeting, Dearborn, Mich., 29 Oct 1984 (Contract DE-AC05-84OR-21400)

(DE85-005238; CONF-8410103-6) Avail: NTIS HC A02/MF A01 The status and potential for application of ceramic coatings to diesel and turbine engine components were assessed. Properties were tabulated for numerous materials from the oxide, carbide, nitride, and boride families. Promising new deposition methods and in-situ gas and solid phase characterization techniques are identified. Emphasis was placed on zirconia thermal carrier coatings, but coatings for reducing wear, erosion, and friction were also addressed. The use of coatings will expand in the future and permit higher performance and more reliable heat engines. DOE

N85-29066# Technische Univ., Berlin (West Germany). Inst. fuer Nichtmetallische Werkstoffe.

SINTERACTIVE SILICON NITRIDE PREPARATION OF **POWDERS Final Report, Jun. 1983**

H HAUSNER, A. MARCKS, R. PEITZSCH, and G. WOETTING Bundesministerium fuer Forschung und Technologie Dec. 1984 93 p refs in GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-84-303, ISSN-0340-7608) Avail NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19.50

The sintering behavior of silicon nitride powders of different origin was investigated for use in gas turbine engines. The influence of powder characteristics, sintering additives and processing parameters on densification are discussed. A high-temperature dilatometer which operates up to 2300 C under a nitrogen pressure of 50 bar maximum was developed to study the sintering kinetics. Thermogravimetric investigations concerning the weight loss during sintering were performed Author (ESA)

N85-29073# Illinois Univ, Urbana. Dept. of Mechanical and Industrial Engineering.

RESEARCH TEST FACILITY FOR EVAPORATION AND COMBUSTION OF ALTERNATIVE JET FUELS AT HIGH AIR **TEMPERATURES Annual Technical Report, 1 Feb. 1983 - 30** Jan. 1984

J. E. PETERS, H. KRIER, K K. KIM, R. E. COVERDILL, J. E. KIRWAN, S. C. MEISNER, and K. W. KIM 1 Mar. 1984 45 p refs

(Contract F49620-83-K-0027)

(AD-A153830; UILU-ENG-84-4001; AFOSR-85-0383TR) Avail. NTIS HC A03/MF A01 CSCL 21B

Improved gas turbine combustion performance will require the effective utilization of alternative fuels and advanced combustor concepts. Further understanding of spray combustion processes including fuel evaporation and flame propagation is required. Research is underway which features a high pressure and temperature non-vititated air system to provide air at simulated gas turbine inlet conditions. A special fuel injection system was designed to produce monodisperse sprays for the purpose of evaporation and eventual combustion experiments in our newly developed test facility. This report represents a summary of the engineering activities during the first year (of a two year contract) which was focused on the construction of a combustion test facility in which the evaporation and burning rates of jet fuels can be measured as a function of inlet conditions and fuel properties A large heat exchanger facility which supports this research can

11 CHEMISTRY AND MATERIALS

deliver continuously non-vitiated air at flowrates up to 1 kg/sec and 600 kPa at temperatures from 300 to 900K. Details of the evaporation/combustion test section are described. Also included are the design of the fuel injection system and test results of the injector showing monodisperse sprays with drop diameters of approx. 70 micrometers. GRA

N85-29074# Naval Research Lab., Washington, D. C. Combustion and Fuels Branch.

THE DISTRIBUTION OF HIGHER N-ALKANES IN PARTIALLY FROZEN MIDDLE DISTILLATE FUELS Final Report, Oct. 1982 - Sep. 1984

T. L. VANWINKLE, W. A. AFFENS, E. J. BEAL, R. N. HAZLETT, and J. DEGUZMAN 10 Apr. 1985 39 p refs

(AD-A153940; AD-E801121; NRL-8869) Avail: NTIS HC

A03/MF A01 CSCL 21D

In conjunction with continuing studies on the effect of composition on the freezing points of middle distillate fuels, attention was directed to partially frozen fuels. The crystals and residual liquid from partially frozen JP-5 and DFM fuel samples derived from both petroleum and shale were separated from each other and collected by means of the NRL liquid-solid separator apparatus (LSS) at several temperatures below the freezing points of the original samples. The original fuel samples, the solid material (precipitate), and liquid (filtrate) were characterized by gas chromatography (GC). The filtrate data were straightforward. As expected, Van't Hoff plot of the n-alkanes concentrations (log concentrations vs reciprocal absolute temperature) formed straight lines, and their slopes demonstrated the importance of the higher n-alkanes in fuel crystallization at cold temperatures. The precipitate data presented some problems of interpretation since it was observed that the waxy crystal precipitate matrix entrapped significant amounts of liquid (filtrate). The data on the solids which were obtained by these methods demonstrated that the higher n-alkanes play the key role in fuel crystallization at low temperatures, concentrating as much as tenfold in the crystallized solids compared to the liquid. Also, it was clearly shown that the n-alkanes form the major part, up to least 95% by weight in some fuels, of the solid crystals formed. GRA

N85-29100# Joint Publications Research Service, Arlington, Va. LIGHTNING-SAFE CARBON FIBER COMPOSITE FOR AIRBUS TAIL UNIT

In its West Europe Rept.: Sci. and Technol. (JPRS-WST-84-032) p 25-26 25 Sep. 1984 Repr. from Frankfurt. Zeitung/Blick Durch die Wirtschaft (Franfurt am Main), 1 Aug. 1984 p 6 Avail: NTIS HC A03/MF A01

Airplanes with large-area structures of graphite-fiber composite materials (CFK) fly with absolute safety even in storms. This was demonstrated during a recent series of lightning strike tests on an Airbus-A310 vertical tail spar of the Airbus material developed and built by Messerschmitt-Boelkow-Blohm GmbH (MBB) in Hamburg and Stade. The 300,000 volt lightning bolts were generated in the Institute for Plasma Physics at the University of Hannover. Lengthy studies by MBB and test measurements on CFK samples in the Institute for Plasmas Physics show how to design for safety from lightning strikes. The tests on the CFK vertical tail spar include direct effects such as holes in the material and melted rivets and indirect effect such as the coupling of the electromagnetic energy of the lightning into the aircraft's electronic circuits. Damage is shown to be minimal.

N85-29105# Joint Publications Research Service, Arlington, Va. DFVLR RESEARCH IN ALUMINUM-LITHIUM ALLOYS Abstract Only

In its West Europe Rept.: Sc. and Technol. (JPRS-WST-84-035) p 25-26 29 Oct. 1984 Transl. into ENGLISH from Frankfurter Zeitung/Blick Durch Die Wirtsch. (Frankfurt/Main), 16 Aug. 1984 p 1

Avail: NTIS HC A04/MF A01

The youthful metal aluminum is receiving competition from modern composite materials such as graphite-fiber reinforced plastics whose specific strengths (strength per unit of weight) can be higher than modern high-strength aluminum alloys. Of course, the strength of composite materials is strongly directional, but materials applications frequently do not require strength isotropy. Thus, with such composite materials, designers can undercut the already low specific weight--2.8 grams per cubic centimeter-of modern high-strength aluminum alloys and lower the weight of aircraft structures. This translates into fuel savings, an attractive offenng since the climb in fuel prices in the 1970s. A Boeing study in this area forecasts that the weight fraction of aluminum will decrease during the next decade from today's approximately 80 percent to 10 percent while the weight fraction of composite materials will increase from today's approximately 3 percent to 65 percent G.L.C.

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A85-37074

FASTENERS FOR COMPOSITE STRUCTURES EXAMINED

J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, June 1985, p. 8-14.

Recognizing the trend toward composite primary structures in the aerospace industry, mechanical fastener manufacturers reexamined fastener designs with a view to a better performance match with the novel airframe designs. Increased loadbearing area has emerged as the primary strategy for composite joint performance improvement, increasing clamp loads while minimizing the possibility of crushing damage or delamination around the fastener hole. Attention is given to the design details and performance characteristics of the proprietary fastener designs designated 'Maxifoot rivet', 'Composi-Lok II', 'Olympic-Lok rivet', and 'Huck-Clinch rivet'.

A85-37177#

EXPERIMENTAL DETERMINATION OF THE EFFECT OF NONLINEAR STIFFNESS ON THE VIBRATION OF ELASTIC STRUCTURES

G. MAYMON (Ministry of Defence, Armament Development Authonty, Tel Aviv, Israel; Georgia Institute of Technology, Atlanta, GA) and L. W. REHFIELD (Georgia Institute of Technology, Atlanta, GA) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 1-7. refs

A method for the determination of the coefficient of non-linearity of a geometrical non-linear elastic system is proposed. The method is based on measuring the 'jump-down' points which exist in geometrically non-linear systems. A plot of the amplitude squared vs. the frequency squared at the amplitude 'jump-down' points for several excitation levels yields a straingth line whose slope is related to the coefficient of no -linearity. The method is demonstrated on a simple elastic system - a clamped clamped beam - and excellent results are obtained from theoretical analysis, experimental static tests and the suggested dynamic test. The experiments also validate the theoretical model of a cubic stiffness relationship.s The 'jump-down' points are shown to be experimentally well defined, and the value of the coefficient of non-linearity determined by the method is insensitive to the accuracy of many 'hard to measure' parameters. Author

A85-37181#

INFLUENCE OF FIGHTER AIRCRAFT LOAD SPECTRUM VARIATIONS ON FATIGUE CRACK INITIATION AND GROWTH E. REINBERG (Israel Aircraft Industries, Ltd., Engineering Div., Tel Aviv, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 31-35.

Experimental and analytical studies of spectrum sensitivity effects are reported. A typical high performance fighter aircraft load spectrum was used as a baseline. The spectrum variations ranged from realistic variations, that might be expected among operational aircraft, to variations to investigate spectrum development and test procedures. Tests represented crack initiation and growth out of an open or a fastener filled hole in aluminum alloy 2014-T6 specimens It was found that changes caused by any spectrum variation are similar (but not identical) in both fatique life and crack growth life. The most pronounced effects on fatigue performance were caused by usage changes omission (elimination) of low peaks and truncation of high peaks. The least pronounced effects on fatigue performance were due to load sequence changes and introduction of load markers. The analytical study revealed that the FATLIFR program, used in crack initiation analysis, gives slightly unconservative predictions. The sensitivity of the predictions to low peaks was very poor, the CRACKS4 program predictions of crack growth were good for such spectrum changes as mild usage, low peak omission and negative load truncation. Author

A85-37186#

CRACK GROWTH ANALYSIS IN MULTIPLE LOAD PATH STRUCTURE

D. SHALEV (Israel Aircraft Industries, Ltd., Engineering Div, Tel Aviv, Israel) IN Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 64-66 refs

An analytical method for crack growth rate in multiple load path structure is presented, when one of the load path element is cracked. A load redistribution occurs due to stiffness change The method is based on establishing an effective stiffness which accounts for this phenomenon. The Effective stiffness is achieved by using energy considerations before cracking and during crack growth. The paper describes the implementation of the effective stiffness within finite element analysis. The result is a ratio between the stress before and after cracking. That ratio is applied on stress intensity and for the residual strength calculation when compared to net-section yielding. A test was performed on a typical aircraft splice element and a comparison was made between the analytical results and test data. Author

A85-37187#

A PROGRAM FOR COMPUTERIZED STRUCTURAL RESIZING OF AIRCRAFT STRUCTURE SUBJECT TO STRENGTH AND LOCAL PANEL BUCKLING CRITERIA UNDER MULTIPLE LOADING

J. BURVIN, A. AMAR, Z ZAPHIR (Israel Aircraft Industries, Ltd., Tel Aviv, Israel), and M. BARUCH (Israel Aircraft Industries, Ltd., Tel Aviv; Technion - Israel Institute of Technology, Haifa, Israel) IN. Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers - Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 67-77. refs

A computerized resize procedure based on a practical fully stressed design of aircraft structure subject to local panel buckling and strength criteria under multiple loading conditions is presented. The modified structure is reanalyzed and updated internal loads are calculated. Material strength, minimum gauge and allowable stress for tension along with local panel buckling interaction curves are considered in computing margins of safety. This iterative process is repeated until these margins of safety become positive for a given load envelope. The iterative resizing algorithm is a practical, automated approach to deal with large scale structures under multiple loading conditions subjected to various design constraints Its application on various wing structure configurations shows that it can provide a practical tool for obtaining efficient aircraft structures Program STAIRS which was developed i this study incorporates the resize algorithm as well as pre and post analysis subprograms. Author

A85-37192#

CRITICAL FLUTTER PARAMETERS OF ORTHOTROPIC RECTANGULAR FLAT PANELS WITH IN-PLANE LOADS

L. BEINER (Negev, University, Beersheba, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 115-120.

A flutter analysis of flat, rectangular orthotropic panels with in-plane stresses is performed for two different types of boundary conditions using Galerkin's method Variation of the critical speed parameter is obtained in a simple form, common to both types of boundary conditions, for an extensive range of parameters. It is shown that the critical speed parameter increases with the orthotropicity ratio, the chord-to-span ratio, and the stresswise in-plane tensile stress, and is higher for clamped panels than for their simply-supported counterparts C D.

A85-37216

SUBSONIC MULTIPLE-JET AERODYNAMIC WINDOW

W. MASUDA, Y. MAEDA (Nagaoka, Technological University, Nagaoka, Japan), and Y. SHIRAFUJI (Mitsubishi Electric Corp, Shizuoka, Nagaoka, Technological University, Nagaoka, Japan) Review of Scientific Instruments (ISSN 0034-6748), vol. 56, May 1985, p 677-681. refs

An experimental apparatus, which simulates a subsonic multiple-jet aerodynamic window, is fabricated and aerodynamic characteristics of the single-curved jet and the multiple-curved jets are studied. The effect of the window configuration on the quantity representing the power consumption is evaluated experimentally. Within the range of the present experiments, it is shown that the magnitude of the power consumption of the multiple-jet aerodynamic window can be made less than that of the single-jet scheme, if at least three stages of jets are utilized. It is also shown that the design of the window configuration is important to reduce the power consumption and to obtain the stable operation of multiple-curved jets.

A85-37472

REDUCING THE EFFECTS OF RIVET HOLES ON FATIGUE LIFE BY ADHESIVE BONDING

J Y MANN, R. A. PELL, R. JONES, and M. HELLER (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) Theoretical and Applied Fracture Mechanics (ISSN 0167-8442), vol 3, May 1985, p. 113-124. refs

Rivet holes are potential sites for fatigue-crack initiation in aircraft structures Several methods for improving the life of such details were investigated including coating the surface of the hole with adhesive, cold-expansion of the holes, the insertion of close-fit rivets, and the use of adhesively-bonded rivets. Of the various techniques examined, only that involving adhesively-bonded rivets provided any significant improvements in fatigue life. It resulted in a reduction in the fatigue-crack propagation rate of about 50 percent compared with that for specimens incorporating open holes. A finite-element analysis indicated that adhesive bonding significantly reduces both the local-stress concentration at the hole and the stress intensities at the crack tips, thus retarding crack initiation and reducing fatigue-crack propagation rates. However, the effective reduction in stress intensity resulting from bonding (about 17 percent) is much less than the 50 percent predicted by the finite-element analysis. This discrepancy is attributed mainly to shortcomings in the model for defining the characteristics and behavior of the adhesive. Author

A85-37625#

EXPERIMENTAL RESEARCH ON THE EFFECT OF SEPARATION FLOW ON ABLATION IN SUPERSONIC TURBULENT FLOW

H. YINDA (China Aerodynamics Research and Development Center, Mianyang, Sichuan, People's Republic of China) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 5 p. refs (AIAA PAPER 85-0975)

The development of a ground-test capability for simulating heating and pressure profile of the steps and cavities on a reentry vehicle surface, in order to study heat shield surface ablation phenomena is discussed. By means of an experimental technique which uses a flat-plate specimen containing steps and cavities placed at a small angle in a supersonic arc-heated flow, the ablation phenomena and surface temperature are examined The results obtained, as well as a description of the facility, test method, model design, instrumentation, and its calibration are presented. The experiment is carried out in a CARDC arc heater whose operating conditions are 1-2 MPa of the arc chamber pressure and 4.2-12.6 MJ/Kg of the total enthalpy. It is shown that with the proper parameters, the ablation data can be corrected.

A85-37706

DYNAMIC GAS TEMPERATURE MEASUREMENT SYSTEM

D. L. ELMORE and W. B. WATKINS (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) ISA Transactions (ISSN 0019-0578), vol. 24, no. 2, 1985, p. 73-82.

The objective of this effort was to develop a gas temperature measurement system with compensated frequency response of 1 kHz and capability to operate in the exhaust of a gas turbine combustor. The concept selected for detailed development was a thermocouple probe with thermo-elements of two different diameters. The severity of the test environment required sensor elements with length-to-diameter ratios of approximately 15. Transient thermal conduction effects were identified as important for this sensor design; a preliminary finite-element conduction model quantified the errors expected by neglecting conduction A compensation method was developed to account for effects of conduction and convection. This method was verified in analog electrical simulations and used to compensate dynamic temperature data from a laboratory combustor and a gas turbine engine. Detailed data compensations are presented. Analysis of error sources in the method was done to derive confidence levels for the compensated data. Author

A85-38069

DYNAMIC BEHAVIOUR OF COLD WIRES IN HEATED AIRFLOWS (T IN THE RANGE FROM 300 TO 600 K)

C. PETIT, P. PARANTHOEN, J. C. LECORDIER, and P. GAJAN (Rouen-Haute Normandie, Universite, Mont-Sant-Aignan, Seine-Maritime, France) Experiments in Fluids (ISSN 0723-4864), vol. 3, no. 3, 1985, p. 169-173. refs

A theoretical and experimental investigation of cold wire frequency response is presented for the case of heated airflows (T less than 600 K). Experiments using an external heating technique have been carried out for sensors in different flow situations. Particular attention has been paid to the influence of temperature on cold wire transfer function charactenstics (time-constant and plateau level). Author

A85-38169#

EXPLOSIVE FORMING OF LOW CARBOON STEEL SHEET INTO A STEPPED DISC SHAPE

S. BALASUBRAMANIAM, S. SARVAT ALI, and E. S. BHAGIRADHA RAO (Defence Metallurgical Research Laboratory, Hyderabad, India) Defence Science Journal (ISSN 0011-748X), vol. 34, July 1984, p. 235-256. refs

This paper deals with the explosive forming of deep drawing guality steel into a two stepped disc type shape. An attempt has been made to predict the forming parameters from theoretical considerations by equating the disc shape with an equivalent dome Results of forming this shape in a single-stage vis-a-vis forming in two-stages are compared. Author

A85-38233

HOVERCRAFT SKIRT DESIGN AND MANUFACTURE

R. L. WHEELER and A. N KEY (British Hovercraft Corp., Ltd., Cowes, Isle of Wight, England) Future, Spring 1985, p. 8-17.

A development history is presented for the skirt designs of large hovercraft, with attention to the design methodology and ventication techniques employed to arrive at performance improvements over several design generations. The air flow and mechanical interactions among the various constituents of the skirt are noted for the spectrum of sea state and maneuvering conditions that are encountered by hovercraft of English Channel ferry type. The constitution of an integrated CAD/CAM design and fabrication process for hovercraft skirts is detailed. O.C.

A85-38352#

STRUCTURAL OPTIMIZATION

Y. HIRANO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 32, no. 360, 1984, p. 9-14. In Japanese. refs

Structural optimizaton in aircraft design is analyzed and illustrated with special emphasis given to the minimum weight problem. The direct optimization method includes the one-direction and direct searching techniques and the gradient method. The indirect optimization method includes techniques such as: fully stressed design, general repeating method, and simultaneous mode design. A mathematical analysis of the indirect method is provided.

A85-38403

SELECTING THE CORRECT BEARING CAN IMPROVE AVIONIC INSTRUMENT PERFORMANCE

M. HOARD (Kaydon Corp., Muskegon, MI) Defense Systems Review and Military Communications, vol 3, no. 4, 1985, p. 36, 38, 39

The performance level and reliability of avionic sensing/scanning devices are primarily dependent on the properties of the bearing that supports their moving elements; this also holds true for gimbals in inertial guidance systems, radar navigation, and target acquisition/fire control systems. Standard thin section bearings are best suited for avionic instrumentation, since they are characterized by very small races and rolling elements with respect to diameter. Attention is presently given to nearly universally applicable bearing designs, together with their properties and comparative advantages. 00

A85-38510

FLOW SEPARATION FROM THE LEADING EDGE OF AN AIRFOIL AND THE EFFECT OF ACOUSTIC PERTURBATIONS ON THE SEPARATED FLOW [OTRYV POTOKA OT PEREDNEI KROMKI PROFILIA I VLIIANIE NA NEGO AKUSTICHESKIKH VOZMUSHCHENII]

V. V. KOZLOV PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Mar.-Apr. 1985, p. 112-115. In Russian refs

The structure of the separated flow at the leading edge of a symmetrical airfoil is investigated by thermoanemometry in a low-turbulence subsonic wind tunnel. It is shown that the superposition of an acoustic field leads to a reattachment of the boundary layer and an elimination of global flow separation. The hysteresis effect of the acoustic field on the reattachment of the separated boundary layer is examined V.L.

A85-38536#

DESCRIPTION AND TEST METHODS FOR A FREQUENCY OUTPUT ACCELEROMETER

A. M. GOGIC and R. B. PETERS (Sundstrand Data Control, Inc., Instrument Systems Div., Redmond, WA) IN: Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings . Washington, DC, Institute of Navigation, 1984, p. 108-117.

A vibrating beam accelerometer is described as representative of a newly emerging class of frequency output sensors. The output characteristics of these sensors are inherently digital in nature and generally nonlinear. Their digital nature requires that interfaces be defined entirely in digital terms, and that these interfaces be carefully thought out so as not to introduce unnecessary problems related to sampling noise, resolution, and aliasing. Nonlinearity requires modeling in a microprocessor for most applications and also introduces a potential for input rectification if not handled correctly. In addition, the fact that the input is acceleration means that vibration isolators are not generally practical, and rather wide band inputs must be accommodated. Methods are described for measuring the characteristics of these sensors, and for efficient conversion of their outputs to high accuracy digital words, corrected for the effects of nonlinearity and temperature.

A85-38600

DETERMINATION OF THE OPTIMUM LUBRICANT CHANGE PERIOD FOR THE JOINTS OF THE LANDING GEAR OF AIRCRAFT [OPREDELENIE RATSIONAL'NOI PERIODICHNOSTI SMENY SMAZKI V SHARNIRAKH SHASSI LETATEL'NYKH APPARATOV]

V S. UGRIUMOV and B. G. BEDRIK Khimia i Tekhnologua Topliv I Masel (ISSN 0023-1169), no. 5, 1985, p. 35, 36. In Russian

An approach to the determination of the optimum lubrication period for the joints of landing gear is presented whereby the service life of a lubricant is determined on the basis of the maximum permissible friction coefficient. To determine the service life of a lubricant, the lubricant is tested under conditions simulating real friction pairs. For convenience, the lubrication period can also be determined from specially prepared nomograms. As an example, such a nomogram is presented for the lubricant TsIATIM-201. V.L.

A85-38918#

FATIGUE-CRACK PROPAGATION IN AIRCRAFT DURALUMIN SHELL STRUCTURES [ROZWOJ PEKNIEC ZMECZENIOWYCH W LOTNICZYCH KONSTRUKCJACH POWLOKOWYCH Z DURALU]

 W. BLAZEWICZ Technika Lotnicza i Astronautyczna (ISSN 0040-1145), vol. 40, March 1985, p 10-14. In Polish. refs An empirical method for calculating fatigue-crack length in

An empirical method for calculating fatigue-crack length in Duralumin sheet components under service loads is presented The method requires the determination of the magnitude and sequence of occurrence of individual service loads. The formulation of successive crack-length increments is based on a modified stress intensity factor. B.J.

A85-38973#

EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER DISTRIBUTION INSIDE THE GAP OF A FLAT PLATE-FLAP COMBINATION IN A SHOCK TUNNEL

G. TANG (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1985, p. 88-92. In Chinese, with abstract in English. refs

A85-39003#

SIMPLIFIED IMPLICIT BLOCK-BIDIAGONAL FINITE DIFFERENCE METHOD FOR SOLVING THE NAVIER-STOKES EQUATIONS

E. VON LAVANTE (Texas A&M University, College Station, TX) and V. S. V. LYER AIAA Journal (ISSN 0001-1452), vol. 23, July 1985, p. 1130-1132 refs

The simplified implicit block-bidiagonal finite difference method is proposed in order to overcome the numerical instability problems associated with the solution of two-dimensional Navier-Stokes equations when solved by the MacCormack (1981) algorithm. This novel method involves the use of the spectral formal form in the block-bidiagonal system of equations, and is demonstrated, in light of application in several flow cases, to improve computational efficiency by a factor of 3. Since viscous effects are, however, overestimated, the method requires a postprocessor employing the full implicit MacCormack scheme to redefine the boundary layer part of the solution. Numerical instabilities are avoided through the use of a nearly converged solution as the initial profile. O.C.

A85-39061

ACQUISITION OF DETAILED HEAT TRANSFER BEHAVIOR IN COMPLEX INTERNAL FLOW PASSAGES

D. E. METZGER, R. S. BUNKER, and C. S. FAN (Arizona State University, Tempe, AZ) IN: Advances in aerospace propulsion, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc, 1984, p 47-53. refs (SAE PAPER 841503)

Flow passages associated with internal cooling of high temperature engine components, especially those in gas turbine engines, frequently have very complex surface geometries. The flow channels usually are roughened to enhance heat transfer rates, and often incorporate sharp turns. The acquisition of detailed local heat transfer coefficient distributions over complex surface geometries is often extremely difficult or prohibitively expensive using conventional techniques. A relatively new method of acquiring heat transfer coefficients through use of surface coatings that have precise melting points is described. As an example of the use of the technique, it is applied to the study of the effect of various rib roughness patterns on heat transfer through 90 deg turns in a rectangular cooling channel.

A85-39062

INSTRUMENTATION FOR GAS TURBINE RESEARCH IN SHORT-DURATION FACILITIES

M G DUNN, G. LUKIS, M. URSO, R J HIEMENZ, R. L. ORSZULAK, and N. J. KAY (Arvin/Calspan Advanced Technology Center, Buffalo, NY) IN: Advances in aerospace propulsion; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 55-67. refs

(Contract F33615-81-C-2017; F33615-79-2075;

F33615-76-C-2092)

(SAE PAPER 841504)

This paper presents a detailed description of instrumentation and data recording techniques currently in use at Calspan in the performance of gas turbine related research in short-duration facilities. By short-duration is meant total test times on the order of 20 milliseconds with the requirement of sampling rates in the range of 20 kHz to 2 MHz Typical data records obtained as part of this research are presented to illustrate their application.

Author

A85-39117

A STUDY OF THE THERMAL INERTIA OF A THERMOCOUPLE EXPOSED TO SHORT TEMPERATURE PULSES AT HIGH REYNOLDS NUMBERS [ISSLEDOVANIE TEPLOVOI INERTSII TERMOPARY PRI KRATKOVREMENNYKH IMPUL'SAKH TEMPERATURY I POVYSHENNYKH CHISLAKH REINOL'DSA]

A. B. BEREZOVSKII and I. I. VLASOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 1, 1985, p. 77-79 In Russian

A method for the dynamic testing of thermal transducers is described which is based on the use of a 'slow-compression' wind tunnel. The general design of the wind tunnel and the test procedure are briefly discussed, and test results are presented for a thermocouple used in the temperature transducer of a turbofan engine. The results cover the pressure range 0.7-1.5 MPa, the temperature range 280-420 K, and the flow density range 10-160 kg/(sq m s) V.L.

A85-39131

CHARACTERISTICS OF A TWO-DIMENSIONAL TURBULENT JET IN A BOUNDED SLIPSTREAM [KHARAKTERISTIKI PLOSKOI TURBULENTNOI STRUI V OGRANICHENNOM SNOSIASHCHEM POTOKE]

S. K. VORONOV, T. A. GIRSHOVICH, and A. N. GRISHIN (Moskovskii Aviatsionnyi Institut, Moscow, USSR) Inzhenerno-Fizicheskii Zhurnal (ISSN 0021-0285), vol. 48, June 1985, p. 904-911. In Russian. refs

A method for computing a two-dimensional turbulent jet injected at a right angle into a channeled flow is presented, taking into account the rarefaction behind the jet. The conditions at the front

12 ENGINEERING

let boundary are approximated using a solution to a displacement flow problem and data available on the flow around elliptical bodies. The boundedness of the flow and the jet velocity to stream velocity ratio are found to have a considerable effect on the jet trajectory; the axial velocity distribution in the jet, the nondimensional velocity profiles, and the back boundary of the stream, however, are not affected noticeably by these parameters. Analytical results are corroborated by experimental data for a two-dimensional jet in free and bounded flows, exhibiting complete qualitative and partial quantitative agreement.

A85-39165

AIRPLANE MOUNTED ACCESSORY GEARBOX DESIGN

V. CUNNINGHAM (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Starting systems technology; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984. Warrendale, PA, Society of Automotive Engineers, Inc., 1984, p. 105-115.

(SAE PAPER 841605)

The characteristics required for the definition, development, and acquisition of a satisfactory Airframe-Mounted Accessory Gearbox are discussed. The areas of gearbox design that are covered include the housing, mounting pads, driveshaft, oil pumps, lubrication and cooling, types and sizes of bearings, and the resonance, balance, widths, class of gears, as well as gear scoring and gear teeth backlash. Oil filters, seals, and screens are addressed along with relief valves and sumps. Tests for load, attitude, speed, heat rejection, and for the altitude and attitude of vent systems are briefly discussed. The control of oil flow rate and of oil flow to gears and bearings are addressed. C.D

A85-39170

EXPLICIT FORMULATION FOR A HIGH PRECISION TRIANGULAR LAMINATED ANISOTROPIC THIN PLATE FINITE ELEMENT

C. JEYACHANDRABOSE and J. KIRKHOPE (Carleton University, Ottawa, Canada) Computers and Structures (ISSN 0045-7949), vol. 20, no 6, 1985, p. 991-1007 refs

An efficient formulation of the stiffness matrix is presented for a high precision triangular laminated anisotropic thin plate finite element The formulation is baed on the classical lamination theory which is reviewed binefly. The stiffness matrix is obtained simply by pre and post multiplication of a few basic matrices, which are presented explicitly. It is believed that this formulation is almost an order of magnitude faster than those available for similar order elements. In addition, the present element formulation is readily applicable as a thin flat shell element. A complete listing of FORTRAN subroutines is presented for the users, to ease implementation of the algorithm Author

A85-39240

THE FLOW PAST TWO CYLINDERS HAVING DIFFERENT DIAMETERS

A. J. BAXENDALE, I. GRANT (Henot-Watt University, Edinburgh, Scotland), and F. H. BARNES (Edinburgh, University, Edinburgh, Scotland) Aeronautical Journal (ISSN 0001-9240), vol. 89, April 1985, p 125-134. Research supported by the Science and Engineering Research Council of England. refs

The present investigation is concerned with the flow about two circular cylinders aligned parallel to each other and perpendicular to the flow, taking into account the case in which the diameter of the upstream cylinder is half that of the downstream cylinder. The experiments were performed in an open-circuit wind tunnel. The working section of the tunnel is 1.4 m long, and is octagonal in cross section with the opposite faces 0.46 m apart. The tunnel produces a uniform flow with a free-stream turbulence of less than 1 percent at 10 m/s. Measured data are presented with the aid of graphs for the case in which the cylinders are in tandem and for the case in which they are found in a staggered arrangement. Attention is given to the pressure distributions around a cylinder, the positions of the stagnation point, the Strouhal numbers, and the drag and lift coefficients. G.R.

A85-39450

NONSTATIONARY DEFORMATION OF STRUCTURAL ELEMENTS AND THEIR OPTIMIZATION [NESTATSIONARNOE DEFORMIROVANIE ELEMENTOV KONSTRUKTSII I IKH OPTIMIZATSIIA]

S. S. KOKHMANIUK, A. S. DMITRIEV, G. A. SHELUDKO, A. N. SHUPIKOV, and L. G. ROMANENKO Kiev, Izdatel'stvo Naukova Dumka, 1984, 188 p In Russian. refs

The problem of the nonstationary oscillations of deformable systems with unilateral and bilateral coupling between their elements is investigated. In particular, attention is given to the stress-strain analysis of beams, single- and multi-layer plates, and shells under gradually increasing or abruptly applied moving loads and under inertialess loading. Optimum design problems for such structures are examined, and the structural factors contributing to a stress and weight reduction in elastic bodies are discussed.

V.L.

A85-39459

SPECTRAL ANALYSIS OF OPTIMAL AND SUBOPTIMAL GYRO MONITORING FILTERS

J. I. GALDOS (MIT, Lexington, MA) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-21, May 1985, p. 372-378. refs

Gyro monitoring filters are used to estimate and correct gyro drift rates of local-level inertial navigation systems. Conventional gyro monitoring filters are usually designed based on a simplified model of gyro drift rate. Furthermore, the effectiveness of these filters - and of many filters of the 'Kalman' type - is often measured in terms of the root mean square (rms) criterion in contrast to the spectral content criterion typical of classical Wiener filtering theory. This paper has two objectives: to propose a gyro monitoring filter which is based on a more detailed model of gyro drift rate, and to propose a method of filter performance evaluation which uses as criterion a measure of the spectral content of the error process. The proposed gyro monitoringg filter is shown to have improved spectral contents resulting in superior navigation performance for the gyro error models used in the calculations (comparable to commercial-grade aircraft gyros). Author

A85-39605#

INFLUENCE OF THE BLOCKAGE RATIO ON THE EFFICIENCY OF SWIRL GENERATION WITH VANE SWIRLERS

E KILIK (California State University, Long Beach, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 6 p. refs

(AIAA PAPER 85-1103)

Four swirlers, two with flat and two with curved vanes, have been experimentally tested and compared for two blockage ratios in order to determine the influence of the blockage ratio on the aerodynamic characteristics of the downstream recirculation region and the pressure drop through the swirlers. To this end, pressure drop and flow field measurements have been made for each swirler in the issuing isothermal free swirling jets. Hot-wire anemometry and a five-hole pressure probe have been used for the measurements. Results show that the pressure drop increases with increasing blockage ratio for a fixed mass flow rate. However, the recirculation region becomes larger and stronger and the reverse mass flow rate increases

A85-39619#

EFFECTS OF INLET PRESSURE FLUCTUATIONS ON AXIAL FLOW COMPRESSORS - SOME EXPERIMENTAL AND THEORETICAL RESULTS

D. K. DAS (New York, State University, Utica, NY) and A. TRIPPI (Pisa, Universita, Pisa, Italy) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs

(AIAA PAPER 85-1135)

The effects of unsteady inlet flow on the dynamic response of a multistage axial flow compressor have been studied both theoretically and experimentally. Results from experimental tests carried out at different compressor operating points and pulsation frequencies are presented. The experimental data are then used to validate a mathematical model for the dynamic behavior of the compressor. Author

A85-39643#

FUEL DROPLET SIZE MEASUREMENTS WITH A LASER DOPPLER INTERFEROMETER

J. R. TAYLOR (General Electric Co., Aircraft Engine Business Group, Evendale, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. refs

(AIAA PAPER 85-1182)

It is pointed out that the injection and atomization of liquid fuel into a gas turbine combustion system plays a major role in many key aspects of combustion system performance. Fuel droplet diameters represent one of the parameters which determine the burning rate. The present investigation is concerned with a commercially available laser Doppler interferometer which has been used by an American manufacturer of aircraft engines to measure fuel droplet size distributions downstream of several different fuel injectors and combinations of fuel injectors and combustor dome swirl cups. The considered instrument has a very small sample volume, which permits measurements of droplet size distributions and droplet Sauter Mean Diameters (SMD) at a large number of discrete points in the spray pattern. The design and the principles of operation of the droplet sizing interferometer (DSI) are discussed along with alignment procedures, test configurations, and test results. G.R.

A85-39742#

QUANTITATIVE EVALUATION OF TRANSIENT HEAT TRANSFER ON AXIAL FLOW COMPRESSOR STABILITY

R. A. CRAWFORD (Tennessee, University, Tullahoma, TN) and A. E. BURWELL (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p. refs

(AIAA PAPER 85-1352)

An essential factor for acceptable engine performance and safety in the case of an aircraft gas turbine engine is the stable operation of the compression system. A number of basic research programs were conducted to investigate the influence of transient heat transfer effects on axial flow compressor stability. The results of these programs led to the conclusion that sound theoretical models predict a significant influence of transient heat transfer on compressor stability. However, no transient turbine engine data were available to validate model predictions. The present investigation utilizes high quality transient turbine engine data to quantify and support the reported conclusion. Attention is given to core compressor thermal energy storage, standard stability tests for gas turbine engines, transient mass flow calculations, transient heat transfer calculations, blade heat transfer flux, heat transfer results, and a comparison. G.R.

A85-39780*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NUMERICAL CALCULATION OF SUBSONIC JETS IN CROSSFLOW WITH REDUCED NUMERICAL DIFFUSION

R. W. CLAUS (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p. Previously announced in STAR as N85-25263. refs

(AIAA PAPER 85-1441)

A series of calculations are reported for two, subsonic jet in crossflow geometries. The parametric variation examined are the lateral spacing of a row of jets. The first series of calculations corresponds to a widely space jet geometry, S/D = 4, and the second series corresponds to closely spaced jets, S/D = 2. The calculations are done with alternate differencing schemes to illustrate the impact of numerical diffusion. The calculated jet trajectories agreed well with experimental data in the widely spaced jet geometry, but not in the closely spaced geometry. E A.K.

A85-39796*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

TRANSIENT TECHNIQUE FOR MEASURING HEAT TRANSFER COEFFICIENTS ON STATOR AIRFOILS IN A JET ENGINE ENVIRONMENT

H. J GLADDEN and M P. PROCTOR (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. Previously announced in STAR as N85-25794 refs (AIAA PAPER 85-1471)

A transient technique was used to measure heat transfer coefficients on stator airfoils in a high-temperature annular cascade at real engine conditions. The transient response of thin film thermocouples on the airfoil surface to step changes in the gas stream temperature was used to determine these coefficients In addition, gardon gages and paired thermocouples were also utilized to measure heat flux on the airfoil pressure surface at steady state conditions. The tests were conducted at exit gas stream Reynolds numbers of one-half to 1.9 million based on true chord. The results from the transient technique show good comparison with the steady-state results in both trend and magnitude. In addition, comparison is made with the STAN5 boundary layer code and shows good comparison with the trends. However, the magnitude of the experimental data is consistently higher than the analysis. Author

A85-39797#

DEVELOPMENT OF A NONINTERFERENCE TECHNIQUE FOR MEASURING TURBINE ENGINE ROTOR BLADE STRESSES

H. T JONES (Sverdrup Technology, Inc, Arnold Engineering Development Center, Arnold Air Force Station, TN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985, 6 p

(AIAA PAPER 85-1472)

A technique for noninterference measurement of turbine engine rotor blade stresses is being developed as an alternative to conventional strain-gage measurement systems. The noninterference blade stress-measurement technique senses blade-tip deflections and infers blade stresses by using blade-tip-deflection to stress-conversion algorithms. Blade-tip sensors, mounted on the periphery of the rotor stage, sense blade-tip passing of all blades in the stage. The resultant signals are processed to extract integral and nonintegral-type blade vibration information. A full-scale nonintegrative stress measurement system is being developed to incorporate improvements identified during testing of single-stage prototype systems. The full-scale system will have multistage capability and allow blade-tip measurements in both the cold and hot sections of turbine engines. Author

A85-39873#

AN INVESTIGATION OF HIGH PERFORMANCE, SHORT THRUST AUGMENTING EJECTORS

T. YANG, T. JIANG (Clemson University, Clemson, SC), D. R. PITTS (Tennessee, University, Knoxville, TN), and F. NTONE American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 8 p. Research supported by the South Carolina Energy Research and Development Center. refs.

(Contract N00167-81-C-0087)

(ASME PAPER 84-WA/FE-10)

The design of air-to-air, thrust augmenting ejectors having short curved wall diffusers utilizing boundary layer control is discussed. The design is achieved by an inverse method which uses the vorticity at the diffuser inlet as a flow parameter in the analysis. Three diffusers having ejector length-to-mixing chamber diameter ratios of approximately 6.1 and mixing chamber inlet area-to-primary nozzle area ratios of 20:1 and 40:1 were designed and tested. A new high level of performance was analytically predicted and achieved performances, velocity distributions and pressure distributions are presented.

A85-39878#

VERTICAL PLATE FIN WITH CONJUGATED FORCED CONVECTION-CONDUCTION TURBULENT FLOW

C.-K CHEN (National Cheng Kung University, Tainan, Republic of China), J. W. CLEAVER (Liverpool, University, Liverpool, England), and F.-S. LIEN American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec 9-14, 1984. 6 p. refs (ASME PAPER 84-WA/HT-8)

Numerical calculations of local heat transfer coefficients are presented for steady turbulent forced convection flow over a vertical plate fin. The local heat transfer coefficient is solved with the convective boundary layer equations of fluid and the heat conduction equation of fin, simultaneously. The eddy-diffusivity formulas used by Cebeci and Smith (1974) are utilized to model the Reynolds stresses. An inplicit finite difference method is employed. The results of local heat transfer coefficient and local heat flux are found to be irregular near the transition region. The overall heat transfer rate, the local heat transfer coefficient, the local heat flux and the fin temperature are presented for Pr=0.7 (air) and various values of Nc. Author

A85-39888#

INFLUENCE OF DOWNSTREAM DISTANCE ON SIMPLEX ATOMIZER SPRAY CHARACTERISTICS

N. K RIZK and A. H. LEFEBVRE (Purdue University, West Lafayette, IN) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984 7 p. refs (ASME PAPER 84-WA/HT-25)

An examination is made of the effects of variations in fuel-injection pressure and distance downstream from the nozzle on the spray characteristics of simplex swirl atomizers. Both mean drop size and drop-size distribution are measured using a commercial particle sizer as well as a conventional light-scattering technique. Evidence is presented to show that although fuel evaporation and droplet coalescence may be contributing factors, the observed variation in spray characteristics with distance downstream of the nozzle is due mainly to the different relative velocities that exist between drops of different size and the surrounding air. The results obtained by the two techniques employed in drop-size measurement are compared and show good Author agreement

A85-39897#

APPLICATION OF BOUNDARY ELEMENT METHOD TO HEAT TRANSFER COEFFICIENT MEASUREMENTS AROUND A GAS **TURBINE BLADE**

Y NAKATA and T. ARAKI (Toshiba Corp., Toshiba Research and Development Center, Kawasaki, Japan) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec 9-14, 1984. 10 p. refs (ASME PAPER 84-WA/HT-69)

Boundary-element method (BEM) with the complete linear element is developed and applied to the steady-state measurements for local heat-transfer coefficients (htc) around a gas turbine blade, especially on actual engine conditions. In the steady-state two-dimensional heat-conduction problem with convective heat-transfer boundary conditions, the solution for the inverse-mixed problem is formulated generally by BEM, where local htc or even fluid temperature may be assigned unknown at any boundary nodal point. Then, the new data-analysis technique for local htc measurements is proposed in which htc on the outside of a hollow blade is computed by BEM from measured blade temperatures on the outer surface, and several measurement simulations are demonstrated to investigate the estimation accuracy. The local htc distribution estimated with about 30 thermocouples has lain within the range of + or - 10 percent compared with the distribution that ought to be. Author

A85-39898*# Rensselaer Polytechnic Inst., Troy, N. Y. HEAT TRANSFER INVESTIGATION IN THE JUNCTION REGION OF CIRCULAR CYLINDER NORMAL TO A FLAT PLATE AT 90 **DEG LOCATION**

H. T. NAGAMATSU (Rensselaer Polytechnic Institute, Troy, NY) and J. N. HINCKEL (Instituto de Estudos Avancados, Sao Jose dos Campos, Sao Paulo, Brazil) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 7 p. refs

(Contract NSF MEA-80-06806; NAG3-292)

(ASME PAPER 84-WA/HT-70)

External heat-transfer rates were measured on a flat plate in the junction region of a circular cylinder mounted normal to the plate at a location 90 deg from the stagnation point. This configuration simulates the junction of the shroud with gas-turbine vanes. Heat-transfer results are presented for laminar, transition, and turbulent boundary layers for a Mach number of 0 14 with gas temperatures of approximately 750 deg R over a flat plate at room temperature. The measurements were made in air for a unit Reynolds number, Re/cm, range of 11,000 to 58,000. Heat-transfer measurements were conducted in the 70-ft long, 4-in. diameter shock tube. A shock-wave reflection technique was used to produce a flow Mach number of 0.14. Thin-film platinum heat gages were mounted on the flat plate and along the line of the stagnation point of the cylinder to measure the local heat flux in the junction region. The experimental heat-transfer data were correlated with the laminar and turbulent boundary-layer theories for the flat plate. With the cylinder the heat fluxes on the flat plate were greatly increased in the junction region compared to the heat flux for the plate alone. Author

A85-39899#

THE TRANSPIRED TURBULENT BOUNDARY LAYER IN VARIOUS PRESSURE GRADIENTS AND THE BLOW-OFF CONDITION

D. P. GEORGIOU and J. F. LOUIS (MIT, Cambridge, MA) American Society of Mechanical Engineers, Winter Annual Meeting, New Orleans, LA, Dec. 9-14, 1984. 8 p refs

(Contract E(49-18)-2295) (ASME PAPER 84-WA/HT-71)

Experimental data are reported from studies of the cooling effectiveness and conditions leading to blow-off in transpiration cooling (TC). The TC configuration used featured a sintered bronze plate in a hot blowdown wind tunnel Cooled air was pumped through the plate and data were gathered with calorimeters downstream of a piece of sandpaper which tripped the boundary layer Pressure taps were also used. Local pressure gradient effects were small, but local accelerations reduced the cooling effectiveness The downstream Stanton numbers were sensitive to the upstream coolant-injection ratio. Increasing the injection rate had, at best, only a small effect on the local heat flux.

M.S.K.

N85-27946*# Cleveland State Univ., Ohio.

UNSTEADY FLOW IN MULTISTAGE TURBINES Abstract Only S P SURAMPUDI In NASA. Lewis Research Center Struct. Integrity and Durability of Reusable Space Propulsion Systems p 37-38 May 1985 refs

Avail. NTIS HC A09/MF A01 CSCL 20D

The development of an efficient model for the response of a multistage turbine to either a total pressure or total temperature distortion is discussed. Each turbine blade row is modeled as an actuator disk and is often used to describe the flow through turbine and compressor blade rows. The flow approaching the blade row is assumed to be subsonic and inviscid. The distortion occurs at upstream infinity and is in the form of total pressure or total temperature. A solution was found to unsteady Euler equations by using a finite volume method. With prescribed inlet and boundary conditions flow variables such as density, pressure, and velocities can be calculated at cell centers in the entire flow region. The inlet and exit of the blade row coincide with lines of constant. E.A.K.

698

N85-27947*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

UNSTEADY HEAT TRANSFER DUE TO TIME-DEPENDENT FREE STREAM VELOCITY Abstract Only

R. S. R. GORLA and A. AMERI In NASA. Lewis Research Center Struct. Integrity and Durability of Reusable Space Propulsion Systems p 39-40 May 1985 refs Avail: NTIS HC A09/MF A01 CSCL 20D

The present work was undertaken in order to study the unsteady combined convection from a horizontal circular cylinder to a transverse flow. A coordinate perturbation method is used to transform the governing set of partial differential equations into a system of ordinary differential equations. The free stream time-dependent velocity was assumed to be sinusoidal and the boundary layer response due to both low as well as high frequencies of oscillation will be studied Currently numerical solutions are being obtained for the distribution of the unsteady Nusselt number and the friction factor. Author

N85-28140# National Aerospace Lab., Amsterdam (Netherlands).

THE APPLICATION OF NUMERICAL CONTROL (NC) IN MANUFACTURING WIND TUNNEL MODELS

1983 14 p In DUTCH; ENGLISH summary Sponsored by Netherlands Agency for Aerospace Programs

(B8580078) Avail: NTIS HC A02/MF A01

A numerically controlled milling machine with an accuracy of 0.01 to 0.02 mm adapted to the manufacturing of wind tunnel models, and a three axis measuring machine with an accuracy of 0.01 mm and a resolution of 0.05 mm on which models can be measured quickly and accurately are described. A procedure in which a given plasticine model is measured by the measuring machine to obtain the coordinates for models without numerical data is outlined. Author (ESA)

N85-28159# Joint Publications Research Service, Arlington, Va. PROPULSION EFFICIENCY OF VIBRATING BODIES IN SUBSONIC GAS STREAM Abstract Only

M N. KOGAN and M. V. USTINOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-85-004) p 83 15 May 1985 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti I Gaza (Moscow), no. 4, Jul. - Aug. 1984 p 128-132 Original language document was announced in IAA as A85-10111 Avail: NTIS HC A06/MF A01

An axisymmetric body in a subsonic gas stream, namely an airfoil periodically deforming without loss of symmetry and change of length, is examined from the standpoint of thrust-power relation. The corresponding surface-time integrals for the drag force and the propulsion power are formulated in a cylindrical system of coordinates and evaluated, assuming a potential flow of the gas with small perturbations by the body. A time-independent source distribution density term is added to this time-dependent solution to insure a positive airfoil cross-sectional area. The maximum theoretical efficiency, or minimum power for given thrust, is calculated on this basis and the shape of the body is sought for which the real efficiency will approach the maximum theoretical one as closely as possible. Making the length of the body invariable in time leads to a discretely varying drag coefficient.

N85-28191*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

MICROWAVE RESPONSES OF THE WESTERN NORTH ATLANTIC

J. M. STACEY and M. A. GIRARD 15 Feb. 1985 35 p refs Original contains color illustrations (Contract NAS7-918)

(NASA-CR-175888; JPL-PUB-85-12; NAS 1.26:175888) Avail.

NTIS HC A03/MF A01 CSCL 20N

Features and objects in the Western North Atlantic Ocean the Eastern Seaboard of the United States - are observed from Earth orbit by passive microwaves. The intensities of their radiated flux signatures are measured and displayed in color as a microwave flux image. The features of flux emitting objects such as the course of the Gulf Stream and the occurrence of cold eddies near the Gulf Stream are identified by contoured patterns of relative flux intensities. The flux signatures of ships and their wakes are displayed and discussed. Metal data buoys and aircraft are detected. Signal to clutter ratios and probabilities of detection are computed from their measured irradiances. Theoretical models and the range equations that explain passive microwave detection using the irradiances of natural sources are summarized. Author

N85-28266# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

PROCEEDINGS OF THE 9TH US AIR FORCE AND THE FEDERAL REPUBLIC OF GERMANY DATA EXCHANGE AGREEMENT MEETING, VISCOUS AND INTERACTING FLOW FIELD EFFECTS

A. W. FIORE Aug. 1984 313 p Meeting held at Silver Spring, Md., 9-10 May 1984

(AD-A153020) Avail: NTIS HC A14/MF A01 CSCL 20D

The 9th U.S Air Force/Federal Republic of Germany Data Exchange Agreement Meeting entitled Viscous and Interacting Flow Field Effects was sponsored by the Air Force Flight Dynamics Laboratory. It was held on the 9th and 10th of May, 1984 at the Naval Surface Weapons Center in Silver Spring Maryland. This report contains the detailed proceedings of that meeting It contains both theoretical and experimental results concerning a great variety of topics in the area of boundary layer research. The speed range extends from subsonic to hypersonic Mach numbers. The types of boundary layers reported include laminar, transitional, and turbulent in the presence of attached and/or separated conditions. B.W.

N85-28276# Transamerica Delaval, Inc., Santa Monica, Calif. Biphase Energy Systems.

FLOW CHARACTERISTICS OF A PARTIALLY SUBMERGED LIQUID PICKUP Final Report

D. BARTZ 17 Feb. 1984 156 p refs

(Contract DE-AC03-80ER-10687)

(DE85-008744; DOE/ER-10687/T2) Avail. NTIS HC A08/MF A01

The technology for two-phase power production is discussed. The Biphase turbine is a state-of-the-art two-phase turbine with many potential advantages, including low cost, high efficency, high torque, and simplicity: The potential exists for substantial performance improvements DOE

N85-28328# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

HEATING PARAMETER ESTIMATION USING COAXIAL THERMOCOUPLE GAGES IN WIND TUNNEL TEST ARTICLES M.S. Thesis

N. T. CAHOON Dec. 1984 132 p

(AD-A153039; AFIT/GAE/AA/84D-3) Avail. NTIS HC A07/MF A01 CSCL 09B

A heat energy balance is applied to a coaxial thermocouple gage for parameter estimation in wind tunnel test articles. This method can significantly reduce wind tunnel test costs and time. Modifications to the data reduction program HEATEST (HEATing ESTimation) are made. The programs allows for transient test techniques to be used as well as assuming an isothermal wall. A non-linear convective heat transfer coefficient model may also be used Data is generated to test the new program. Temperature profiles throughout the thermocouple gage were good and were compared with changes in time step, thermocouple length, and number of discrete node points. The estimation of the convective heat transfer coefficient and thermal conductivity were excellent. N85-28379# Argonne National Lab., III. CERAMIC TURBOCHARGERS: A CASE STUDY OF A NEAR-TERM APPLICATION OF HIGH-STRENGTH CERAMICS R. P. LARSEN and L. R. JOHNSON Aug. 1984 22 p refs (Contract W-31-109-ENG-38) (DE85-006495; ANL/CNSV-47) Avail: NTIS HC A02/MF A01

The most likely near term, high volume application of structural ceramics in heat engines is in turbocharger rotors. These will be the first mass produced ceramic components applicable to both gasoline and diesel engines. The principal objective is to estimate relative costs of ceramic turbocharger rotors vs conventional metal rotors. Thus the focus is on the economics, manufacturing, marketing strategies, and benefits related to the introduction and use of ceramic turbochargers, rather than on the detailed technical issues surrounding the microstructure and processing aspects of the new ceramic technologies. The use of ceramics first in rotors and later in other turbocharger components was significant impacts on cost, size, performance, and overall market growth of turbos DOF are given.

N85-28380# Argonne National Lab., III. Center for Transportation Research.

FUTURE OF CERAMIC TURBOCHARGERS: PROMISES AND PITFALLS

R. P. LARSEN Nov. 1984 8 p refs Presented at the 22nd Automotive Technol. Develop. Contractors' Coordination Meeting, Dearborn, Mich., 29 Oct. - 2 Nov. 1984

(Contract W-31-109-ENG-38)

(DE85-006209; CONF-8410103-9) Avail: NTIS HC A02/MF A01 The turbocharger is the most likely near term application of a mass produced ceramic component applicable to both gasoline and diesel engines. A ten fold increase in turbocharger use is projected for the US market over the next eight years, and the total worldwide demand at the end of that time will exceed six million units per year. Ceramic turbochargers are expected to play a significant role in that growth. Overall turbocharger costs could decline as much as 50% during the next eight years, largely due to the use of ceramics, and ceramic turbochargers which could capture more than 75% of the total market. The difficulties of mass producing ceramic rotors and other components are discussed as a primary pitfall to the introduction and development of this advanced technology. DOF

N85-28430# National Aerospace Lab, Amsterdam (Netherlands). Structures and Materials Dept.

ENGINEERING SIGNIFICANCE OF FATIGUE THRESHOLDS AND SHORT FATIGUE CRACKS FOR STRUCTURAL DESIGN

R. J. H WANHILL 1 Feb. 1984 15 p refs Presented at 2nd Intern. Conf on Fatigue and Fatigue Thresholds, Birmingham, England, Sep. 1984

(NLR-MP-84001-U; B8561153; AD-B090358L) Avail. NTIS HC A02/MF A01

The significance of fatigue thresholds and short fatigue cracks for engineering structures with respect to design philosophy (safety and durability, the anticipated service loads and nondestructive inspection (NDI)) are examined. Examples for spacecraft payloads, aircraft structures (including landing gear and jet engines), offshore and littoral structures, thick-walled pressure vessels, wind turbines, power generating equipment and ship propellers are given.

Author (ESA)

N85-28431# National Aerospace Lab , Amsterdam (Netherlands). Structures and Materials Div.

FRANGIBILITY OF OBSTACLES AT AIRPORTS

J. F. M. WIGGENRAAD 30 Jan. 1984 14 p refs Presented at Intern. Conf. and Exposition on Struct. Impact and Crashworthiness, London, 16-20 Jul. 1984

(NLR-MP-84002-U; B8561154; AD-B090357L) Avail: NTIS HC A02/MF A01

The idea that design requirements for the frangibility of obstacles at airports can be developed if empirical relations can be established between the damage to aircraft resulting from a collision and the energy necessary to disconnect (part of) the obstacle and to subsequently accelerate it is discussed. This approach is analogous to a procedure followed with success in the case of bird impacts. A modular structure with easily breakable joints and low fragment mass is advocated. Author (ESA)

N85-28432# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

RESEARCH ON STRUCTURES AND MATERIALS

40 p Sponsored by Netherlands Agency for refs 1983 Aerospace Programs Original contains color illustrations (B8580080) Avail: NTIS HC A03/MF A01

Research on aircraft loads, structures, and materials is described Fatigue load monitoring in service; fatigue life prediction under service loading conditions; analysis of fatigue crack propagation, and development of standardized fatigue load spectra are discussed. Buckling and post-buckling behavior of stiffened structures; deformations in crack tip zones; strength of cracked structures; and experimental deformation analysis are treated. Evaluation of advanced aluminum alloys; high temperature materials; composite materials; adhesive bonded joints; fracture; environmental fatigue; stress corrosion; and high temperature corrosion are summarized. Author (ESA)

N85-29116# National Aerospace Lab., Amsterdam (Netherlands). Technical Group ETW.

CRYOGENIC TEST TECHNOLOGY, 1984

R. J. NORTH, D. SCHIMANSKI, and J. P. HARTZUIKER, ed. Apr. 1985 28 p refs (AGARD-AR-212) Avail: NTIS HC A03/MF A01

This report reviews the new information available on cryogenic test technology since the report of the Converters' Group on Cryogenic Test Technology was written in 1981 The present position is summarized. The major events since the Converters' report have been the completion and commissioning of the National Transonic Facility (NTF), the suspension of further work on the Douglas 4-WT blowdown tunnel, the conversion of ONERA T2 for cryogenic operation, the steady progress with the DF-LP KKK, and the slow but positive progress with the ETW project, including installation of the pilot tunnel PETW. B.W.

N85-29150*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELECTRO-EXPULSIVE SEPARATION SYSTEM Patent Application

L. A HASLIM and R. D LEE, inventors (to NASA) 31 May 1985 51 p

(NASA-CASE-ARC-11613-1; NAS 1.71:ARC-11613-1;

US-PATENT-APPL-SN-739792) Avail: NTIS HC A04/MF A01 CSCL 09A

An electro-expulsive system has one or more overlapped conductors, each comprising a flexible ribbon conductor, which is folded back on itself. The conductors are embedded in an elastomeric material Large current pulses are fed to the conductors from power storage units As a result of the antiparallel currents, the opposed segments of a conductor are forcefully separated and the elastomeric material is distended. Void in the elastomer aid the separation of the conductor segments. The distention is almost instantaneous when a current pulse reaches the conductor and the distention tends to remove any solid body on the surface of the elastomenc material. NASA

N85-29186# Wisconsin Univ., Madison. Mathematics Research Center.

HYPERBOLIC PHENOMENA IN THE FLOW OF VISCOELASTIC **FLUIDS Technical Summary Report**

D. D. JOSEPH Jan. 1985 93 p

(Contract DAAG29-80-C-0041; DAAG29-82-K-0051)

(AD-A153533; MRC-TSR-2782) Avail: NTIS HC A05/MF A01 CSCL 20D

This paper treats the problem of hyperbolicity, change of type and nonlinear wave propagation in the flow of viscoelastic fluids. Rate equations for fluids with and without instantaneous elasticity are derived and discussed The equations of fluids with instantaneous elasticity are hyperbolic in unsteady flow and can change type in steady flow. The wave speeds depend on velocities and stresses. Some estimates of wave speeds into states of rest are given. For many of the popular models of fluids the vorticity is the field variable which changes type. The vorticity of all fluids with instantaneous elasticity can change type in motions which perturb rigid ones Experiments and analysis exhibiting vorticity of changing type are exhibited. The linearized viscoelastic problem is governed by equations having the properties of a telegraph equation. The damping is small when the fluid is very elastic. Elastic fluids have a long memory, a large time (Weissenberg number) for relaxation. The damping is rapid when the relaxation time is small even when the flow is very supercritical. It is shown that steady flow around a body is of transonic type. The linearized problem for flow over a flat plate is reduced to an integral equation for the vorticity distribution on the plate.

N85-29313# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst. fuer Strukturmechanik.

STRUCTURAL ANALYSIS

Nov. 1984 365 p refs In GERMAN and ENGLISH Colloq. held at Brunswick, 4 Jun. 1987 Report will also be announced as translation (ESA-TT-917)

(DFVLR-MITT-84-21; ISSN-0176-7739) Avail: NTIS HC A16/MF A01, DFVLR, Cologne DM 95

Coupling of tension and torsion in rods; field consistency in finite element analysis; buckling and post-buckling behavior of shallow shells; optimization of axially compressed carbon fiber reinforced plastic cylinders, a substructure technique applied to fracture mechanics of composites; stress intensity factors as indicators of crack propagation in unidirectional laminates; and static aeroelastic phenomena of composite wings are discussed.

Deutsche Forschungs- und Versuchsanstalt fuer N85-29314# Luft- und Raumfahrt, Brunswick (West Germany)

RESEARCH ON STRUCTURAL ANALYSIS AT THE DFVLR. BRUNSWICK

B GEIER In DFVLR Struct. Anal. p 9-40 Nov. 1984 refs In GERMAN; ENGLISH summary

Avail. NTIS HC A16/MF A01; DFVLR, Cologne DM 95

The science of structural mechanics is reviewed, emphasizing computational problems in aerospace research. Lightweight construction with composite materials is defined as the central topic. In an assessment of the present state of the art, it is concluded that a very satisfactory situation is achieved in the analysis of linear problems, but not in the solution of nonlinear problems and in structural optimization. Author (ESA)

Deutsche Forschungs- und Versuchsanstalt fuer N85-29321# Luft- und Raumfahrt, Brunswick (West Germany). Inst fuer Strukturmechanik.

THE STATIC AEROELASTICITY OF A COMPOSITE WING

M PIENING In its Struct, Anal. p 319-364 Nov. 1984 refs In GERMAN; ENGLISH summary

Avail NTIS HC A16/MF A01; DFVLR, Cologne DM 95

parametric investigations procedure Α for of the static-aeroelastic behavior of anisotropic wings with average to large aspect ratio was developed. By exploiting the directional stiffness properties of a composite material, coupling of bending and torsional deformations can be achieved. This can be used to influence the spanwise lift distribution, the internal structural forces, and the permissible flying speeds limited by the aeroelastic behavior of the wing Static divergence can be avoided and forward wing sweep can be realized. The differential equations describing the aeroelastic behavior of a beamlike wing structure are solved by applying the multiple shooting method. Examples show the effects of fiber orientations on lift distributions of a composite wing.

Author (ESA)

N85-29325# Aeronautical Research Labs., Melbourne (Australia).

DESCRIPTION AND ILLUSTRATION OF THE USE OF CRACKS IV

C. S DENTRY Aug. 1984 62 p (AD-A153543; ARL/STRUC-TM-389) Avail: NTIS HC A04/MF A01 CSCL 20K

This Memorandum provides an explanation of the procedure required to implement the computer program CRACKS IV for the calculation of crack growth rates. The procedure is illustrated by means of sample calculations. Author (GRA)

13

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion, environment pollution, geophysics; meteorology and climatology; and oceanography.

A85-37720

FURTHER OBSERVATIONS OF X-RAYS INSIDE THUNDERSTORMS

M. MCCARTHY and G. K PARKS (Washington, University, Seattle, WA) Geophysical Research Letters (ISSN 0094-8276), vol. 12, June 1985, p. 393-396.

(Contract NSF ATM-83-00164; NSF ATM-84-07143)

A control and an X-ray detector were flown into thunderstorms in 1984. The X-ray detector found statistically significant radiation flux increases in the energy range from 5 to over 110 keV for time intervals of several seconds each. Simultaneously, the control detector showed no statistically significant changes. The X-ray flux is sometimes seen to increase prior to observed lightning discharges and then return to background levels within 0.1 seconds of a lightning flash initiation. The temporal development of these X-ray bursts is discussed and related to inferring the scale size of the X-ray emitting regions. Author

A85-39213#

AIRCRAFT PERFORMANCE IN A JAWS MICROBURST

W. FROST (Tennessee, University; FWG Associates, Inc., Tullahoma, TN), H.-P. CHANG (Tennessee, University, Tullahoma, TN), J. MCCARTHY, and K L. ELMORE (National Center for Atmospheric Research, Boulder, CO) (Conference on Radar Meteorology, 21st, Edmonton, Alberta, Canada, September 19-23, 1983, Preprints, p. 630-637) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 561-567 NSF-NOAA-supported research. Previously cited in issue 12, p. 1774, Accession no. A85-28776. refs

(Contract DOT-FA01-82-Y-10513)

A85-39218#

MODEL OF THE WIND FIELD IN A DOWNBURST

S. ZHU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China, Toronto, University, Toronto, Canada) and B ETKIN (Toronto, University, Toronto, Canada) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 595-601. refs

The downburst weather phenomenon produces a flow like that of a jet directed vertically downward at the ground. The resulting velocity field near the ground has been modeled as a classical ideal fluid flow generated by a suitable singularity distribution. The resulting model of horizontal, lateral, and vertical winds near the ground is quite realistic, and very useful for investigating landing and takeoff of airplanes under downburst conditions. It can be used both for analysis and on-line real-time simulations. Author

New Mexico Inst. of Mining and Technology, A85-39526* Socorro.

NIGHTTIME **OBSERVATIONS** OF THUNDERSTORM ELECTRICAL ACTIVITY FROM A HIGH ALTITUDE AIRPLANE M. BROOK, C. RHODES (New Mexico Institute of Mining and Technology, Socorro, NM), O. H. VAUGHAN, JR. (NASA, Marshall Space Flight Center, Huntsville, AL), R. E ORVILLE, and B. VONNEGUT (New York, State University, Albany, NY) (National Science Foundation, International Conference on Atmospheric Electricity, 7th, Albany, NY, June 4-8, 1984) Journal of Geophysical Research (ISSN 0148-0227), vol. 90, June 30, 1985, p. 6111-6120. refs

(Contract NAS8-32893; NAS8-33380; NAS8-33817;

N00014-80-C-0312; N00014-84-K-0069; F19628-78-C-0007; NSF ATM-79-21080; NSF ATM-80-26533)

Observations of nocturnal thunderstorms from three aerial cameras flown at an altitude of 20 km and at an airspeed of 200 m/s are analyzed and compared with previous ground-based observations. Both diffuse illumination in the cloud and unobscured segments of lightning channels a kilometer or longer in clear air around and above the cloud are observed. A similarity is noted to exist between the airborne and the ground-based lightning spectra registered It is further asserted that discrimination between cloud-to-ground and intracloud flashes and the counting of ground strokes can be achieved through the use of optical pulse pairs identified with leader return-stroke events in the cloud-to-ground flashes studied. L.T.

N85-28450# Naval Weapons Center, China Lake, Calif. NAVY GEOTHERMAL PLAN

Dec. 1984 21 p

(AD-A152478; AD-E900438; NWC-TP-6612) Avail: NTIS HC A02/MF A01 CSCL 08G

Domestic geothermal resources with the potential for decreasing fossil fuel use and energy costs exist at a significant number of Navy facilities. The Geothermal Plan is part of the Navy Energy R and D Program that will evaluate Navy sites and provide a technical. economic, and environmental base for subsequent resource use. One purpose of the Program will be to provide for the transition of R and D funded exploratory efforts into the resource development phase. GRA

N85-28458# Sandia Labs., Albuquerque, N Mex. FIELD TEST REPORT OF THE DEPARTMENT OF ENERGY'S 100-KW VERTICAL AXIS WIND TURBINE

R. O. NELLUMS Feb 1985 61 p refs

(Contract DE-AC04-76DP-00789)

(DE85-008475; SAND-84-0941) Avail: NTIS HC A04/MF A01

Three second generation Darrieus type vertical axis wind turbines of approximately 120 kW capacity per unit were installed in 1980-1981. Through March 1984, over 9000 hours of operation had been accumulated, including 6600 hours of operation on the unit installed in Bushland, Texas. The turbines were heavily instrumented and have yielded a large amount of test data. Test results of this program, including aerodynamic, structural, drive train, and economic data are presented. Among the most favorable results were an aerodynamic peak performance coefficient of 0.41; fundamental structural integrity requiring few repairs and no major component replacements as of March 1984; and an average prototype fabrication cost of approximately \$970 per peak kilowatt of output. A review of potential design improvements IS presented. DOF

N85-28463# Department of Energy, Washington, D. C. Wind Technology Div.

A 5-YEAR RESEARCH PLAN, 1985-1990. WIND ENERGY TECHNOLOGY: GENERATING POWER FROM THE WIND Jan. 1985 35 p refs

(DE85-008427; DOE/CE-T11) Avail: NTIS HC A03/MF A01

The Department of Energy's current view of the research requirements for wind energy technology is presented. The goal of the Federal Wind Energy Program is to conduct research to establish a technology base and to support industry in confirming the viability of wind energy as an energy supply alternative. The federal program plan for achieving the good is outlined, and activities planned for fiscal years 1985 through 1989 are described. The four main features of the strategy are: (1) to identify how improvements in wind technology can be achieved; (2) to provide a framework for research and development activities; (3) to provide a management plant to ensure that progress is attained; and (4) to recognize the critical importance of an effective partnership between government and industry. DOE

N85-28471# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst. fuer Physik der Atmosphaere.

INVESTIGATION OF AIR POLLUTION IMPACT IN EASTERN BAVARIA: MEASUREMENT RESULTS FROM AUGUST AND SEPTEMBER, 1984

D. PAFFRATH, W PETERS, and J. LIDL refs In GERMAN; ENGLISH summary Jan 1985 137 p

(DFVLR-FB-85-03; ISSN-0171-1342) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 29

Measurement results of the spatial distribution of SO2, NO, O3 and particles, obtained using aircraft and vans, are presented. The distribution of impact of the various components in relation to meteorological conditions and the influence of local pollution sources is discussed. Author (ESA)

N85-29364*# Toledo Univ., Ohio WAKE EFFECTS ON THE AERODYNAMIC PERFORMANCE OF HORIZONTAL AXIS WIND TURBINES

A. A. AFJEH Aug. 1984 176 p refs (Contract NCC3-5, DE-AI01-76ET-20320)

(NASA-CR-174920; DOE/NASA/0005-1; NAS 1 26:174920)

Avail. NTIS HC A09/MF A01 CSCL 10A

Success of vortex theories in the performance analysis of horizontal axis wind turbines depends greatly upon accurate specification of the geometry of the vortex wake. Two analysis methods were developed, a new simplified free wake method (SFW) and a prescribed wake method. An earlier wake model of helicopter rotors is extended for wind turbine applications, the fast free wake method (FFW). The FFW was accomplished by partitioning the flow field downstream of the rotor into three regions: (1) the near wake, modeled as a series of straight vortex lines, (2) the intermediate wake, modeled as a number of vortex rings; and (3) the far wake, taken to be a semi-infinite cylindrical wake. In the SFW, a new wake model is proposed. The model assumes that the wake is composed of an intense tip vortex and a diffused inboard wake, consistent with the experimentally observed wake of hovering helicopters. It is assumed that the vortex formation was almost immediate as opposed to the actual gradual rolling-up of the tip vortex. The method is demonstrated by assuming that the wake expansion can be represented by an analytical expression. E.A.K.

N85-29432*# National Aeronautics and Space Administration, Washington, D C.

CONTRIBUTIONS ON THE SUBJECT OF LONGITUDINAL MOVEMENTS OF AIRCRAFT IN WIND SHEARS Ph.D. Thesis -Technischen Univ., 1983

P. KRAUSPE Jun. 1985 228 p refs Transl. into ENGLISH of German Thesis p 1-233 Original language document was announced in IAA as A84-45526 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASW-4004)

(NASA-TM-77837; NAS 1.15:77837) Avail: NTIS HC A11/MF A01 CSCL 04B

The effect of downburst-type wind shears on the longitudinal dynamic behavior of an unguided aircraft is simulated numerically on the basis of published meteorological data and the flight characteristics of an A300-B passenger jet. The nonlinear differential equations of the aircraft motion are linearized by conventional methods, and the wind effects are introduced via the linear derivatives of the wind components referred to the wind gradients to obtain simplified technical models of the longitudinal response to all possible types of constant-gradient wind shears during the first 20-60 sec. Graphs, maps, and diagrams are provided, and a number of accidents presumed to have involved wind shears are analyzed in detail. (IAA)

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A85-37198#

FIRST-ORDER FEEDBACK STRATEGIES FOR VARIABLE SPEED PLANAR PURSUIT-EVASION GAMES

H. G. VISSER and J. SHINAR (Technion - Israel Institute of Technology, Haifa, Israel) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 165-178. refs

A variable speed planar non-linear pursuit-evasion game between two aircraft is analyzed using a singular perturbation technique. Based on the experience with a singular perturbation dynamic model for a one-sided optimal control version of a planar interception, a singular perturbation model is formulated by including velocity dynamics in the 'reduced-order' problem. Analytic first order corrections are developed and incorporated in the feedback control strategies of both pursuer and evader. Both zeroth-order and first-order singular perturbation approximations are compared with the exact open-loop solution. The results obtained in the numerical examples are satisfactory and encouraging. Additional experiments are required to determine the entire domain of validity of the first-order SP algorithm. The resulting computatinal algorithm is attractive for both ground based simulation and airborne implementation.

A85-37211#

INTEGRATED CADCAM - AN APPROACH FOR ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURE

 T. R. LOGAN (Boeing Commercial Airplane Co., Seattle, WA) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers . Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 309-317 refs This paper surveys integrated CADCAM systems for advanced

This paper surveys integrated CADCAM systems for advanced composite application and reviews an integrated CADCAM project to support advanced composite primary structure development. That interactive computer graphic approach is based on integrated system architecture and database design. Development moves through a classical system life cycle but is supplemented by pilot system development and evaluation as a precursor to production system definition. The survey outlines development steps and discusses experience gained to date during the pilot portion of the project, as well as longer range goals. Author

A85-37396

ROBOTIC DRILLING OF ACRYLIC WINDSHIELDS AND CANOPIES FOR FIGHTER AIRCRAFT

L C. CRISLER (McDonnell Aircraft Co., St. Louis, MO) IN: National Technical Conference, 16th, Albuquerque, NM, October 9-11, 1984, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1984, p. 417-427.

This paper describes a robot drilling cell which is used to drill large assemblies such as windshields and canopies of fighter aircraft The cell was developed by McDonnell Douglas Corporation under an Air Force funded contract entitled 'Advanced Robotic System Technologies and Applications, Task C' The drilling cell is off-line programmed with MCL (Manufacturing Control Language), driven with a microprocessor based hierarchical control system,

15 MATHEMATICAL AND COMPUTER SCIENCES

and utilizes vision, tactile, and discrete sensors. Subjects that will be addressed will include the multiple level control system, the material handling and parts presentation methods, the automatic cell calibration and diagnostic systems, and each of the cell devices such as the robot, drill motors, end effector, vision system, and tactile sensors. Author

A85-39551#

NEW CONCEPTS IN CONTROL THEORY, 1959-1984 (DRYDEN LECTURESHIP IN RESEARCH)

A. E. BRYSON, JR. (Stanford University, Stanford, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p 417-425. Previously cited in issue 06, p. 723, Accession no. A84-17920. refs

A85-39563#

A MISSILE DUEL BETWEEN TWO AIRCRAFT

B. JARMARK (Saab-Scania AB, Linkoping, Sweden) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p. 508-513. refs

A delicate differential game is formed by two aircraft performing a long-range missile duel. The duel starts for each aircraft with a semiaggressive phase until the launch of the missile, when a pure evasion commences. In numerically solving the nonlinear differential game problem, an optimization algorithm is used consisting of a modified first-order differential dynamic programming method combined with an effective convergence-control technique. The three-dimensional spatial motion of point mass vehicles with realistic models is treated. The results of optimizing the problem point out the potential of new tactics. If the vehicles are free to maneuver in altitude, the contributions from the missiles will dominate the outcome of the game. Of particular importance is the desirable ability to enter the game at a higher altitude than that of the opponent.

A85-39564*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A MULTILOOP ROBUST CONTROLLER DESIGN STUDY USING SINGULAR VALUE GRADIENTS

J. R. NEWSOM (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) and V MUKHOPADHYAY (Joint Institute for Advancement of Flight Sciences, Hampton, VA) (Guidance and Control Conference, Gatlinburg, TN, August 15-17, 1983, Collection of Technical Papers, p. 173-180) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug. 1985, p. 514-519 Previously cited in issue 19, p. 2891, Accession no. A83-41677. refs

A85-39565#

TIME-DOMAIN STABILITY ROBUSTNESS MEASURES FOR LINEAR REGULATORS

R. K. YEDAVALLI (Stevens Institute of Technology, Hoboken, NJ), S. S. BANDA, and D. B. RIDGELY (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, July-Aug 1985, p. 520-524. refs

(Contract AF-AFOSR-83-0139, F33615-84-K-3606)

The stability robustness aspect of linear systems is analyzed in the time domain. A bound on the perturbation of an asymptotically stable linear system is obtained to maintain stability using Liapunov matrix equation solution. The resulting bound is shown to be an improved upper bound over the ones recently reported in the literature. The proposed methodology is then extended to Linear Quadratic (LQ) and Linear Quadratic Gaussian (LQG) regulators. Examples given include comparison with an aircraft control problem previously analyzed. ₩85-28708*# National Aeronautics and Space Administration, Washington, D. C.

ADDING COMPUTATIONALLY EFFICIENT REALISM TO MONTE CARLO TURBULENCE SIMULATION

C. W. CAMPBELL May 1985 21 p refs (NASA-TP-2469; M-485; NAS 1.60:2469) Avail: NTIS HC A02/MF A01 CSCL 12B

Frequently in aerospace vehicle flight simulation, random turbulence is generated using the assumption that the craft is small compared to the length scales of turbulence The turbulence is presumed to vary only along the flight path of the vehicle but not across the vehicle span. The addition of the realism of three-dimensionality is a worthy goal, but any such attempt will not gain acceptance in the simulator community unless it is computationally efficient. A concept for adding three-dimensional realism with a minimum of computational complexity is presented. The concept involves the use of close rational approximations to irrational spectra and cross-spectra so that systems of stable, explicit difference equations can be used to generate the turbulence. Author

N85-28712# National Aerospace Lab., Amsterdam (Netherlands).

OPERATIONS RESEARCH

In DUTCH; ENGLISH summary Sponsored by 1983 15 p Netherlands Agency of Aerospace Programs

(B8561897) Avail: NTIS HC A02/MF A01

Research projects were carried out to improve the effectiveness and safety of civil and military aircraft operations. Quantitative methods such as (computer) simulations (either on a deterministic or statistical basis), network planning, and linear programming are used. Intercontinental and continental civil aircraft traffic; air traffic in the vicinity of airports; and ground traffic at airports are discussed. Military flight path measurements, low level and ground attack missions, and electronic countermeasures are discussed.

Author (ESA)

N85-29099# Joint Publications Research Service, Arlington, Va **MBB EXPANDS CADAM SYSTEM FOR A 320 PROGRAM**

In its West Europe Rept.: Sci. and Technol. (JPRS-WST-84-032) p 23-24 25 Sep. 1984 Transl. into ENGLISH from Flug Rev. (Stuttgart), Aug. 1984 p 82-83

Avail: NTIS HC A03/MF A01

The use of computers in aircraft design in West Germany is discussed Monitor screens are used extensively in computer aided design or the European Airbus. Time gain in drafting and drafting modifications is an important feature. E.R.

National Aeronautics and Space Administration. N85-29686*# Ames Research Center, Moffett Field, Calif.

EXTRACTION OF AERODYNAMIC PARAMETERS FOR AIRCRAFT AT EXTREME FLIGHT CONDITIONS

K. W. ILIFF May 1985 24 p refs Presented at the AGARD Symp. on Unsteady Aerodyn. Fundamentals and Appl. to Aircraft Dyn., Goettingen, West Germany, 6-9 May 1985

(NASA-TM-86730; H-1290; NAS 1.15:86730; AGARD-PAPER-24) Avail: NTIS HC A02/MF A01 CSCL 12B

The maximum likelihood estimator has been used to extract stability and control derivatives from flight data for many years. Most of the literature on aircraft estimation concentrates on new developments and applications, assuming familiarity with basic concepts. This paper briefly discusses the maximum likelihood estimator and the aircraft equations of motion that the estimator uses. The current strength and limitations associated with obtaining flight-determined aerodynamic coefficients in extreme flight conditions is assessed. The importance of the careful combining of wind tunnel results (or calculations) and flight results and the thorough evaluation of the mathematical model is emphasized The basic concepts of minimization and estimation are examined for a simple computed aircraft-example, and the cost functions that are to be minimized during estimation are defined and discussed. Graphic representations of the cost functions are given to help illustrate the minimization process. Finally, the basic

concepts are generalized, and estimation of stability and control derivatives from flight data is discussed. Author

16

PHYSICS

Includes physics (general); acoustics, atomic and molecular physics; nuclear and high-energy physics; optics, plasma physics; solid-state physics; and thermodynamics and statistical physics.

A85-37209#

INTERACTION BETWEEN ACOUSTICS AND SUBSONIC DUCTED FLOW IN A RAMJET CONFIGURATION

E. GUTMARK (Southern California, University, Los Angeles, CA) and K. C. SCHADOW (U.S. Navy, Naval Weapons Center, China Lake, CA) IN: Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers Haifa, Israel, Technion - Israel Institute of Technology, 1984, p. 289-296. refs

A subsonic ducted air flow was studied experimentally using a hot-wire anemometer and a high frequency response pressure transducer. The experiments were performed in three stages. A free jet, a jet discharged into an open and closed duct and a forced jet in a closed duct. The shear layer instability frequencies associated with the initial vortex shedding, first vortex merging, and jet-column instability were identified in the unforced cases. Subsequently, the interaction of the jet flow with the first longitudinal pressure mode excited in the acoustic cavity was studied. The highest response of the jet flow to the acoustic wave was obtained when the forcing frequency matched the local most amplified frequency, for example, the first vortex merging frequency in the initial shear layer or the preferred jet frequency at the end of the potential core. Author

A85-37583#

AN IMPROVED PROCEDURE FOR CALCULATING THE AEROTHERMODYNAMIC PROPERTIES OF A VITIATED AIR TEST MEDIUM

E. S. POWELL (Calspan Corp., Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 20th, Williamsburg, VA, June 19-21, 1985. 12 p. refs

(AIAA PAPER 85-0913)

The work reported is the development of an analytic procedure for the prediction of the aerothermodynamic properties of a test medium composed of the products of combustion of a hydrocarbon in air. The analytic forms chosen to represent the properties are based on results from statistical thermodynamics. The parameters in the analytic forms are evaluated using a generalized least-squares technique. The major steps in the development of the procedure are discussed. The results are shown to be accurate in comparison to the best available data base, internally consistent, and acceptable for modest extrapolations. The numerical results are specific to one facility, but the approach is applicable to any similar facility. Application of the procedure developed will allow aerodynamic data obtained in a vitiated air test medium to be analyzed with confidence. Author

A85-37898* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

POWER SPECTRAL DENSITY OF SUBSONIC JET NOISE

K. B M. Q. ZAMAN and J. C. YU (NASA, Langley Research Center, Hampton, VA) Journal of Sound and Vibration (ISSN 0022-460X), vol. 98, Feb. 22, 1985, p. 519-537. refs

The power-spectrum density (PSD) of the far-field noise of a subsonic unheated axisymmetric jet is investigated by analysis of about 80 sets of published noise spectra and of spectra obtained using 12.7 and 25.4-mm-diameter compressed-air jets at exit velocities 66 and 104 m/s and 67 and 91 m/s, respectively, in

the NASA Langley anechoic flow facility. The results are presented in tables and graphs and characterized in detail. Findings reported include Strouhal-number scaling of the PSD at theta = 30 deg or more, scaling with the product of the Helmholtz number and the Doppler factor at theta less than 30 deg, best collapse at source convection Mach number 0.5, variation of PSD amplitude as U to the 6.5th at theta = 90 deg, and no sharp PSD-amplitude variation at any critical Reynolds number. T.K.

A85-38432

AERODYNAMIC SOUND GENERATION CAUSED BY VISCOUS PROCESSES

F OBERMEIER (Max-Planck-Institut fuer Stroemungsforschung, Gottingen, West Germany) Journal of Sound and Vibration (ISSN 0022-460X), vol. 99, March 8, 1985, p. 111-120. refs

A theoretical investigation of the effects of viscosity on aerodynamic sound generation by unheated low Mach-number flow is discussed. By means of the method of matched asymptotic expansions, which allows for a consistent estimation of the order of magnitude of each term in the hydrodynamic flow field as well as in the sound field, an analytical solution in terms of a multipole expansion is derived. The physical interpretation of the mathematical outcome of various theories by Morfey (1976), Kempton (1976), Hardin, and Kambe and Minota (1983) is compared and re-examined. M.D.

A85-39220#

NOISE OF COUNTER-ROTATION PROPELLERS

D. B. HANSON (United Technologies Corp., Aircraft Systems Dept., Windsor Locks, CT) Journal of Aircraft (ISSN 0021-8669), vol. 22, July 1985, p. 609-617. Previously cited in issue 01, p 73, Accession no. A85-10856 refs

A85-39349

THE BATTLE AGAINST NOISE IN INDUSTRY [BOR'BA S SHUMOM NA PROIZVODSTVE]

E. IA. IUDIN, ED. Moscow, Izdatel'stvo Mashinostroenie, 1985, 400 p. In Russian. No individual items are abstracted in this volume.

The physiological effects of noise in manufacturing plants and other industrial facilities are discussed, and several common noise abatement methods are described. Consideration is given to the acoustic properties of three types of noise which are present in industrial plants: aerohydrodynamic noise; mechanical noise; and electromagnetic noise. Among the specific noise abatement techniques discussed are: sound isolation by means of noise-absorbant screens, insulation or noise-emitting media; and acoustic interference The use of earplugs and external ear protectors for protection of individual workers in noisy work environments is also considered.

N85-28784 Department of the Air Force, Washington, D.C. OPTICAL SYSTEM FOR MEASURING SHADOWGRAPH DATA Patent

E. O COLE and V. H. YETERIAN, inventors (to Air Force) 19 Feb. 1985 11 p Supersedes AD-D009952

(AD-D011642; US-PATENT-4,500,206,

US-PATENT-APPL-SN-434671; US-PATENT-CLASS-356-376) Avail: US Patent and Trademark Office CSCL 17H

An optical system for measuring azimuth and elevation angular data for making a shadowgraph of an object under study is discussed. The system includes a pair of scaled assemblies which are secured together perpendicular to each other, with each of the scaled assemblies having degree markings thereon. An object under study, such as a scale model of an aircraft, is positioned within an imaginary sphere formed by the two scaled assemblies Azimuth and elevation angular measurements are then obtained by the use of laser systems as the model aircraft is rotated within the imaginary sphere of the ring assemblies. GRA N85-28916# Loughborough Univ of Technology (England). ROTORCRAFT NOISE

J. B. OLLERHEAD In AGARD Helicopter Aeromech. 38 p Apr. 1985 refs

Avail: NTIS HC A15/MF A01

The mechanisms of rotor noise generation are reviewed including methods for noise prediction and low noise design. Attention is focussed on the subjective effects of helicopter noise and the consequent requirements for statutory noise regulation. The economic and operational implications are discussed.

G L.C.

17

SOCIAL SCIENCES

Includes social sciences (general), administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A85-37950#

COSTS AND TARIFF LEVIES IN AIR TRANSPORTATION [COSTES Y TARIFACION EN EL TRANSPORTE AEREO]

R. MONTERO MORENO (Iberia Lineas Aereas de Espana, Madrid, Spain) IAA/Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), Feb. 1985, p. 27-33. In Spanish.

An evaluation is made of the factors which uniquely enter into the assessment of commercial air transportation tariff rates by regulatory bodies. Attention is given to such measures of commercial productivity as seats/route, seats/km, and yield and load factors. A brief historical account is given of the evolution of aeronautical tariffs, and a comparative account is given of the international and national tariff practices currently encountered; the latter are with reference to Spain. OC.

A85-39369

AIR TRANSPORT DEREGULATION - THE US EXPERIENCE AND ITS APPLICABILITY TO EUROPE

I. M. STELZER (National Economic Research Associates, Inc., England) (Institute of Air Transport, Symposium, Paris, France, May 1984) Aerospace (UK) (ISSN 0305-0831), vol. 12, June-July 1985, p. 18-22. refs

An assessment is conducted for the thesis that 'American-style deregulation', involving free market entry and competitively determined fare structures, can as successfully be applied to Europe as it has been to the U.S. In addition to evaluating the fare reductions effected by U.S. deregulatory experience, attention is given to deregulation's effect on quality and variety of services, operating costs and efficiencies, profitability, and safety. The benefits derived to date from partial deregulation measures by the British and Dutch, and the prospects for European Economic Community acceptance of a deregulatory program, are discussed.

N85-28871# National Aerospace Lab., Amsterdam (Netherlands).

TECHNICAL SERVICES AT NLR

1983 19 p refs (B8561898) Avail: NTIS HC A02/MF A01

The organization and activities of the technical design department, technical projects department, and workshops of the Netherlands National Aerospace Laboratory are outlined.

Author (ESA)

N85-29838# Air Force Logistics Management Center, Gunter AFS, Ala.

AUTOMATED MAINTENANCE SYSTEM TEST PROGRAM INCREMENT VI PRODUCTION SCHEDULING Final Evaluation Report

L. J. CHAMBERS Oct. 1984 45 p

(AD-A153694; AD-F630669; AFLMC-LM760720) Avail. NTIS HC A03/MF A01 CSCL 051

The purpose of this report is to document evaluation results of automated production scheduling processes within the Automated Maintenance System (AMS). The processes were developed and tested at Dover AFB, Delaware. Maintenance management functions affected by AMS Increment includes scheduling and tracking of reparable parts and items requiring calibration. Workcenters affected at the time of the appraisal included all Avionics Maintenance shops, the Avionics Reparable Processing Center (RPC), and the Field Maintenance Environmental Systems Shop. This report contains the evaluation methodology, findings and recommendations for future program development. GRA

N85-29839# Air Force Logistics Management Center, Gunter AFS, Ala.

DEPLOYABLE CORE AUTOMATED MAINTENANCE SYSTEM (DCAMS)

D. M. CRIPPEN, S. E. ALTEN, and J. K. SHAW Aug. 1984 17

(AD-A153695; AD-F630671; AFLMC-LM831215) Avail: NTIS HC A02/MF A01 CSCL 15E

We examined hardware requirements for development of a Deployable Core Automated Maintenance System (DCAMS). Our six alternatives covered the spectrum from a mainframe computer, the Tactical Shelter System, to the Air Force standard microcomputer, Zenith Z-100. Criteria used for the evaluation looked at ease of maintenance, survivability, physical characteristics, transportability, and compatibility with CAMS We recommend using a microcomputer network to best satisfy the hardware requirement for DCAMS. Since DCAMS is not funded, we also recommend an interim system be developed by the AFLMC to provide limited support until DCAMS is ready. The system would be developed on the AF standard microcomputer and provide engine tracking, scheduled maintenance requirements, and aircraft status information. GRA

N85-29841# Naval Postgraduate School, Monterey, Calif. USING INCENTIVES TO IMPROVE MAINTAINABILITY M.S. Thesis

L. FARNEN, JR. Dec. 1984 93 p

(AD-A153792) Avail: NTIS HC A05/MF A01 CSCL 05A

The objective of this thesis was to determine if contract incentives were appropriate for use in Dept. of Defense contracts for the purpose of motivating defense contractors to improve the maintainability of weapon systems under design. To accomplish the objective it was necessary to review the components of maintainability to determine appropriate targets for the incentives and to study the concepts and issues involved in the use of incentives to motivate contractor performance. The conclusions were based in part of the responses obtained during interviews conducted with Government representatives and engineering, contracting, and corporate and program management personnel from the defense industry. In addition, the incentive program in the case of the F/A-18 aircraft was reviewed and analyzed to determine the reason for its success. GRA

N85-29844# Politecnico di Tonno (Italy). Dept. of Aerospace Engineering.

ACTIVITIES OF THE DEPARTMENT OF AEROSPACE ENGINEERING Annual Report, 1983

Apr. 1984 39 p refs

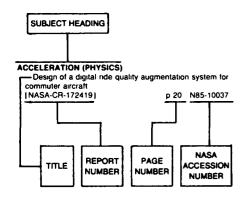
Avail: NTIS HC A03/MF A01

Research in aeronautics and astronautics; fluid dynamics and propulsion; structures and materials; and systems engineering and management is summarized. Wind tunnel tests on commercial aricraft models, incompressible, transonic, and supersonic flow tests; laser interactions, biomedical fluid dynamics; advanced composite aircraft structures; and aircraft instrumentation are discussed. Author (ESA)

SUBJECT INDEX

OCTOBER 1985

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first

Δ

A-310 AIRCRAFT

- The cockpit of the Airbus A310 p 655 A85-37896 A-320 AIRCRAFT
- p 646 A85-37946 A 320 - Third generation Airbus
- ABLATION Experimental research on the effect of separation flow
- on ablation in supersonic turbulent flow p 694 A85-37625 [AIAA PAPER 85-0975] Stability of a stationary solution to the ablation p 623 A85-38555 equation
- **ACCELERATED LIFE TESTS** Accelerated testing of gas-turbine aircraft engines using
- the 'softening' method p 660 A85-39118 ACCELEROMETERS Description and test methods for a frequency output
- accelerometer p 694 A85-38536 ACCURACY From measurement uncertainty to measurement

communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 **ACOUSTIC ATTENUATION**

- Approach to interior noise control I Damped trim p 650 A85-39221 panels The battle against noise in industry
- p 705 A85-39349 ACOUSTIC EXCITATION
- Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 ACOUSTIC PROPAGATION
- Interaction between acoustics and subsonic ducted flow p 704 A85-37209 in a ramjet configuration The effectiveness of acoustic repellants in frightening p 639 A85-37543 birds away from airports
- ACOUSTIC RETROFITTING Meeting the 1985 FAA noise regulations with old engines
- and modern acoustic technology [AIAA PAPER 85-1120] p 651 A85-39616

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CTIVE CONTROL
Development of an active laminar flow nacelle
[AIAA PAPER 85-1116] p 629 A85-39613
Active Control Systems Review, Evaluation and
Projections
[AGARD-CP-384] p 676 N85-27883
Active Control Technology (ACT) Past, present and
future p 676 N85-27884
The state-of-the-art and future of flight control
systems p 677 N85-27885
A perspective on superaugmented flight control advantages and problems p 677 N85-27886
advantages and problems p 677 N85-27886 Aspects of application of ACT systems for pilot workload
alleviation p 677 N85-27887
X-29 digital flight control system design
p 677 N85-27889
The evolution of ACS for helicopters Conceptual
simulation studies to preliminary design
p 677 N85-27890
Some flight test results with redundant digital flight
control systems p 678 N85-27892
ACT flight research experience p 678 N85-27894
Flight testing and development of the F/A-18A digital
flight control system p 678 N85-27896
OLGA An open loop gust alleviation system
p 678 N85-27897
Demonstration of relaxed static stability on a commercial
transport p 679 N85-27898
Active control landing gear for ground load alleviation
p 679 N85-27902
Wing buffeting active control testing on a transport
aircraft configuration in a large sonic windtunnel
p 679 N85-27903
How to handle failures in advanced flight control systems
of future transport aircraft p 679 N85-27905
The evolution of active control technology systems for
the 1990's helicopter p 680 N85-27911
CTUATORS
Rationalizing the choice of an actuating mechanism for
a jet drive p 661 A85-39124
DAPTIVE CONTROL
Integrated flight/propulsion control - Adaptive engine
control system mode
[AIAA PAPER 85-1425] p 669 A85-39772
Automatic flight control modes for the AFTI/F-111
mission adaptive wing aircraft p 680 N85-27909
DDITIVES
Jet fuel instability mechanisms
[NASA-CR-175856] p 690 N85-28127
DHESIVE BONDING
Reducing the effects of rivet holes on fatigue life by
adhesive bonding p 693 A85-37472
The bonding of materials for propulsion systems
p 687 A85-39175
Fracture toughness of adhesively bonded joints
p 688 A85-39492
DHESIVES
An overview of structural repair adhesives
p 686 A85-37407
The bonding of materials for propulsion systems
p 687 A85-39175
ERIAL RUDDERS
Characteristics of the oscillations of a tail unit in a flow
of an incompressible gas p 649 A85-39125
ERODYNAMIC CHARACTERISTICS
A new unsteady prescribed wake model of the
aerodynamic behavior of a rotor in forward flight
p 617 A85-37178
Subsonic multiple-jet aerodynamic window
p 693 A85-37216
Determination of aerodynamic characteristics of bodies
in weakly perturbed gas flows p 619 A85-37341
Perturbed motion of airplane and safe store
separation p 674 A85-38168
• •
Aerodynamic charactenstics of the Weis-Fogh
mechanism p 623 A85-38370
Ci Beta of unswept flat wings in sideslip II
p 623 A85-38371
A study of the critical flow rate through cascades of the slightly best article upper the large particle method
win success post autoic using the large particle method

p 624 A85-38562

The aerodynamics of the Tu-154B aircraft --- Russian p 649 A85-38850 book Fundamentals of the flight operations of helicopters Aerodynamics --- Russian book p 649 A85-38875 The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966 Investigation on configurations in longitudinal direction wind-tunnel testing of forward swept wings p 625 A85-38969 Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing [AIAA PAPER 85-1286] p 631 A85-39700 Some effects of sweep direction and strakes for wings with sharp leading edges [CA-8421] p 634 N85-27826 A method to calculate the parameters of wings of arbitrary planform [AD-A152689] p 635 N85-27831 Design of robust controllers for a multiple input-multiple control system with uncertain parameters output application to the lateral and longitudinal modes of the KC-135 transport aircraft [AD-A153100] p 675 N85-27877 p 679 N85-27901 The aerodynamics of control Wind-tunnel evaluation of a 21-percent-scale powered nodel of a prototype advanced scout helicopter p 637 N85-28923 [NASA-TP-2420] Wake effects on the aerodynamic performance of honzontal axis wind turbines [NASA-CR-174920] p 702 N85-29364 AERODYNAMIC COEFFICIENTS The evaluation of aerodynamic coefficients for projectiles fired from a hovering helicopter p 618 A85-37203 Hypersonic gas dynamics [AIAA PAPER 85-0999] p 621 A85-37643 Engine inlet interaction with a prop-fan propulsion system [SAE PAPER 841478] p 627 A85-39058 Investigation of transonic inlet drag characteristics [SAE PAPER 841539] p 627 A85-35 p 627 A85-39063 Aerodynamics of an aspect ratio 8 wing at low Reynolds p 628 A85-39223 numbers Propellant options for long duration, high altitude unmanned aircraft [AIAA PAPER 85-1326] p 689 A85-39727 The development of the generalized escape system simulation program [ASME PAPER 84-WA/DSC-201 p 651 A85-39869 Subsonic and transonic aerodynamics of a wraparound fin configuration [AD-A1536461 o 637 N85-28927 **AERODYNAMIC CONFIGURATIONS** Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323 The drag of simple shaped bodies in the rarefied hypersonic flow regime [AIAA PAPER 85-0998] p 621 A85-37642 Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661 Hovercraft skirt design and manufacture p 694 A85-38233 Development in UK rotor blade technology p 615 A85-38236 Configuration of shock waves closing a local supersonic p 623 A85-38481 zone An application of source-panel and vortex methods for aerodynamic solutions of airship configurations p 624 A85-38789 [AIAA PAPER 85-0874] Investigation on configurations in longitudinal direction wind-tunnel testing of forward swept winds p 625 A85-38969 Application of 3-D flow computations to gas turbine aerodynamic design

[AIAA PAPER 85-1216] p 630 A85-39659 Supersonic aerodynamic characteristics of canard, tailless, and att-tail configurations for 2 wing planforms p 634 N85-27822 [NASA-TP-2434]

AERODYNAMIC DRAG

AERODYNAMIC LOADS Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility p 634 N85-27823 [NASA-TP-2485] Methods for design aerodynamics of modern transport aırcraft p 636 N85-27838 (DFVLR-FB-85-05) Addition of flexible body option to the TOLA computer program, part 1 [NASA-CR-132732-1] p 652 N85-27855 The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908 Propulsion efficiency of vibrating bodies in subsonic gas stream p 699 N85-28159 AERODYNAMIC DRAG Lift and drag of airfoils in nonuniform supersonic p 618 A85-37200 Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661 The effect of the bluntness shape on the drag coefficient of a body in hypersonic flow of a rarefied gas p 624 A85-38564 Aerodynamic test results for a wing-mounted turboprop sion installation propula [SAE PAPER 841480] p 627 A85-39060 Investigation of transonic inlet drag characteristics [SAE PAPER 841539] p 627 A85-39063 Theoretical considerations in effectiveness of winglets the aerodynamic p 628 A85-39224 A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers [AIAA PAPER 85-1463] p 633 A85 p 633 A85-39792 Aerodynamic performance of a wing in ground effect using the PANAIR program [AD-A153303] p 635 N85-27832 Ice shapes and the resulting drag increase for a NACA 0012 autoil [NASA-TM-83556] p 641 N85-27839 AERODYNAMIC FORCES Lift and drag of airfoils in nonuniform supersonic stream p 618 A85-37200 Perturbed motion of airplane and safe store p 674 A85-38168 separation An experimental investigation of the aerodynamic effects on a body of revolution in turning flight p 624 A85-38782 [AIAA PAPER 85-0866] AÈRODYNAMIC HEAT TRANSFER Pitot pressure and heat transfer measurements in hydrazine thruster plumes p 685 A85-37599 [AIAA PAPER 85-0934] Stability of a stationary solution to the ablation p 623 A85-38555 equation Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock p 695 A85-38973 tunnel AERODYNAMIC HEATING A review of some approximate methods used in aerodynamic heating analyses [AIAA PAPER 85-0906] p 620 A85-37580 Measurement of wing-leading-edge heating rates on and tunnel models using the thin-film technique p 681 A85-37622 [AIAA PAPER 85-0972] Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661 Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10 [AIAA PAPER 85-1061] p 621 A85-37675 Dynamic behaviour of cold wires in heated airflows (T in the range from 300 to 600 K) p 694 A85-38069 Stability of a stationary solution to the ablation p 623 A85-38555 equation Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock p 695 A85-38973 tunnel Unsteady heat transfer due to time-dependent free stream velocity p 699 N85-27947 AERODYNAMIC INTERFERENCE Shading and interference effects during the rotation of a plate - in aerodynamics p 624 A85-38559 An integral method of wall interference correction for p 682 A85-38962 low speed wind tunnel Noise of counter-rotation propellers p 705 A85-39220 Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds p 628 A85-39241 Companson of advanced turboprop installation on swept

and Unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686 Adaptive wall wind tunnels and wall interference correction methods [DFVLR-IB-222-84-A-37] p 683 N85-27912

Natural frequencies and flight loads of composite main p 647 A85-38361 rotor blade for helicopter Unsteady blade row interactions in a multi-stage compressor [AIAA PAPER 85-1134] p 630 A85-39618 Research on structures and matenals --- aircraft structures (B85800801 p 700 N85-28432 AERODYNAMIC NOISE Aerodynamic sound generation caused by viscous processes p 705 Å85-38432 Investigation on reducing the flow noise of the 0.6 m x p 682 A85-38968 0.6 m trisonic wind tunnel p 705 N85-28916 Rotorcraft noise **AERODYNAMIC STABILITY** Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility p 634 N85-27823 [NASA-TP-24851 Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects p 699 N85-28266 [AD-A153020] AERODYNAMIC STALLING Dynamic overshoot of the static stall angle p 628 A85-39225 Stall transients of axial compression systems with inlet distortion [AIAA PAPER 85-1348] p 632 A85-39740 Quantitative evaluation of transient heat transfer on axial flow compressor stability [AIAA PAPER 85-1352] p 697 A85-39742 Application of system identification techniques to all combustor dynamics [AIAA PAPER 85-1353] p 669 A85-39743 High speed compressor ng as a stall recovery research tool [AIAA PAPER 85-1428] p 682 A85-39773 Dynamic engine behavior during post surge operation of a turbofan engine [AIAA PAPER 85-1430] p 669 A85-39774 Wing tunnel investigation of dynamic stall of an NACA 0018 autfoil oscillating in pitch p 635 N85-27830 [NAE-AN-27] Turbulence structure in the boundary layers of an oscillating airfoil AD-A1536311 p 637 N85-28926 AERODYNAMICS An aerodynamic performance model for hybrid heavy lift evetome [AIAA PAPER 85-0865] p 648 A85-38781 Aerodynamics of a new aerostat design with inverted-Y fine [AIAA PAPER 85-0867] p 624 A85-38783 Upwind-difference methods for aerodynamic problems governed by the Euler equations [REPT-84-23] p 635 N85-27834 Test devices for aeronautical research and technology p 683 N85-27914 [NASA-TM-77651] Helicopter aeromechanics introduction and historical p 653 N85-28914 review Subsonic and transonic aerodynamics of a wraparound fin configuration [AD-A153646] p 637 N85-28927 A computational method for wings of arbitrary planform [AD-A153788] p 638 N85-28929 AEROELASTICITY Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies p 618 A85-37197 Development in UK rotor blade technology p 615 A85-38236 An assessment of the suitability of the BHGA structural test rig for aerodynamic testing of hang gliders p 652 N85-27853 [CA-8505] Flight trials of a modified gulfstream commander carrying xternal stores p 653 N85-27859 [AD-A153376] Helicopter Aeromechanics [AGARD-LS-139] p 617 N85-28913 Recent developments in the dynamics of advanced rotor ystems p 653 N85-28917 systems The static aeroelasticity of a composite wing p 701 N85-29321 AERONAUTICS Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of Papers p 615 A85-37176 The ideas of K E Tsiolkovskii and present-day scientific p 685 A85-38775 problems --- Russian book AEROSPACE ENGINEERING

The ideas of K E Tsiolkovskii and present-day scientific problems --- Russian book p 685 A85-38775

Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship [AIÃA PAPER 85-0876] p 649 A85-38791 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A review of some recent U.K. propeller developments [AIAA PAPER 85-1261] p 666 A85-39684 Technical services at NLR [B8561898] p 705 N85-28871 Research on structural analysis at the DFVLR, p 701 N85-29314 Brunswick AEROSPACE INDUSTRY Fasteners for composite structures examined p 692 A85-37074 p 658 A85-38436 Turboshaft truce in Europe AEROSTATICS Basic aerostatics - A tutona [AIAA PAPER 85-0864] p 624 A85-38780 The Cyclo-Crane - A new concept to heavy vertical lift [AIAA PAPER 85-0871] p 648 A85-38786 AEROTHERMODYNAMICS improved procedure An for calculating the aerothermodynamic properties of a vitiated air test medium p 704 A85-37583 [AIAA PAPER 85-0913] Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack p 620 A85-37593 [AIAA PAPER 85-0924] Low density aerothermodynamics [AIAA PAPER 85-0994] p 620 A85-37640 Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels [AIAA PAPER 85-1003] p 681 A85-37644 Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study [AIAA PAPER 85-1313] p 668 A85-39718 Future fundamental combustion research for aeropropulsion systems p 671 N85-27870 [NASA-TM-87049] Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles [AD-A153039] p 699 N85-28328 AFTERBODIES Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft p 649 A85-39066 [SAE PAPER 841543] A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers [AIAA PAPER 85-1463] p 633 A85 p 633 A85-39792 Results of AGARD assessment of prediction capabilities for nozzle afterbody flows [AIAA PAPER 85-1464] o 633 A85-39793 AILERONS Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis [NAK-TR-861 p 681 N85-28950 AIR An improved procedure for calculating the aerothermodynamic properties of a vitiated air test medium [AIAA PAPER 85-0913] p 704 A85-37583 Density and velocity profiles in non-equilibrium laminar boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626 Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073 AIR FLOW Interaction between acoustics and subsonic ducted flow in a ramjet configuration p 704 A85-37209 Aerodynamic performance of a wing in ground effect using the PANAIR program [AD-A153303] p 635 N85-27832 AIR JETS Interaction of twin turbulent circular let p 617 A85-37049 AIR LAW Rotterdam Arport and the Common Market p 641 N85-27840 **AIR NAVIGATION** NATCS - Navigation Aided Target Control System for nultiple drone applications p 642 A85-37803 Integrated Inertial Sensor Assembly program status p 642 A85-37810 Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution p 642 A85-37830 images Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air p 643 A85-37832 navigation Commercial aviation GPS Navigation Set architecture p 644 A85-38538

SUBJECT INDEX

Program to support the approval of supplemental navigation aids in the National Airspace System p 644 A85-38541 Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 The AFTI/F16 terrain-aided navigation system [DE85-008411] p 645 N85-28935 AIR POLLUTION Testing of materials and coatings for jet engine components under simulated operational conditions p 672 N85-27873 [B8580073] Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471 AIR START Air turbine starter sizing for a proper bleed source match p 661 A85-39153 [SAE PAPER 841509] Pressunzed Air Start System (PASS) for small gas turbine engin p 662 A85-39161 [SAE PAPER 841571] AIR TO AIR MISSILES A missile duel between two aircraft p 703 A85-39563 AIR TRAFFIC Air traffic Instruments, airports, companies, post, cargo p 641 N85-28932 and passengers AIR TRAFFIC CONTROL Communication in automated air-traffic-control systems p 644 A85-38647 --- Russian book National airspace review, change 1 p 644 N85-27844 [AD-A152369] Developments in the area of air traffic control systems and the relation with meteorology p 645 N85-27848 [NLR-MP-84029-U] A general area air traffic controller simulation using colour graphics p 645 N85-28933 AD-A1536341 AIR TRANSPORTATION Costs and tariff levies in air transportation p 705 A85-37950 Air transport deregulation - The US experience and its applicability to Europe p 705 A85-39369 AIRBORNE LASERS Terrain/wire and wirelike obstacles warning system for p 655 A85-38363 elicopters AIRBORNE RADAR APPROACH Investigation of imaging and flight guidance concepts or rotorcraft zero visibility approach and landing n 644 N85-27843 [NASA-CB-166571] AIRBORNE/SPACEBORNE COMPUTERS The interactive generation of specifications for an p 679 N85-27906 onboard software series (GISELE) Certifying complex digital systems on civil aviation p 680 N85-27907 aircraft AIRCRAFT ACCIDENTS Frangibility of obstacles at airports p 700 N85-28431 NLR-MP-84002-U1 AIRCRAFT COMMUNICATION NATCS - Navigation Aided Target Control System for p 642 A85-37803 multiple drone applications Communication in automated air-traffic-control systems Russian book p 644 A85-38647 **AIRCRAFT COMPARTMENTS** Examination of fire safety of commercial aircraft cabins p 639 A85-37693 Approach to interior noise control I - Damped trim p 650 A85-39221 nanels AIRCRAFT CONFIGURATIONS p 648 A85-38440 Something old, something new Stability and control results for advanced turboprop aft-mount installations n 675 A85-39059 (SAE PAPER 8414791 AIRCRAFT CONSTRUCTION MATERIALS p 646 A85-38302 The limits of stratofilm Recent materials problems relating to catastrophic alloon failures p 647 A85-38303 balloon failures Research trend in advanced technology helicopter p 647 A85-38360 Study on the comfortability of helicopter - Flight test of p 647 A85-38365 acoustic noise level Repairing commercial aircraft jet engine nacelle composite structures p 616 A85-39068 [SAE PAPER 841567] Material evaluation of second-generation composites for ransport wing application [SAE PAPER 841520] p 688 A85-39291 Research on structures and materials --- aircraft structures p 700 N85-28432 [B85800801 DFVLR research in aluminum-lithium allovs p 692 N85-29105

AIRCRAFT CONTROL Control response measurements of the Skyship-500 airship [AIAA PAPER 85-0881] p 649 A85-38796 Stability and control results for advanced turboprop aft-mount installations [SAE PAPER 841479] p 675 A85-39059 Rationalizing the choice of an actuating mechanism for p 661 A85-39124 a let drive . Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208 New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control p 703 A85-39551 Toward a unifying theory for aircraft handling qualities p 651 A85-39554 A multiloop robust controller design study using singular p 703 A85-39564 value gradi Slow and fast state variables for three-dimensional flight p 675 A85-39567 dynamics Controller requirements for uncoupled aircraft motion, volume 1 [AD-A153173] p 675 N85-27878 In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying es of statically unstable transport aircraft [DFVLR-FB-84-12] p 676 N85-27880 Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed rance [DFVLR-FB-84-52] p 676 N85-27882 Active Control Technology (ACT) Past, present and p 676 N85-27884 future The state-of-the-art and future of flight control p 677 N85-27885 systems Aspects of application of ACT systems for pilot workload p 677 N85-27887 leviation Some flight test results with redundant digital flight control systems p 678 N85-27892 An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893 Demonstration of relaxed static stability on a commercial p 679 N85-27898 p 679 N85-27901 transport The aerodynamics of control The STOL and maneuver technology program integrated p 680 N85-27910 control system development AIRCRAFT DESIGN Fatigue life evaluation program for the Kfir aircraft p 645 A85-37182 Computer aided tube routing design in aircrafts p 615 A85-37183 A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling A85-37187 criteria under multiple loading p 693 Crack propagation analysis of longitudinal skin cracks in a pressurized cabin p 645 A85-37188 Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323 n 655 The cockpit of the Airbus A310 A85-37896 Tweety-bird replacement --- from T-37B to Fairchild T-46A trainer aircraft p 646 A85-37945 p 646 A 320 - Third generation Airbus A85-37946 Soviets tailor cargo transport remote-site for p 646 A85-38244 operations Teledyne Ryan focuses R & D effort on new RPVs, target versions p 646 A85-38245 External caps - An approach to stress reduction in balloons p 647 A85-38306 Structural optimization --- in aircraft design p 694 A85-38352 Man-powered aircraft --- review p 615 A85-38353 Who needs advanced-technology airliners? p 647 A85-38434 p 648 A85-38440 Something old, something new Aerodynamics of a new aerostat design with inverted-Y fins [AIAA PAPER 85-0867] p 624 A85-38783 Design of a small airship p 648 A85-38787 [AIAA PAPER 85-0872] Secondary power generation system considerations for advanced aircraft [SAE PAPER 841604] p 650 A85-39164 Airplane mounted accessory gearbox design [SAE PAPER 841605] p 696 A85-39165 Substantiation of the applicability of VSAERO panel method to subsonic inlet design [AIAA PAPER 85-1119] p 629 A85-39615 Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 A review of some recent U.K. propeller developments

[AIAA PAPER 85-1261]

p 666 A85-39684

AIRCRAFT ENGINES

Aircraft preliminary design companison of advanced compound engines with advanced turbine engines for helicopter applications [AIAA PAPER 85-1276] p 666 A85-39693 PNS predicted shock location and jump conditions at supersonic and hypersonic speeds --- Parabolized Navier-Stokes [AIAA PAPER 85-1407] p 632 A85-39766 The integration of a new concept in VTOL aircraft oropulsion [AIAA PAPER 85-1448] p 651 A85-39785 Starduster - A solar powered high altitude airplane [AIAA PAPER 85-1449] p 651 A85-39786 Methods for design aerodynamics of modern transport aucraft [DFVLR-FB-85-05] p 636 N85-27838 Test flight of IL-76TD long-range transport variant p 641 N85-27842 Technical services at NLR p 705 N85-28871 [B8561898] Future of V/STOL aircraft systems A survey of opinions NASA-TM-866891 p 654 N85-28937 MBB expands CADAM system for a 320 program p 704 N85-29099 AIRCRAFT DETECTION Algorithms for improved, heading assisted, maneuver tracking p 644 A85-39458 AIRCRAFT ENGINES Lift and thrust of a linear synchronous engine with a olid-conductor stator winding p 658 A85-37550 Modernizing engine displays p 658 A85-38956 solid-conductor stator winding Advances in aerospace propulsion, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 [SAF SP-594] p 659 A85-39057 Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 An investigation of the autorotation of gas-turbine ngines under startup conditions p 659 A85-39104 A comparative evaluation of certain promising engines under startup conditions gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine stage p 660 A85-39107 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39115 Accelerated testing of gas-turbine aircraft engines using p 660 A85-39118 the 'softening' method The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 engines A comparison of experimental characteristics of porous p 660 A85-39120 and blade impellers An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft p 660 A85-39121 system Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 [SAF SP-598] p 661 A85-39151 Computer-aided start-system design and venfication p 661 A85-39152 [SAE PAPER 841508] Air turbine starter sizing for a proper bleed source [SAE PAPER 8415091 p 661 A85-39153 Lubrication systems for air turbine starters [SAE PAPER 841547] p 662 A85-39157 Starter-engine interface concepts [SAE PAPER 841548] p 662 A85-39158 F-20 air turbine cartridge start system p 662 A85-39160 [SAE PAPER 841570] Critical speed testing of the Grumman X-29A power take-off shaft subsystem p 662 A85-39163 [SAE PAPER 841603] Series flow tandem fan - A high-speed V/STOL ropulsion concept [SAE PAPER 841496] p 650 A85-39204 Meeting the 1985 FAA noise regulations with old engines and modern acoustic technology [AIAA PAPER 85-1120] p 651 A85-39616 The unducted fan engine p 665 A85-39648 [AIAA PAPER 85-1190] Prospects and problems of advanced open rotors for commercial aircraft p 665 A85-39649 [AIAA PAPER 85-1191] Engine design for maintenance and support p 665 A85-39654 [AIAA PAPER 85-1204] Usage monitoring - A milestone in engine life management [AIAA PAPER 85-1206] p 665 A85-39656 United States Air Force engine damage tolerance requirements

[AIAA PAPER 85-1209] p 665 A85-39657

AIRCRAFT EQUIPMENT

Military engine durability improvements through innovative advancements in turbine design and materials p 666 A85-39664 Vanable cycle turboshaft technology for rotor-craft of

[AIAA PAPER 85-1278] p 666 A85-39695 Secondary power unit options for advanced fighter aucraft

p 666 A85-39696 [AIAA PAPER 85-1280] 'Smart' engine components - A micro in every blade? p 668 A85-39707 [AIAA PAPER 85-1296] Application of 3-D aerothermal model and flow

temperature study [AIAA PAPER 85-1313] p 668 A85-39718

poststall combustor dynamics [AIAA PAPER 85-1353] p 669 A85-39743

p 690 A85-39763 High speed compressor ng as a stall recovery research

p 682 A85-39773 [AIAA PAPER 85-1428] Dynamic engine behavior during post surge operation

of a turbofan engine [AIAA PAPER 85-1430] p 669 A85-39774

Modeling post-stall operation of aircraft gas turbine enaines p 669 A85-39775 [AIAA PAPER 85-1431]

Propulsion influences on air combat [AIAA PAPER 85-1457] p 651 A85-39789

- The conception and development of a family of small engines for the 1990's [AIAA PAPER 85-1460] p 670 A85-39791
- Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 An investigation into the soot production processes in
- gas turbine engina p 690 N85-27992 [AD-A152710] Compressor and turbine models - numerical stability and other aspects
- p 673 N85-28948 [AD-A153811] AIRCRAFT EQUIPMENT
- Terrain/wire and wirelike obstacles warning system for helicopters p 655 A85-38363 Auxiliary and emergency power system

p 662 A85-39162 [SAE PAPER 841572] Algorithms for improved, heading assisted, maneuver

p 644 tracking A85-39458 AIRCRAFT FUEL SYSTEMS

A method for the evaluation of the boundary lubricating properties of aviation turbine fuels p 687 A85-37495 AIRCRAFT FUELS

- Fuel freeze point investigations [AD-A152801] p 690 N85-28129
- Heat management system for aircraft [AD-D011658] p 654 N85-28936 AIRCRAFT GUIDANCE

investigation of imaging and flight guidance concepts for rotorcraft zero visibility approach and landing p 644 N85-27843 [NASA-CR-166571]

AIRCRAFT HAZARDS Protection of materials and technical equipment against birds p 638 A85-37540 Examination of fire safety of commercial aircraft p 639 A85-37693 cabins

Aircraft performance in a JAWS microburst p 701 A85-39213

p 701 A85-39218

Auxiliary and emergency power system

- Selecting the correct bearing can improve avionic instrument performance p 694 A85-38403 Advanced Aircrew Display Symposium, 6th, Patuxent
- River, MD, May 15, 16, 1984, Proceedings p 655 A85-38951 review of UK activity Airborne electronic color displays - A
- since 1981 p 656 A85-38953 Integration of sensor and display subsystems

p 656 A85-38955 p 658 A85-38956 Modernizing engine displays Display technology and the role of human factors p 656 A85-38957

AIRCRAFT LANDING

Thrust vectored take-off, landing and ground handling of an airship [AIAA PAPER 85-0877] p 641 A85-38792

A-system for take-off and landing-measurements (STALINS) [B85800721 p 645 N85-27849

Addition of flexible body option to the TOLA computer program, part 1 [NASA-CR-132732-11 p 652 N85-27855

Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation p 652 N85-27856 [NASA-CR-132732-2]

In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft p 676 N85-27880 (DFVLR-FB-84-12)

AIRCRAFT MAINTENANCE An overview of structural repair adhesives p 686 A85-37407 Application of technology to achieve value - Added in-service support --- of jet engines p 659 A85-39067 (SAE PAPER 841566) Repairing commercial aircraft jet engine nacelle composite structures [SAE PAPER 841567] p 616 A85-39068 Engine system field expenence simulation program [SAE PAPER 841601] p 659 A85-39071 Advanced techniques for health and usage monitoring of helicopter transmissions [AIAA PAPER-85-1142] p 617 A85-39621 Engine design for maintenance and support p 665 A85-39654 [AIAA PAPER 85-1204] Deployable Core Automated Maintenance System (DCAMS) [AD-A153695] p 706 N85-29839 AIRCRAFT MANEUVERS

First-order feedback strategies for variable speed planar p 703 A85-37198 pursuit-evasion games Algorithms for improved, heading assisted, maneuver

p 644 A85-39458 tracking A missile duel between two aircraft p 703 A85-39563

Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft [AIAA PAPER 85-1466] p 670 A85-39794 Parameter identification results of tests in nonsteady

symmetric flight with the Hawker Hunter Mk 7 [NLR-TR-83042-U] p 653 N85-27860

The STOL and maneuver technology program integrated control system development p 680 N85-27910 AIRCRAFT MODELS

Parameter identification results of tests in nonsteady symmetric flight with the Hawker Hunter Mk 7 NLR-TR-83042-U] p 653 N85-27860

AIRCRAFT NOISE Study on the comfortability of helicopter - Flight test of p 647 A85-38365 acoustic noise level Approach to intenor noise control I - Damped trim panels p 650 A85-39221

AIRCRAFT PARTS Fatigue life evaluation program for the Kfir aircraft

p 645 A85-37182 Computer aided tube routing design in aircrafts p 615 A85-37183

Crack growth analysis in multiple load path structure p 693 A85-37186

The problems ansing in testing of carbon-based materials for structural components of airframes p 686 A85-37339

Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600

AIRCRAFT PERFORMANCE A 320 - Third generation Airbus p 646 A85-37946 Mirage 2000 fighter combines acceleration, low-speed

p 646 A85-38243 stability AV-8B-mean Manne V/STOL machine p 648 A85-38437

Progress report on the engineering development of the Magnus Aerospace LTA 20-1 arship [AIAA PAPER 85-0876]

- p 649 A85-38791 The aerodynamics of the Tu-154B aircraft --- Russian book p 649 A85-38850 Applications of state estimation in aircraft flight-data
- p 650 A85-39211 analysis Aircraft performance in a JAWS microburst

p 701 A85-39213 Drive system development for Proprian Test Assessment

Program [AIAA PAPER 85-1188] p 664 A85-39646 Propulsion influences on air combat

(AIAA PAPER 85-1457) p 651 A85-39789 Parameter identification results of tests in nonsteady symmetric flight with the Hawker Hunter Mk 7

p 653 N85-27860 (NLR-TR-83042-U) Demonstration of relaxed static stability on a commercial p 679 N85-27898 transport Realisation of relaxed static stability on a commercial

transport p 679 N85-27899 AIRCRAFT PILOTS Advanced avionics management system prevents pilots

from being swamped by information overload p 655 A85-38401

Robotic drilling of acrylic windshields and canopies for p 703 A85-37396 fighter aircraft Methods for the assembly of aircraft structures p 616 A85-38641 Russian book AIRCRAFT RELIABILITY Development of the BK 117 helicopter p 674 A85-38369 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 United States Air Force engine damage tolerance requirements [AIAA PAPER 85-1209] p 665 A85-39657 AIRCRAFT SAFETY Chemical preparations for protecting aircraft against birds p 638 A85-37541 Examination of fire safety of commercial aircraft p 639 A85-37693 cabins Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847 AIRCRAFT SPECIFICATIONS Development of the BK 117 helicopter p 674 A85-38369 AIRCRAFT STABILITY Perturbed motion of airplane and safe store p 674 A85-38168 separation Discussions on the regular behavior of the longitudinal dynamic response of aircraft during variable sweep flights p 674 A85-38974 Stability and control results for advanced turboprop aft-mount installations [SAE PAPER 841479] p 675 A85-39059 A perspective on superaugmented flight control dvantages and problems p 677 N85-27886 advantages and problems Demonstration of relaxed static stability on a commercial transport p 679 N85-27898 Realisation of relaxed static stability on a commercial transport p 679 N85-27899 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part

[IFD-1/84-PT-1] p 654 N85-28939 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind [IFD-1/84-PT-2]

p 654 N85-28940 Contributions on the subject of longitudinal movements of aircraft in wind shears [NASA-TM-77837]

p 702 N85-29432 AIRCRAFT STRUCTURES

Fasteners for composite structures examined p 692 A85-37074

Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177

Influence of fighter aircraft load spectrum variations on

fatigue crack initiation and growth o 693 A85-37181 A program for computenzed structural resizing of aircraft

structure subject to strength and local panel buckling criteria under multiple loading p 693 A85-37187 Concepts and application of aircraft damage tolerance

p 645 A85-37206 anatysis Repair composite procedures for sinewave

p 686 A85-37380 substructure An overview of structural repair adhesives

p 686 A85-37407 Aircraft service testing of ultrasonically welded panels

p 646 A85-37408 Reducing the effects of rivet holes on fatigue life by

adhesive bonding p 693 A85-37472

Methods for the assembly of aircraft structures ---Russian book p 616 A85-38641 Fatigue-crack propagation in aircraft Duralumin shell

p 695 A85-38918 structures The bonding of materials for propulsion systems p 687 A85-39175

Efficiencies of multiple-input techniques for aircraft ground vibration testing SAE PAPER 8415751

p 682 A85-39274

p 650 A85-39164

p 662 A85-39166

p 666 A85-39696

p 673 N85-28944

AIRCRAFT POWER SUPPLIES

B-1B secondary power subsystem

advanced aircraft

aircraft

aircraft

[SAE PAPER 841604]

[SAE PAPER 841607]

[AIAA PAPER 85-1280]

AIRCRAFT PRODUCTION

NASA-TP-24631

Secondary power generation system considerations for

Secondary power unit options for advanced fighter

Advanced secondary power system for transport

Integrated CADCAM - An approach for advanced

composite primary aircraft structure p 703 A85-37211

Model of the wind field in a downburst AIRCRAFT HYDRAULIC SYSTEMS p 662 A85-39162 [SAE PAPER 841572] AIRCRAFT INSTRUMENTS

Application of system identification techniques to

visualization technique to the combustor exit gas

Combustion technology - A Navy perspective

[AIAA PAPER 85-1400] tool

(AIAA PAPER 85-12211

the 90's

Assessment of damage tolerance in composites p 688 A85-39598 Damage tolerance of composite cylinders p 688 A85-39600 New materials and techniques for aircraft structures [B85800741 p 653 N85-27861 Heat resistant Carbon Fiber Reinforced Plastics (CFRP) ardening equipment [MBB/LFA33/CFK/PUB/007] p 690 N85-27976 Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects p 699 N85-28266 [AD-A153020] Research on structures and materials --- aircraft structures [B8580080] p 700 N85-28432 Further investigations to improve the fatigue life of the Mirage 1110 wing main span [ARL-STRUC-TM-397] p 654 N85-28938 MBB expands CADAM system for a 320 program p 704 N85-29099 Structural Analysis p 701 N85-29313 [DEVI R-MITT-84-21] Research on structural analysis at the DFVLR, Brunswick p 701 N85-29314 Activities of the Department of Aerospace Engineering p 706 N85-29844 AIRCRAFT WAKES The influence of blade wakes on the performance of outwardly curved combustor pre-diffusers [AIAA PAPER 85-1291] p 667 A85-39704 AIRFOIL PROFILES Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow Design of a basic profile for a low sweep airfoil Part 2 Experimental investigation on the DFVLR-W1 airfoil profile in the Brunswick transonic wind tunnel p 635 N85-27833 [DFVLR-FB-85-01-PT-2] Integral profile method for production of carbon fiber sheets p 690 N85-27975 [MBB/LFA34/CFK/PUB/006] AIRFOILS A second-order approximate method for transonic small-disturbance potential flow and its application to the analysis of flows over airfoils p 625 A85-38922 Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796 Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility VASA-TP-2485] p 634 N85-27823 Users manual for coordinate generation code [NASA-TP-2485] CROSRA [NASA-CR-172584] p 634 N85-27824 User's manual for airfoil flow field computer code SRAIR p 634 N85-27825 [NASA-CR-172585] Numerical study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828 p 635 N85-27828 Wing tunnel investigation of dynamic stall of an NACA 0018 airfoil oscillating in pitch [NAE-AN-27] o 635 N85-27830 Ice shapes and the resulting drag increase for a NACA 0012 autoil [NASA-TM-83556] p 641 N85-27839 Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed range [DFVLR-FB-84-52] p 676 N85-27882 A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463 Turbulence structure in the boundary layers of an oscillating airfoil [AD-A153631] p 637 N85-28926 A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928 A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850] p 638 N85-28930 AIRFRAME MATERIALS The problems arising in testing of carbon-based materials for structural components of airframes p 686 A85-37339 New materials and techniques for aircraft structures [B8580074] p 653 N85-27861 AIRFRAMES USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B p 652 N85-27858 [AD-A153161] **AIRLINE OPERATIONS** Air transport deregulation - The US expenence and its applicability to Europe p 705 A85-39369

Rotterdam Airport and the Common Market p 641 N85-27840 AIRPORT PLANNING Korea's air transport - Planned expansion p 681 A85-37949 OWEMA report A project study concerning the ossibilities and the desirability of a east-west runway for Maastricht Airport (Netherlands) as a Euro-regional air freight center p 685 N85-28955 [B8476490] AIRPORTS The effectiveness of acoustic repellants in frightening p 639 A85-37543 birds away from airports Rotterdam Airport and the Common Market p 641 N85-27840 Airport and airway system cost allocation model Volume User's manual p 683 N85-27917 [AD-A152877] Frangibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431 Air traffic Instruments, airports, companies, post, cargo p 641 N85-28932 and passengers AIRSHIPS Lighter-Than-Air Systems Conference, 6th, Norfolk, VA, June 26-28, 1985, Technical Papers p 616 A85-38776 North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A85-38777 Tethered aerostat operations in the manne environment [AIAA PAPER 85-0860] p 640 A85-38778 High Endurance Lighter Than Air (HELTA) Program (AIAA PAPER 85-0861) p 640 A85-38779 Basic aerostatics - A tutorial [AIAA PAPER 85-0864] p 624 A85-38780 Aerodynamics of a new aerostat design with inverted-Y fins [AIAA PAPER 85-0867] p 624 A85-38783 The design and development of the Grace Aircraft GAC-20 airship [AIAA PAPER 85-0869] p 648 A85-38784 What an airship manufacturer faces in a certification program today p 641 A85-38785 [AIAA PAPER 85-0870] Design of a small airship [AIAA PAPER 85-0872] p 648 A85-38787 The need to return to hydrogen in airships [AIAA PAPER 85-0873] p 648 A85-38788 An application of source-panel and vortex methods for aerodynamic solutions of airship configurations [AIAA PAPER 85-0874] p 624 A85-38789 Wind tunnel investigation of the interaction of an airship configuration with lifting rotors [AIAA PAPER 85-0875] p 625 A85-38790 Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship [AIAA PAPER 85-0876] p 649 A85-38791 Thrust vectored take-off, landing and ground handling of an airship p 641 A85-38792 [AIAA PAPER 85-0877] Dynamic charactenstics of the STARS aerostat [AIAA PAPER 85-0880] p 674 A85 p 674 A85-38795 Control response measurements of the Skyship-500 airship [AIAA PAPER 85-0881] p 649 A85-38796 The Tethered Aerostat Antenna Program (TAAP) demonstration phase [AIAA PAPER 85-0883] p 616 A85-38797 AIRSPACE Airport and airway system cost allocation model Volume User's manual [AD-A152877] p 683 N85-27917 AIRSPEED Engine inlet interaction with a prop-fan propulsion system [SAE PAPER 841478] p 627 A85-39058 ALGORITHMS The AFTI/F16 terrain-aided navigation system [DE85-008411] p 645 N85-28935 Piloted simulation of an algorithm for onboard control of time-optimal intercept [NASA-TP-2445] p 681 N85-28949 ALKANES The distribution of higher n-alkanes in partially frozen middle distillate fuels [AD-A153940] p 692 N85-29074 ALL-WEATHER AIR NAVIGATION The Command Flight Path Display - All weather, all missions p 656 A85-38959 Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847 ALLOCATIONS Airport and airway system cost allocation model Volume User's manual [AD-A152877] p 683 N85-27917

ALTITUDE TESTS Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 6 p 669 A85-39765 Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins [NASA-TM-86418] p 652 N85-27852 ALUMINUM ALLOYS The influence of microstructure on temperature-dependent flow properties of TI-6AI-4V the p 687 A85-38749 ANGLE OF ATTACK A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of attack p 619 A85-37333 Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack [AIAA PAPER 85-0924] p 620 A85-37593 ANISOTROPIC PLATES Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element p 696 A85-39170 ANNUAL VARIATIONS Protection of materials and technical equipment against birds p 638 A85-37540 ANNULAR FLOW Interaction of twin turbulent circular jet p 617 A85-37049 Investigation of the effect of two endwall contours on the performance of an annular nozzle cascade [AIAA PAPER 85-1218] p 630 A85-39661 A further assessment of numerical annular dump diffuser flow calculations [AIAA PAPER 85-1440] p 633 A85-39779 ANTARCTIC REGIONS Feasibility studies of 'Polar Patrol Balloon' p 647 A85-38321 ANTENNAS Avionics data base [AD-A152415] p 657 N85-27863 ANTONOV AIRCRAFT Soviets tailor cargo transport for remote-site perations p 646 A85-38244 operations APPLICATIONS PROGRAMS (COMPUTERS) The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion p 661 A85-39122 chambers APPROXIMATION A review of some approximate methods used in aerodynamic heating analyses [AIAA PAPER 85-0906] p 620 A85-37580 Characteristics of steady-state hypersonic flow about blunted bodies with discontinuities in generators p 636 N85-28155 ASPECT RATIO Aerodynamics of an aspect ratio 8 wing at low Reynolds p 628 A85-39223 numbers Computer studies of hybrid slotted working sections with p 628 A85-39241 nonaxisymmetric norzie the NASS minimum steady interference at subsonic speeds Summary of performance from the NASA Langley Static Test Facility AIAA PAPER 85-13471 p 668 A85-39739 Aerodynamic performance of a wing in ground effect using the PANAIR program [AD-A153303] p 635 N85-27832 ASSEMBLING Methods for the assembly of aircraft structures ---Russian book p 616 A85-38641 ASTRONAUTICS Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of p 615 A85-37176 Papers The ideas of K E Tsiolkovskii and present-day scientific problems --- Russian book p 685 A85-38775 ATMOSPHERIC BOUNDARY LAYER Three powered sailplanes as meteorological instrumentation for atmospheric boundary layer studies at DFVLR [DFVLR-FB-84-50] p 653 N85-27862 ATMOSPHERIC COMPOSITION The University of Wyoming's small scientific balloon p 639 A85-38309 program ATMOSPHERIC ELECTRICITY Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 ATMOSPHERIC ENTRY SIMULATION Experimental research on the effect of separation flow

on ablation in supersonic turbulent flow [AIAA PAPER 85-0975] p 694 A85-37625

ATMOSPHERIC MODELS Model of the wind field in a downburst p 701 A85-39218

ATMOSPHERIC SOUNDING ATMOSPHERIC SOUNDING Long-duration flights using MIR (infrared balloon system) --- for stratospheric study p 639 A85-38307 The University of Wyoming's small scientific balloon p 639 A85-38309 program ATMOSPHERIC TURBULENCE An investigation into the hovening behaviour of the LTA 20-1 airship in calm and turbulent air [AIAA PAPER 85-0878] p 641 A85-38793 ATMOSPHERIC WINDOWS Subsonic multiple-jet aerodynamic window p 693 A85-37216 ATOMIZERS influence of downstream distance on simplex atomizer ay characteristics [ASME PAPER 84-WA/HT-25] p 698 A85-39888 ATTACK AIRCRAFT AV-8B-mean Marine V/STOL machine p 648 A85-38437 LHX - A giant leap p 648 A85-38438 Propulsion influences on air combat p 651 A85-39789 [AIAA PAPER 85-1457] ATTITUDE CONTROL Controller requirements for uncoupled aircraft motion, volume 2 p 676 N85-27879 [AD-A153300] ATTITUDE GYROS Helicopter flight test of a ring laser gyro Attitude and p 643 A85-38529 Heading Reference System Attitude determination in a limb-scanning balloon p 655 A85-38319 radiometer AUTOMATIC CONTROL Communication in automated air-traffic-control systems - Russian book p 644 A85-38647 AUTOMATIC FLIGHT CONTROL Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364 New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control p 703 A85-39551 Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 mission adaptive wing aircraft AUTOMATION Automated maintenance system test program increment VI production scheduling [AD-A153694] p 706 N85-29838 AUTOROTATION An investigation of the autorotation of gas-turbine p 659 A85-39104 engines under startup conditions AUXILIARY POWER SOURCES Auxiliary and emergency power system [SAE PAPER 841572] p 6 p 662 A85-39162 Secondary power generation system considerations for advanced aircraft [SAE PAPER 841604] p 650 A85-39164 B-1B secondary power subsystem [SAE PAPER 841607] p 662 A85-39166 AVIONICS Advanced avionics management system prevents pilots from being swamped by information overload p 655 A85-38401 Selecting the correct bearing can improve avionic p 694 A85-38403 instrument performance Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings p 643 A85-38526 Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings p 655 A85-38951 Integration of sensor and display subsystems p 656 A85-38955 An argument for standardization in modern aircraft crew stations p 657 A85-38961 Integrated flight/propulsion control - Adaptive engine control system mode [AIAA PAPER 85-1425] p 669 A85-39772 Avionics data base [AD-A152415] p 657 N85-27863

- The Avionics Flight Evaluation System (AFES) of DFVLR [DFVLR-MITT-85-01] p 657 N85-27864 Avionics Data Base users manual
- [AD-A153810] p 657 N85-28942 AXES OF ROTATION
- Wake-effects-on-the-aerodynamic performance of honzontal axis wind turbines [NASA-CR-174920] p 702 N85-29364
- AXIAL COMPRESSION LOADS Assessment of damage tolerance in composites
 - p 688 A85-39598

AXIAL FLOW

Quasi-three-dimensional blade design code p 622 A85-37928

- A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors I - Axial flow, p 622 A85-37931 stream function formulation Stall transients of axial compression systems with inlet distortion
- [AIAA PAPER 85-1348] o 632 A85-39740 AXIAL FLOW TURBINES
- The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine p 660 A85-39107 stage AXIAL LOADS
- Fracture toughness of adhesively bonded joints p 688 A85-39492 AXISYMMETRIC BODIES
- A system of shock and rarefaction waves in flows past p 618 A85-37330 bodies with complex shapes Determination of aerodynamic characteristics of bodies p 619 A85-37341 in weakly perturbed gas flows The drag of simple shaped bodies in the rarefied
- p 621 A85-37642 AXISYMMETRIC FLOW
- Computation of the thrust performance of axisymmetric p 622 A85-37932 nozzles Characteristics of steady-state hypersonic flow about
- p 636 N85-28155

- B-1 AIRCRAFT
 - B-1B secondary power subsystem [SAE PAPER 841607] p 662 A85-39166 B-52 AIRCRAFT
- Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545
- B-70 AIRCRAFT Supersonic cruise technology
- p 617 N85-28912 [NASA-SP-472] BACKGROUND NOISE
- Background noise measurements from jet exit vanes designed to reduced flow pulsations in an open-jet wind tunnel p 683 N85-27916 [NASA-TM-86383]
- BAFFLES Strutless diffuser for gas turbine engine
- [AD-D011662] p 672 N85-28943 BALANCING
- Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149 BALLOON FLIGHT
- Scientific ballooning IX, Proceedings of the Seventh Symposium, Graz, Austria, June 25-July 7, 1984 p 615 A85-38301
- Stratospheric flights with large polyethylene balloons p 639 A85-38304 from equatorial latitudes
- Long-duration flights using MIR (infrared balloon system) p 639 A85-38307 for stratospheric study First results of a stratospheric experiment using a
- Montgolfiere Infra-Rouge (MIR) --- balloon p 639 A85-38308
- Balloon system and balloon-borne experiments in China p 640 A85-38310
- A balloon tracking system that uses the VHF omidirectional range (VOR) network p 643 A85-38313 An automatic navigation and aspect sensing system for
- p 643 A85-38314 X-ray astronomy Assuring payload security in flight and recovery - Design
- p 640 A85-38315 approaches and flight experience An alternate approach to very long duration ballooning in the northern hemisphere p 640 A85-38316
- Attitude determination in a limb-scanning balloon p 655 A85-38319 radiometer BALLOON SOUNDING
- Long-duration flights using MIR (infrared balloon system) p 639 A85-38307 - for stratospheric study First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) --- balloon
- p 639 A85-38308 The University of Wyoming's small scientific balloon p 639 A85-38309 program Balloon system and balloon-borne experiments in p 640 A85-38310 China
- BALLOON-BORNE INSTRUMENTS Scientific ballooning - IX, Proceedings of the Seventh
- Symposium, Graz, Austria, June 25-July 7, 1984 p 615 A85-38301
- Development of balloon-borne reel-down and-up winch p 640 A85-38311 system Assumng payload security in flight and recovery - Design approaches and flight experience p 640 A85-38315

Attitude determination in a limb-scanning balloon radiomet p 655 A85-38319 BALLOONS Scientific ballooning - IX, Proceedings of the Seventh Symposium, Graz, Austria, June 25-July 7, 1984

- p 615 A85-38301 p 646 A85-38302 The limits of stratofilm Recent materials problems relating to catastrophic p 647 A85-38303 balloon fadures External caps - An approach to stress reduction in
 - p 647 A85-38306 balloons Development of balloon-borne reel-down and-up winch
 - system p 640 A85-38311 A new reeling technique for very long extension scanning
- in the stratosphere p 640 A85-38312 Feasibility studies of 'Polar Patrol Balloon' p 647 A85-38321
- BEAMS (SUPPORTS)
- Nonstationary deformation of structural elements and their optimization p 696 A85-39450 BEARING (DIRECTION)
- Algorithms for improved, heading assisted, maneuver tracking p 644 A85-39458 BEARINĞS
- Selecting the correct bearing can improve avionic instrument performance p 694 A85-38403 BIOACOUSTICS
- The effectiveness of acoustic repellants in frightening p 639 A85-37543 birds away from airports BIRD-AIRCRAFT COLLISIONS
- Protection of materials and technical equipment against
 - p 638 A85-37540 birds Chemical preparations for protecting aircraft against p 638 A85-37541 birds The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas
 - in order to prevent bird-aircraft collisions p 638 A85-37542
 - The effectiveness of acoustic repellants in fightening birds away from airports p 639 A85-37543 Observation of birds in the flight path of aircraft - An
- important stage in the prevention of bird strikes p 639 A85-37544 BLACK SEA
- The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas in order to prevent bird-aircraft collisions p 638 A85-37542

BLADE SLAP NOISE Noise of counter-rotation propellers

- p 705 A85-39220 BLADE TIPS
 - Numerical solution of two- and three-dimensional rotor p 626 A85-38989 tip leakage models Cantilevered stator vane tip leakage studies
 - p 664 A85-39620 [AIAA PAPER 85-1136] Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field
- [AIAA PAPER 85-1220] p 666 A85-39663 Development of a noninterference technique for measuring turbine engine rotor blade stresses AIAA PAPER 85-1472] p 697 A85-39797
- **BLOWDOWN WIND TUNNELS** Transonic Mach number determination in a blow-down
- wind tunnel with solid walls and a downstream throat (VTH-LR-402) p 636 N85-27835 BLUNT BODIES
- A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of attack p 619 A85-37333
- A supersonic inhomogeneous flow of an ideal gas around p 619 A85-37335 blunted bodies A nonstationary transition process caused by injection
- of a gas into the near wake of a body in a supersonic p 619 A85-37336 flow
- Transition measurements heat-transfer instrumentation on a 0 5 bluntness 9 75-deg cone at Mach 7 with and without mass addition
- [AIAA PAPER 85-1004] p 621 A85-37645 Measured and predicted vortex-induced leeward heating
- on a biconic at Mach 6 and 10 p 621 A85-37675 [AIAA PAPER 85-1061]
- The effect of the bluntness shape on the drag coefficient of a body in hypersonic flow of a rarefied gas p 624 A85-38564
- Similarity properties in the problem of flow from a supersonic source past a spherical bluntness p 629 A85-39445
- BLUNT LEADING EDGES
- A second-order approximate method for transonic small-disturbance potential flow and its application to the analysis of flows over airfoits p 625 A85-38922 BODIES OF REVOLUTION
- An experimental investigation of the aerodynamic effects on a body of revolution in turning flight p 624 A85-38782 TAIAA PAPER 85-08661

- hypersonic flow regime (AIAA PAPER 85-0998)
- blunted bodies with discontinuities in generators

В

Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects

p 699 N85-28266 [AD-A153020] BODY-WING AND TAIL CONFIGURATIONS

Multignd calculation of transonic wing-tail-fuselage combinations p 620 flow nast p 628 A85-39216 Supersonic aerodynamic characteristics of canard, tailless, and aft-tail configurations for 2 wing planforms

p 634 N85-27822 [NASA-TP-2434] Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating

Derivatives (MOD) on an experimental part [IFD-1/84-PT-1] p 654 N85-28939 Experimental and theoretical determination of the

wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind [IFD-1/84-PT-2] p 654 N85-28940

BODY-WING CONFIGURATIONS A supersonic panel method based on the triplet

p 617 A85-37191 singularity Wing optimization and fuselage in ntegration for future p 618 A85-37212 generation of supersonic aircraft

Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part p 654 N85-28939 [IFD-1/84-PT-1]

BOEING 707 AIRCRAFT Meeting the 1985 FAA noise regulations with old engines

and modern acoustic technology [AIAA PAPER 85-1120] p 651 A85-39616

BORON Boron slurry fuel atomization evaluation

[AIAA PAPER 85-1184] p 689 A85-39645 BORON FIBERS

Fibers for structurally reliable metal and ceramic composites p 687 A85-37484

BOUNDARY ELEMENT METHOD

Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade p 698 A85-39897 LASME PAPER 84-WA/HT-691 BOUNDARY INTEGRAL METHOD

Diffraction of a single plane wave by a conical wing p 623 A85-38483 An integral method of wall interference correction for

w speed wind tunne p 682 A85-38962 BOUNDARY LAYER CONTROL Development of an active laminar flow nacelle

[AIAA PAPER 85-1116] p 629 A85-39613 An investigation of high performance, short thrust augmenting ejectors

(ASME PAPER 84-WA/FE-10] p 697 A85-39873 Numerical study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828

BOUNDARY LAYER FLOW The free interaction in a supersonic flow over a porous p 626 A85-39021 wall

Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts p 631 A85-39697 [AIAA PAPER 85-1281]

BOUNDARY LAYER SEPARATION The separation of a turbulent boundary layer within a

two-face angle before an obstruction p 619 A85-37340

Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow Numerical and experimental determination of secondary

separation on delta wings in subsonic flow p 628 A85-39219

Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects p 699 N85-28266 [AD-A1530201

Turbulence structure in the boundary layers of an oscillating airfoil

[AD-A153631] p 637 N85-28926 A study of aerodynamic control in stalled flight long laminar separation bubble analysis

[AD-A153850] p 638 N85-28930 BOUNDARY LAYER TRANSITION measurements Transition via heat-transfer

instrumentation on a 0 5 bluntness 9 75-deg cone at Mach 7 with and without mass addition

p 621 A85-37645 [AIAA PAPER 85-1004] On the effect of wing taper and sweep direction on leading edge transition

[CA-8435] p 634 N85-27827 BOUNDARY LAYERS

On the effect of wing taper and sweep direction on leading edge transition [CA-8435] p 634 N85-27827

BOUNDARY LUBRICATION

A method for the evaluation of the boundary lubricating properties of aviation turbine fuels p 687 A85-37495 BOUNDARY VALUE PROBLEMS

The finite element formulation of airflow around a deformable wing by using the incremental finite element p 621 A85-37879 method

Characteristics of a two-dimensional turbulent jet in a bounded slipstream p 695 A85-39131 BRITTI ENESS

Frangibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431

BUBBLES A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850]

p 638 N85-28930 BUFFETING

Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel p 679 N85-27903

BURST TESTS Air turbine starter turbine wheel containment

[SAE PAPER 841546] p 661 A85-39156 RUSHINGS

Further investigations to improve the fatigue life of the Mirage 1110 wing main span

p 654 N85-28938 [ARL-STRUC-TM-397]

С

C-135 AIRCRAFT

Design of robust controllers for a multiple input-multiple output control system with uncertain parameters application to the lateral and longitudinal modes of the KC-135 transport aircraft

[AD-A153100] p 675 N85-27877 CABINS

Examination of fire safety of commercial aircraft p 639 A85-37693 cahins CALCULUS OF VARIATIONS

Numerical solution of the minimum-time flight of a glider through a thermal by use of multiple shooting methods p 638 A85-37489

CALIBRATING

Autocalibration of a laser gyro strapdown inertial p 642 A85-37808 reference/navigation system Transonic Mach number determination in a blow-down wind tunnel with solid walls and a downstream throat [VTH-LR-402] p 636 N85-27835 Construction 1976-1980 Design, manufacturing, calibration of the German-Dutch wind tunnel (DNW) p 683 N85-27913

CANARD CONFIGURATIONS

Supersonic aerodynamic characteristics of canard, tailless, and aft-tail configurations for 2 wing planforms [NASA-TP-2434] p 634 N85-27822 CANS

Flame radiation and liner heat transfer in a tubular-can combustor p 663 A85-39580 CAPS

External caps - An approach to stress reduction in p 647 A85-38306 balloons

CARBON FIBER REINFORCED PLASTICS

Development of a fuselage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction [MBB/LFA34/CFK/PUB/008] p 651 N85-27851

Integral profile method for production of carbon fiber [MBB/LFA34/CFK/PUB/006]

p 690 N85-27975 Heat resistant Carbon Fiber Reinforced Plastics (CFRP) hardening equipment

[MBB/LFA33/CFK/PUB/007] p 690 N85-27976 **CARBON FIBERS**

Lightning-safe carbon fiber composite for Airbus tail unit p 692 N85-29100 CARBON-CARBON COMPOSITES

The problems ansing in testing of carbon-based materials for structural components of airframes p 686 A85-37339

CARGO

Air traffic Instruments, airports, companies, post, cargo p 641 N85-28932 and passengers CARGO AIRCRAFT

- Soviets tailor cargo transport for remote-site p 646 A85-38244 operations
- USSR report Transportation [JPRS-UTR-84-025] p 641 N85-27841 Test flight of IL-76TD long-range transport variant

p 641 N85-27842 OWEMA report A project study concerning the possibilities and the desirability of a east-west runway for Maastricht Airport (Netherlands) as a Euro-regional air

freight center [B8476490] p 685 N85-28955 CASCADE CONTROL

A multiloop robust controller design study using singular value gradients p 703 A85-39564 CASCADE FLOW

CIRCULAR CYLINDERS

A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method p 624 A85-38562

The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967

- Simulation of wake passing in a stationary turbine rotor p 629 A85-39589 cascade Investigation of the effect of two endwall contours on
- the performance of an annular nozzle cascade p 630 A85-39661 [AIAA PAPER 85-1218]
- Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines
- [AIAA PAPER 85-1332] p 631 A85-39728 An investigation of lift augmentation of tandem cascades
- [ASME PAPER 84-WA/FM-3] p 633 A85-39875 CASCADE WIND TUNNELS

Methods for design aerodynamics of modern transport aircraft

[DFVLR-FB-85-05] p 636 N85-27838 CASTING

Precision die forging of blades or gas turbines p 672 N85-28148

- CATALYTIC ACTIVITY The role of surface generated radicals in catalytic
- p 671 N85-27869 combustion CATHODE BAY TUBES
- Color CRT in the F-15 p 656 A85-38954 CELESTIAL NAVIGATION
- An automatic navigation and aspect sensing system for X-ray astronomy p 643 A85-38314

CENTRIFUGAL COMPRESSORS Flowfield and performance measurements in a vaned radial diffuser

LASME PAPER 84-WA/EM-71 p 634 A85-39876 CERAMIC MATRIX COMPOSITES

metal and ceramic Fibers for structurally reliable composites p 687 A85-37484

CERAMICS Feasibility study of the welding of SiC

p 688 A85-39339

- Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28109
- Ceramic turbochargers A case study of a near-term application of high-strength ceramics
- [DE85-006495] p 700 N85-28379 Future of ceramic turbochargers Promises and outfalls
- [DE85-006209] p 700 N85-28380 Ceramic Technology for Advanced Heat Engines
- Project [DE85-008755] p 691 N85-29052 Ceramic coatings for heat engine materials Status and
- future needs [DE85-008759] p 691 N85-29053

Ceramic coatings for heat engine materials DE85-005238] p 691 N85-29054

GPS-based certification for the microwave landing

What an airship manufacturer faces in a certification

Certifying complex digital systems on civil aviation ircraft p 680 N85-27907

Simplified implicit block-bidiagonal finite difference

Passive navigation by triangulation and tracking of

The distribution of higher n-alkanes in partially frozen

Chemical preparations for protecting aircraft against

The 'solution-large molecules' method for calculating

The flow past two cylinders having different diameters

the equilibrium composition of heterogeneous systems

Damage tolerance of composite cylinders

undistinguished features in successive high-resolution

method for solving the Navier-Stokes equations

p 642 A85-37825

p 641 A85-38785

p 695 A85-39003

p 642 A85-37830

p 692 N85-29074

p 638 A85-37541

p 687 A85-39101

p 696 A85-39240

p 688 A85-39600

A-7

CERTIFICATION

program today

CHANNEL FLOW

[AIAA PAPER 85-0870]

CHARGE COUPLED DEVICES

CHEMICAL COMPOSITION

middle distillate fuels

CHEMICAL COMPOUNDS

CHEMICAL EQUILIBRIUM

CIRCULAR CYLINDERS

[AD-A153940]

system

aircraft

images

birds

p 644 A85-38647

COMMUNICATION NETWORKS

--- Russian book COMPATIBILITY

Communication in automated air-traffic-control systems

Deployable Core Automated Maintenance System

Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location [ASME PAPER 84-WA/HT-70] p 698 A85-39898 CIRCULATION Heat management system for aircraft p 654 N85-28936 AD-D0116581 CIRCULATION CONTROL AIRFOILS Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497] p 627 A85-39205 CIVIL AVIATION Global positioning system as a sole means for civil air navigation p 643 A85-37832 Korea's air transport - Planned expansion p 681 A85-37949 Costs and tariff levies in air transportation p 705 A85-37950 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Simulation and analysis of differential GPS p 685 A85-38546 Air transport deregulation - The US experience and its p 705 A85-39369 applicability to Europe Advanced techniques for health and usage monitoring helicopter transmissions [AIAA PAPER-85-1142] p 617 A85-39621 Certifying complex digital systems on civil aviation p 680 N85-27907 aircraft Operations research [B8561897] p 704 N85-28712 COCKPITS p 655 A85-37896 The cockpit of the Airbus A310 p 655 A85-37925 Cockpit of the future? Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings p 655 A85-38951 A systematic program for the development and evaluation of airborne color display systems p 655 A85-38952 Airborne electronic color displays - A review of UK activity p 656 A85-38953 since 1981 COEFFICIENT OF FRICTION Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600 COLLISION AVOIDANCE The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas in order to prevent bird-aircraft collisions p 638 A85-37542 Observation of birds in the flight path of aircraft - An important stage in the prevention of bird strikes p 639 A85-37544 COLOR A systematic program for the development and evaluation of airborne color display systems p 655 A85-38952 Airborne electronic color displays - A review of UK activity p 656 A85-38953 ылсе 1981 Color CRT in the E-15 p 656 A85-38954 A general area air traffic controller simulation using olour graphics p 645 N85-28933 [AD-A153634] COMBAT A missile duel between two aircraft p 703 A85-39563 Propulsion influences on air combat p 651 A85-39789 (AIAA PAPER 85-1457) COMBUSTION CHAMBERS Radiative transfer in a gas turbine combustor p 658 A85-37682 [AIAA PAPER 85-1072] Dynamic gas temperature measurement system p 694 A85-37706 The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion p 661 A85-39122 chambers Flame radiation and liner heat transfer in a tubular-can p 663 A85-39580 combustor Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices [AIAA PAPER 85-1104] p 664 A85-39606 Combustion instability sustained by unsteady vortex combustion [AIAA PAPER 85-1248] p 689 A85-39676 Numerical solutions of ramjet nozzle flows p 631 A85-39689 [AIAA PAPER 85-1270] Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking [AIAA PAPER 85-1288] p 667 A85-39701 Companson of advanced cooling concepts using color thermography --- for high temperature-rise gas combustors p 667 A85-39702 [AIAA PAPER 85-1289] Advanced liner-cooling techniques for gas turbine combustors

[AIAA PAPER 85-1290] p 667 A85-39703

Technology for the design of high temperature rise combustors [AIAA PAPER 85-1292] p 668 A85-39705

Calculation of the flow in a dump combustor [AIAA PAPER 85-1309] p 668 A85-39716 Small gas turbine combustor study - Fuel injector

performance in a transpiration-cooled liner [AIAA PAPER 85-1312] p 668 A85-39717

Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study (AIAA PAPER 85-1313) p 668 A85-39718

Application of system identification techniques to poststall combustor dynamics [AIAA PAPER 85-1353] p 669 A85-39743

Combustion technology - A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763

State of the art and research needs of pulsating combustion

[ASME PAPER 84-WA/NCA-19] p 690 A85-39913 Segmented zoned fuel injection system for use with a combustor

[AD-D011640] p 670 N85-27865 Predictions and measurements of isothermal flowfields in axisymmetric combustor geometries

[NASA-CR-174916] p 671 N85-27867 The role of surface generated radicals in catalytic combustion p 671 N85-27869 Future fundamental combustion research for

[NASA-TM-87049] p 671 N85-27870 Reacton-bonded and fiber-reinforced SiC static and

dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874

Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946

Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073

COMBUSTION EFFICIENCY The role of surface generated radicals in catalytic combustion p 671 N85-27869

COMBUSTION PHYSICS

Radiative transfer in a gas turbine combustor [AIAA PAPER 85-1072] p 658 A85-37682 The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems

p 687 A85-39101 Numerical solutions of ramjet nozzle flows

[AIAA PAPER 85-1270] p 631 A85-39689 COMBUSTION PRODUCTS

An improved procedure for calculating the aerothermodynamic properties of a vitiated air test medium [AIAA PAPER 85-0913] p 704 A85-37583

 [AIAA PAPER 85-0913]
 p 704
 A85-37583

 Jet fuel instability mechanisms
 p 690
 N85-28127

COMBUSTION STABILITY

Unstable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39115 Fuel injection characterization and design methodology to improve lean stability

[AIAA PAPER 85-1183] p 664 A85-39644 Combustion instability sustained by unsteady vortex combustion

[AIAA PAPER 85-1248] p 689 A85-39676 State of the art and research needs of pulsating combustion

[ASME PAPER 84-WA/NCA-19] p 690 A85-39913 COMMAND AND CONTROL

NATCS - Navigation Aided Target Control System for multiple drone applications p 642 A85-37803 COMMERCIAL AIRCRAFT

Examination of fire safety of commercial aircraft cabins p 639 A85-37693 Costs and tariff levies in air transportation

p 705 A85-37950 The ARINC 704 ring laser gyro Inertial Reference

System p 643 A85-38528 Commercial aviation GPS Navigation Set architecture p 644 A85-38538

Aerodynamic test results for a wing-mounted turboprop propulsion installation

[SAE PAPER 841480] p 627 A85-39060 Repaining commercial aircraft jet engine nacelle composite structures [SAE PAPER 841567] p 616 A85-39068

Prospects and problems of advanced open rotors for commercial aurcraft

[AIAA PAPER 85-1191] p 665 A85-39649 Demonstration of relaxed static stability on a commercial transport p 679 N85-27898 Positivation of relaxed static stability on a commercial

Realisation of relaxed static stability on a commercial transport p 679 N85-27899

(DCAMS) [AD-A153695] p 706 N85-29839 COMPENSATORY TRACKING Toward a unifying theory for aircraft handling qualities p 651 A85-39554 COMPONENT RELIABILITY Redundancy management in strapdown navigation systems p 644 A85-38530 Usage monitoring - A milestone in engine life management [AIAA PAPER 85-1206] p 665 A85-39656 COMPOSITE MATERIALS Integrated CADCAM - An approach for advanced composite primary aircraft structure p 703 A85-37211 Development in UK rotor blade technology p 615 A85-38236 Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins [NASA-TM-86418] p 652 N85-27852 Structural Analysis p 701 N85-29313 [DEVLR-MITT-84-21] COMPOSITE STRUCTURES Fasteners for composite structures examined p 692 A85-37074 Repair procedures for composite sinewave p 686 A85-37380 substructure Improved resins for wet layup repair of advanced composite structure p 686 A85-37381 An overview of structural repair adhesives p 686 A85-37407 Repairing commercial aircraft jet engine nacelle composite structures [SAE PAPER 841567] p 616 A85-39068 Assessment of damage tolerance in composites p 688 A85-39598 Damage tolerance of composite cylinders p 688 A85-39600 COMPRESSED AIR Performance of a new nose-lip hot-air anti-icing concept [AIAA PAPER 85-1117] p 664 A85-39614 COMPRESSIBLE FLOW A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors 1 - Axial flow stream function formulation p 622 A85-37931 Supersonic flow around blunt wedge p 636 N85-28158 COMPRESSOR BLADES Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567 Unsteady blade row interactions in a multi-stage compressor [AIAA PAPER 85-1134] p 630 A85-39618 Axial-flow compressor stage post-stall analysis [AIAA PAPER 85-1349] p 632 A85-39741 Precision die forging of blades or gas turbines p 672 N85-28148 COMPRESSOR EFFICIENCY A generalization of experimental data on heat transfer from the working medium to the housing components of the compressor of a gas-turbine engine p 660 A85-39112 Quantitative evaluation of transient heat transfer on axial flow compressor stability [AIAA PAPER 85-1352] p 697 A85-39742 COMPRESSOR ROTORS Ceramic turbochargers A case study of a near-term application of high-strength ceramics [DE85-006495] p 700 N85-28379 COMPRESSORS Testing of materials and coatings for jet engine components under simulated operational conditions [B8580073] p 672 N85-27873 Strutless diffuser for gas turbine engine [AD-D011662] p 672 N85-28943 Compressor and turbine models - numerical stability and other aspects [AD-A153811] p 673 N85-28948 COMPUTATION Heating parameter estimation usina coaxal thermocouple gages in wind tunnel test articles p 699 N85-28328 [AD-A1530391 COMPUTATIONAL CHEMISTRY The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101

COMPUTATIONAL FLUID DYNAMICS

A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of attack p 619 A85-37333

Gas flow in nozzles and lets n 619 A85-37337 Determination of aerodynamic characteristics of bodies in weakly perturbed gas flows p 619 A85-37341 A review of some approximate methods used in

aerodynamic heating analyses [AIAA PAPER 85-0906] p 620 A85-37580 Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of

attack p 620 A85-37593 [AIAA PAPER 85-0924] Computational methods for hypersonic viscous flow over

finite ellipsoid-cones at incidence p 620 A85-37594 [AIAA PAPER 85-09251 The finite element formulation of airflow around a deformable wing by using the incremental finite element

p 621 A85-37879 method Flow-field matrix solution for flow along arbitrarily twisted \$1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927

Quasi-three-dimensional blade design code p 622 A85-37928 The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade Families of vanational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow turbomachines p 622 A85-37930 A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors I - Axial flow, stream function formulation p 622 A85-37931 Computation of the thrust performance of axisymmetric p 622 A85-37932 nozzles A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 program SOLST 1 Instability of plane-parallel supersonic gas flows in the p 623 A85-38551 linear approximation A second-order approximate method for transonic small-disturbance potential flow and its application to the analysis of flows over airfoils p 625 A85-38922 An integral method of wall interference correction for p 682 A85-38962 low speed wind tunnel The computation of transonic nozzle flow-field by a p 625 A85-38963 time-dependent method Numerical simulation of three-dimensional transonic flow p 625 A85-38965 in a turbomachinery p 625 A85-38965 The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966 The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967 An extension of the generalized vortex-lattice method p 626 A85-38972 of supersonic sideslipping wings Computations of projectile Magnus effect at transonic velocities p 626 A85-38981 Numerical solution of two- and three-dimensional rotor p 626 A85-38989 to leakage models Simplified implicit block-bidiagonal finite difference

method for solving the Navier-Stokes equations p 695 A85-39003 The free interaction in a supersonic flow over a porous wall All p 626 A85-39021 Characteristics of a two-dimensional turbulent jet in a

bounded slipstream p 695 A85-39131 Computation of three-dimensional flow using the Euler equations and a multiple-grid scheme

p 627 A85-39200 Computational/experimental pressure distributions on a transonic, low-aspect-ratio wing p 628 A85-39210 Multignd calculation of transonic flow past wing-tail-fuselage combinations p 628 A85-39216 A computational study of the unsteady shock-wave

structure in a two-dimensional transonic rotor p 629 A85-39578 External compression supersonic inlet analysis using a

finite difference two-dimensional Navier-Stokes code p 629 A85-39581

Numerical simulation of a supercritical inlet flow [AIAA PAPER 85-1214] p 630 A85-39658 Application of 3-D flow computations to gas turbine aerodynamic design

p 630 A85-39659 [AIAA PAPER 85-1216] On the modelling of a fully-relaxed propeller

slipstream [AIAA PAPER 85-1262] p 630 A85-39685 Numerical solutions of ramjet nozzle flows p 631 A85-39689 [AIAA PAPER 85-1270]

Calculation of the flow in a dump combustor [AIAA PAPER 85-1309] p 668 A85-39716

Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines

[AIAA PAPER 85-1332] p 631 A85-39728 Accurate and efficient solutions of transonic internal flows

p 631 A85-39729

[AIAA PAPER 85-1334]

PNS predicted shock location and jump conditions at supersonic and hypersonic speeds --- Parabolized Navier-Stokes

[AIAA PAPER 85-1407] o 632 A85-39766 Numerical investigation of internal high-speed viscous flows using a parabolic technique

[AIAA PAPER 85-1409] p 632 A85-39768 A further assessment of numerical annular dump diffuser flow calculations

[AIAA PAPER 85-1440] p 633 A85-39779 Results of AGARD assessment of prediction capabilities for nozzle afterbody flows

[AIAA PAPER 85-1464] p 633 A85-39793 Two-dimensional turbulent flow ar turbomachinery by the finite element method analysis m

[ASME PAPER 84-WA/FM-2] p 633 A85-39874 Vertical plate fin with c convection-conduction turbulent flow conjugated forced

[ASME PAPER 84-WA/HT-8] p 698 A85-39878 Future fundamental combustion research tor aeropropulsion systems

p 671 N85-27870 INASA TM. 970401 COMPUTATIONAL GRIDS

Computation of three-dimensional flow using the Euler equations and a multiple-grid scheme

p 627 A85-39200 A further assessment of numerical annular dump diffuser flow calculations

[AIAA PAPER 85-1440] p 633 A85-39779 COMPUTER AIDED DESIGN

Computer aided tube routing design in aircrafts p 615 A85-37183

A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling criteria under multiple loading p 693 A85-37187 Integrated CADCAM - An approach for advanced composite primary aircraft structure p 703 A85-37211 Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323

The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion p 661 A85-39122 chambers Computer-aided start-system design and verification SAE PAPER 841508] p 661 A85-39152 Aerodynamic research in preparation for a new Dutch [SAE PAPER 841508]

[B8580077] p 636 N85-27836 Methods for design aerodynamics of modern transport aircraft [DFVLR-FB-85-05] p 636 N85-27838 USAF damage tolerant design handbook Guidelines

for the analysis and design of damage tolerant aircraft structures, revision B [AD-A1531611 p 652 N85-27858

Advanced secondary power system for transport aucraft [NASA-TP-2463] p 673 N85-28944

MBB expands CADAM system for a 320 program p 704 N85-29099

COMPUTER AIDED MANUFACTURING Integrated CADCAM - An approach for advanced composite primary aircraft structure p 703 A85-37211 Robotic drilling of acrylic windshields and canopies for ghter aircraft p 703 A85-37396 fighter aircraft

The application of numerical control (NC) in manufacturing wind tunnel models p 699 N85-28140 [88580078]

COMPUTER GRAPHICS

Pictonal format program - Past, present, and future p 656 A85-38958 Estimation of hot gas reingestion for a VTOL aircraft

at the conceptual design stage p 663 A85-39207 [SAE PAPER 841555] The interactive generation of specifications for an

p 679 N85-27906 onboard software series (GISELE) COMPUTER PROGRAMMING A method to calculate the parameters of wings of

arbitrary planform [AD-A152689] p 635 N85-27831

COMPUTER PROGRAMS

Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323

A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355

Computer study of a jet flap ASTVOL 'Harrier' [SAE PAPER 841457] p 650 A8 p 650 A85-39202 Users manual for coordinate generation code CRDSRA

p 634 N85-27824 [NASA-CR-172584] User's manual for airfoil flow field computer code SRAIR

[NASA-CR-172585] p 634 N85-27825

program, part 1 [NASA-CB-132732-1]

p 652 N85-27855 Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation p 652 N85-27856 [NASA-CR-132732-2] Predictions and measurements of isothermal flowfields

in axisymmetric combustor geometries [NASA-CR-174916] p 671 N85-27867

Operational and developmental experience with the F/A-18A digital flight control system p 678 N85-27895

Certifying complex digital systems on civil aviation p 680 N85-27907 aircraft

parameter estimation using Heating coaxial thermocouple gages in wind tunnel test articles [AD-A153039]

p 699 N85-28328 Flight testing for performance and flying qualities p 654 N85-28920

DEAN A program for dynamic engine analysis [NASA-TM-87033] p 673 N85-28945

Description and illustration of the use of CRACKS IV p 701 N85-29325 [AD-A153543]

COMPUTER TECHNIQUES

Calculation of the flow in a dump combustor [AIAA PAPER 85-1309] p 668 A85-39716 ACT applied to helicopter flight control

p 678 N85-27891 Some flight test results with redundant digital flight p 678 N85-27892 control systems

Turbulence structure in the boundary layers of an

oscillating airfoil [AD-A153631] p 637 N85-28926 MBB expands CADAM system for a 320 program p 704 N85-29099

Deployable Core Automated Maintenance System (DCAMS)

[AD-A153695] p 706 N85-29839 COMPUTER VISION

Robotic drilling of acrylic windshields and canopies for fighter aircraft p 703 A85-37396 COMPUTERIZED SIMULATION

First-order feedback strategies for variable speed planar p 703 A85-37198 p 681 A85-37491 pursuit-evasion games European transonic wind tunnel Engine system field experience [SAE PAPER 841601] simulation program p 659 A85-39071

Aircraft performance in a JAWS microburst p 701 A85-39213

Modelling vortex flowfields by supercomputers with p 628 A85-39242 super-size memory

The development of a hardware-in-the-loop engine mulation facility

p 682 A85-39706 [AIAA PAPER 85-1293] The development of the generalized escape system mulation program

SME PAPER 84-WA/DSC-20] p 651 A85-39869 Addition of flexible body option to the TOLA computer [ASME PAPER 84 WA/DSC-20] ogram Part 2 User and programmer documentation

[NASA-CR-132732-2] p 652 N85-27856 OLGA An open loop gust alleviation system

p 678 N85-27897 Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149

Adding computationally efficient realism to Monte Carlo turbulence simulation

[NASA-TP-2469] p 704 N85-28708 Operations research

[B85618971 p 704 N85-28712 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind

p 654 N85-28940 [IFD-1/84-PT-2] DEAN A program for dynamic engine analysis

- [NASA-TM-87033] p 673 N85-28945 Compressor and turbine models - numerical stability and
- other aspects p 673 N85-28948 [AD-A153811] Piloted simulation of an algorithm for onboard control

of time-optimal intercept [NASA-TP-2445] p 681 N85-28949

CONCENTRATION (COMPOSITION) The distribution of higher n-alkanes in partially frozen

middle distillate fuels p 692 N85-29074 [AD-A1539401

CONFERENCES

Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of p 615 A85-37176 Papers

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Addition of flexible body option to the TOLA computer

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- ρ 659 A85-39057 [SAE SP-594] Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, er 15-18, 1984
- (SAE SP-5981 SAE SP-598] p 661 A85-39151 V/STOL. An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984
- (SAE SP-591) p 616 A85-39201 Active Control Systems Review, Evaluation and Projections
- [AGARD-CP-384] p 676 N85-27883 Adaptive wall wind tunnels and wall interference correction methods
- p 683 N85-27912 [DFVLR-IB-222-84-A-37] Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting,
- Viscous and Interacting Flow Field Effects p 699 N85-28266 (AD-A153020) CONICAL BODIES
- Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10
- [AIAA PAPER 85-1061] p 621 A85-37675 Diffraction of a single plane wave by a conical wing p 623 A85-38483
- The isolated nature of solutions with a strong attached shock wave at the edges of a conical wing and a wedge p 623 A85-38488
- CONICAL FLOW
- Computational methods for hypersonic viscous flow over finite ellipsoid-cones at incidence p 620 A85-37594 [AIAA PAPER 85-0925]
- Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins
- p 626 A85-38984 CONICAL NOZZLES
- The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine p 660 A85-39107 stage CONTAINERS
- Flame radiation and liner heat transfer in a tubular-can p 663 A85-39580 combusto CONTRACT INCENTIVES
- Using incentives to improve maintainability p 706 N85-29841 [AD-A153792]
- CONTRACT MANAGEMENT Using incentives to improve maintainability
- p 706 N85-29841 AD-A1537921 CONTRACT NEGOTIATION
- Using incentives to improve maintainability rAD-A1537921 p 706 N85-29841 CONTRAROTATING PROPELLERS
- Noise of counter-rotation propellers
- p 705 A85-39220 CONTROL SIMULATION
- In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft [DFVLR-FB-84-12] p 676 N85-27880
- CONTROL STABILITY A multiloop robust controller design study using singular p 703 A85-39564 value gradients
- Time-domain stability robustness measures for linear p 703 A85-39565 regulators CONTROL SURFACES
- X-29 digital flight control system design
- p 677 N85-27889 p 679 N85-27901 The aerodynamics of control Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161
- A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928
- Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis [NAK-TR-86] p 681 p 681 N85-28950
- CONTROL SYSTEMS DESIGN Robotic drilling of acrylic windshields and canopies for fighter aircraft p 703 A85-37396 Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364
- Time-domain stability robustness measures for linear regulators p 703 A85-39565 Development and evaluation of an integrated flight and propulsion control system
- [AIAA PAPER 85-1423] p 669 A85-39771

- The state-of-the-art and future of flight control systems p 677 N85-27885
- Aspects of application of ACT systems for pilot workload p 677 N85-27887 alleviation
- Application of AFTI/F-16 task-tailo red control modes in p 677 N85-27888 advanced multirole fighters X-29 digital flight control system design
- p 677 N85-27889 The evolution of ACS for helicopters Conceptual
- simulation studies to preliminary design p 677 N85-27890 ACT applied to helicopter flight control
- p 678 N85-27891
- An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893
 - p 678 N85-27894 ACT flight research experience
- Operational and developmental experience with the F/A-18A digital flight control system p 678 N85-27895
- Flight testing and development of the F/A-18A digital
- fligh control system p 678 N85-27896 OLGA. An open loop gust alleviation system p 678 N85-27897
- The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft
- p 680 N85-27908 Automatic flight control modes for the AFTI/F-111
- mission adaptive wing aircraft p 680 N85-27909 The STOL and maneuver technology program integrated control system development p 680 N85-27910 CONTROL THEORY
- New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control p 703 A85-39551
- Design of robust controllers for a multiple input-multiple output control system with uncertain parameters application to the lateral and longitudinal modes of the KC-135 transport aircraft
- [AD-A153100] p 675 N85-27877 Controller requirements for uncoupled aircraft motion, volume 1
- [AD-A153173] p 675 N85-27878 Controller requirements for uncoupled aircraft motion, volume 2
- [AD-A153300] p 676 N85-27879 Active Control Systems Review, Evaluation and Projections
- [AGARD-CP-384] p 676 N85-27883 CONTROLLABILITY
- Toward a unifying theory for aircraft handling qualities p 651 A85-39554
- A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot
- [NRC-24173] p 652 N85-27857 p 678 N85-27894 ACT flight research experience How to handle failures in advanced flight control systems
- of future transport aircraft p 679 N85-27905 Mission requirements and handling qualities p 680 N85-28918
- CONTROLLERS
 - Design of robust controllers for a multiple input-multiple control system with uncertain parameters output application to the lateral and longitudinal modes of the KC-135 transport aircraft
 - [AD-A153100] p 675 N85-27877 Controller requirements for uncoupled aircraft motion. olume 2
 - [AD-A1533001 p 676 N85-27879 ACT applied to helicopter flight control
- p 678 N85-27891 CONVECTIVE FLOW
- Vertical plate fin with conjugated forced convection-conduction turbulent flow
- (ASME PAPER 84-WA/HT-81 p 698 A85-39878 **CONVECTIVE HEAT TRANSFER**
- The effects of surface discontinuities on convective hear transfer in hypersonic flow p 620 A85-37621
- [AIAA PAPER 85-0971] Transition measurements
- instrumentation on a 0 5 bluntness 9 75-deg cone at Mach with and without mass addition [AIAA PAPER 85-1004] p 621 A85-37645
- Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade
- [ASME PAPER 84-WA/HT-69] p 698 A85-39897 Unsteady heat transfer due to time-dependent free stream velocity CONVERGENT NOZZLES p 699 N85-27947
- Study of an asymmetric flap nozzle as a thrust-vectoring
- device p 629 A85-39582 CONVERGENT-DIVERGENT NOZZLES Static investigation of several yaw vectoring concepts
- on nonaxisymmetric nozzles [NASA-TP-2432] p 637 N85-28924

thermography --- for high temperature-rise gas combustors [AIAA PAPER 85-1289] p 667 A85-39702 Small gas turbine combustor study - Fuel injector erformance in a transpiration-cooled liner [AIAA PAPER 85-1312] p 668 A85-39717 COORDINATES Flow-field matrix solution for flow along arbitrarily twisted S1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927

Companson of advanced cooling concepts using color

- CORRELATION Correlation and prediction of rotating stall inception by
- p 629 A85-39245 divergence method COST ESTIMATES Costs and tariff levies in air transportation
- p 705 A85-37950 Airport and airway system cost allocation model Volume
- User's manual (AD-A1528771 p 683 N85-27917 COST REDUCTION
- From measurement uncertainty to measurement communications, credibility, and cost control in propulsio p 682 A85-39243 around test facilities
 - COSTS

COOLING

- Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847 COUPLINGS
- Vibrations of rotors connected through couplings with p 672 N85-28147 backlash CRACK INITIATION
- Influence of fighter aircraft load spectrum variations on tigue crack initiation and growth p 693 A85-37181 fatique crack initiation and growth Engineering significance of fatigue thresholds and short
- faturue cracks for structural design [NLR-MP-84001-U] p 700 N85-28430
- CRACK PROPAGATION Influence of fighter aircraft load spectrum variations on
- fatigue crack initiation and growth p 693 A85-37181 Crack growth analysis in multiple load path structure p 693 A85-37186
- Crack propagation analysis of longitudinal skin cracks in a pressurized cabin p 645 A85-37188 Fatigue-crack propagation in aircraft Duratumin shell
- tructures p 695 A85-38918 USAF damage tolerant design handbook Guidelines structures for the analysis and design of damage tolerant aircraft
- structures, revision B [AD-A153161] p 652 N85-27858 Structural Analys
- IDEVLR-MITT-84-21] p 701 N85-29313
- Description and illustration of the use of CRACKS IV (AD-A153543) p 701 N85-29325
- CRACKING (FRACTURING) Advanced Floatwall combustor
- liner technology eliminates TF30-P-100 transition duct fatigue cracking [AIAA PAPER 85-1288] p 667 A85-39701
- CRANES The Cyclo-Crane - A new concept to heavy vertical lift (AIAA PAPER 85-08711 p 648 A85-38786
- A new concept of hybrid airship p 649 A85-38798 [AIAA PAPER 85-0868] CREEP PROPERTIES
- Low temperature creep and fracture of near alpha p 687 A85-38748 titanium allovs CREW WORKSTATIONS
- An argument for standardization in modern aircraft crew stations p 657 A85-38961 CRIME

Critical speed testing of the Grumman X-29A power

Numerical calculation of subsonic jets in crossflow with

A study of aerodynamic control in stalled flight

An evaluation of the exhaust system configuration from

the cruise efficiency criteria of an engine in an aircraft

Classical and neo-classical cruise-dash optimization

the

p 640 A85-38778

p 662 A85-39163

p 697 A85-39780

p 638 N85-28928

p 660 A85-39121

p 650 A85-39212

p 700 N85-29116

p 681 A85-37491

ın

manne

Tethered aerostat operations

leading-edge vortex formation analysis

Cryogenic test technology, 1984

European transonic wind tunnel

nvironment

CROSS FLOW

[AD-A153758]

CRUISING FLIGHT

system

heat.transfer

[AIAA PAPER 85-0860]

take-off shaft subsystem

reduced numerical diffusion

[AIAA PAPER 85-1441]

CRYOGENIC EQUIPMENT

CRYOGENIC WIND TUNNELS

(AGARD-AR-212)

[SAE PAPER 841603]

CRITICAL VELOCITY

SUBJECT INDEX		
Cryogenic test technology, 1984		
[AGARD-AR-212] CRYSTAL DISLOCATIONS	p 700	N85-29116
The influence of microstru		on the
temperature-dependent flow propertie	sofTi⊣ p687	6AI-4V A85-38749
CRYSTALLIZATION		
The distribution of higher n-alkane: middle distillate fuels	s in pai	rtially frozen
[AD-A153940]	p 692	N85-29074
CUMULATIVE DAMAGE United States Air Force engine of	lamage	e tolerance
requirements [AIAA PAPER 85-1209]	p 665	A85-39657
CUSHIONS Hovercraft skirt design and manufa	cture	
CYLINDERS	p 694	A85-38233
Approximate relationships for deter	mining	pressure at
the surface of a sphere or a cy free-stream Mach numbers		for arbitrary A85-38563
CYLINDRICAL BODIES	p 024	A03-30303
A nonstationary transition process of a gas into the near wake of a bo		
flow		A85-37336
The separation of a turbulent bour	ndary la	iver within a
two-face angle before an obstruction	p 619	A85-37340
P		
D		
DAMAGE		
United States Air Force engine requirements	dama	ge tolerance
[AIAA PAPER 85-1209]	p 665	A85-39657
Description and illustration of the [AD-A153543]	use of p701	
DAMAGE ASSESSMENT		
Fatigue life evaluation program for	the Kfir p 645	
Concepts and application of aircrat	ft dama	ge tolerance
analysis USAF damage tolerant design har	p 645	A85-37206 Guidelines
for the analysis and design of dama		
structures, revision B [AD-A153161]	p 652	N85-27858
DAMPING		
Hyperbolic phenomena in the fi- fluids	ow of	viscoelastic
[AD-A153533]	p 700	N85-29186
DATA ACQUISITION Applications of state estimation i	n aircra	aft flight-data
analysis	p 650	A85-39211
Data processing on the rotor test Brunswick Microprogrammable inf		
processor as key components in a Pl		
acquisition and processing system [DFVLR-MITT-85-03]	р 684	N85-27921
DATA BASE MANAGEMENT SYSTEM		
Avionics Data Base users manual [AD-A153810]	p 657	N85-28942
DATA BASES		
Review of empirical and analyti methodologies	cal spe	cific impulse
[AIAA PAPER 85-1434]	p 669	A85-39776
Avionics Data Base users manual [AD-A153810]	p 657	N85-28942
DATA RECORDING		
Instrumentation for gas turt short-duration facilities	nue r	research in
[SAE PAPER 841504]	p 695	A85-39062
DATA REDUCTION Heating parameter estimation	n usi	ng coaxial
thermocouple gages in wind tunnel to	est artic	les
[AD-A153039] Flight testing for performance and		N85-28328 Jualities
		N85-28920

DEFLECTION

Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A85-39209 DEICERS

p 654 N85-28920

Electro-expulsive separation system [NASA-CASE-ARC-11613-1] p 700 N85-29150

DELTA WINGS

- Wing optimization and fuselage integration for future generation of supersonic aircraft p 618 A85-37212 Numerical and experimental determination of secondary separation on delta wings in subsonic flow p 628 A85-39219
- DENSITY DISTRIBUTION
- A system of shock and rarefaction waves in flows past bodies with complex shapes p 618 A85-37330

DEPLOYMENT

Deployable Core Automated	Maintenar	ice System
(DCAMS)		
[AD-A153695]	p 706	N85-29839
DEPOSITION		
Jet fuel instability mechanisms		
[NASA-CR-175856]	p 690	N85-28127
DESIGN ANALYSIS		
Hovercraft skirt design and ma	nufacture	
	p 694	A85-38233

- The ARINC 704 ring laser gyro inertial Reference System p 643 A85-38528 The design and development of the Grace Aircraft GAC-20 airship
- (AIAA PAPER 85-0869) p 648 A85-38784 Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 Fuel injection characterization and design methodology
- to improve lean stability [AIAA PAPER 85-1183] p 664 A85-39644 DETECTION
- Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data
- [NASA-CR-172589] p 657 N85-28941 DIAMETERS
- The flow past two cylinders having different diameters p 696 A85-39240 DIAPHRAGMS (MECHANICS)
- A new technique to break diaphragms electrically in a double-tube short duration jet simulation facility p 682 A85-38975
- DIES Precision die forging of blades or gas turbines
- p 672 N85-28148
 - Future of ceramic turbochargers Promises and pitfalls
- [DE85-006209] p 700 N85-28380 Ceramic Technology for Advanced Heat Engines Project
- [DE85-008755] p 691 N85-29052 Ceramic coatings for heat engine materials Status and future needs
- [DE85-008759]
 p 691
 N85-29053

 Ceramic coatings for heat engine materials
 [DE85-005238]
 p 691
 N85-29054
- DIESEL FUELS The distribution of higher n-alkanes in partially frozen
- middle distillate fuels [AD-A153940] p 692 N85-29074
- DIFFERENCE EQUATIONS Upwind-difference methods for aerodynamic problems
- governed by the Euler equations [REPT-84-23] p 635 N85-27634 DIFFUSERS
- A further assessment of numerical annular dump diffuser
- [AIAA PAPER 85-1440] p 633 A85-39779 Flowfield and performance measurements in a vaned radial diffuser
- [ASME PAPER 84-WA/FM-7] p 634 A85-39876 DIFFUSION
- Strutless diffuser for gas turbine engine [AD-D011662] p 672 N85-28943
- DIFFUSION WELDING Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors
- [AIAA PAPER 84-0933] p 616 A85-39214 DIGITAL COMMAND SYSTEMS
 - Application of AFTI/F-16 task-tailored control modes in advanced multirole fighters p 677 N85-27888 X-29 digital flight control system design
- p 677 N85-27889 Some flight test results with redundant digital flight control systems p 678 N85-27892 DIGITAL COMPLITERS
- An update of expenence on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893
- Operational and developmental experience with the F/A-18A digital flight control system p 678 N85-27895
- Flight testing and development of the F/A-18A digital flight control system p 678 N85-27896 DIGITAL NAVIGATION
- A companison of several digital map-aided navigation techniques p 642 A85-37829 Description and test methods for a frequency output accelerometer p 694 A85-38536 DIGITAL SIMULATION
- A comparison of several digital map-aided navigation techniques p 642 A85-37829 DIGITAL SYSTEMS
 - Design of digital flight control systems for helicopters p 673 A85-37195

Integrated flight/propulsion control - Adaptive engine control system mode [AIAA PAPER 85-1425] p 669 A85-39772 Certifying complex digital systems on civil aviation rcraft p 680 N85-27907 aucraft DIGITAL TECHNIQUES Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution p 642 A85-37830 mages The development of a hardware-in-the-loop engine mutation facility [AIAA PAPER 85-1293] n 682 A85-39706 DIRECTIONAL CONTROL Controller requirements for uncoupled aircraft motion. volume 1 [AD-A153173] 0.675 N85-27878 DISKS (SHAPES) Explosive forming of low carboon steel sheet into a stepped disc shape p 694 A85-38169 DISPLAY DEVICES Terrain/wire and wirelike obstacles warning system for elicopters p 655 A85-38363 helicopters Advanced avionics management system prevents pilots from being swamped by information overload p 655 A85-38401 Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings p 655 A85-38951 systematic program for the development and evaluation of airborne color display systems p 655 A85-38952 Airborne electronic color displays - A review of UK activity since 1981 p 656 A85-38953 Color CRT in the F-15 p 656 A85-38954 Integration of sensor and display subsystems p 656 A85-38955 p 658 A85-38956 Modernizing engine displays Display technology and the role of human factors p 656 A85-38957 Pictorial format program - Past, present, and future p 656 A85-38958 The Command Flight Path Display - All weather, all missions p 656 A85-38959 An argument for standardization in modern aircraft crew p 657 A85-38961 stations A general area air traffic controller simulation using colour graphics [AD-A153634] p 645 N85-28933 DISTORTION Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Improved statistical analysis method for prediction of maximum inlet distortion p 673 N85-28947 [AD-A153767] DIVERGENCE Correlation and prediction of rotating stall inception by divergence method p 629 A85-39245 DO-28 AIRCRAFT Identification of gust input and gust response characteristics from Do 28 TNT flight test data p 676 N85-27881 [DFVLR-FB-84-48] DOORS Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors [AIAA PAPER 84-0933] p 616 A85-39214 DRAG The drag of simple shaped bodies in the rarefied hypersonic flow regime [AIAA PAPER 85-0998] p 621 A85-37642 DRAG REDUCTION Winglet effects on the flutter of a twin-engine transport-type wing p 650 A85-39217 Numerical study of porous airfoils in transonic flo [NASA-TM-86713] p 635 N85-27828 DRIFT RATE Spectral analysis of optimal and suboptimal gyro p 696 A85-39459 monitoring filters DRILLING Robotic drilling of acrylic windshields and canopies for fighter aircraft p 703 A85-37396 DRONE AIRCRAFT Teledyne Ryan focuses R & D effort on new RPVs, target versions p 646 A85-38245 A multiloop robust controller design study using singular value gradients p 703 A85-39564 DROP SIZE

- Fuel droplet size measurements with a laser Doppler interferometer
- [AIAA PAPER 85-1182] p 697 A85-39643 Influence of downstream distance on simplex atomizer
- spray charactenstics [ASME PAPER 84-WA/HT-25] p 698 A85-39888

DRUGS

- Tethered aerostat operations in the marine environment
- (AIAA PAPER 85-08601 p 640 A85-38778 DUCT GEOMETRY
- Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles [AIAA PAPER 85-1346]
- p 632 A85-39738 DUCTED FAN ENGINES Model test results of the split-fan cross-ducted
- propulsion system concept for medium speed V/STOL aircraft [SAE PAPER 841495] o 663 A85-39203
- DUCTED FLOW Interaction between acoustics and subsonic ducted flow
- in a ramiet configuration p 704 A85-37209 Loss in turbofan thrust caused by boundary layer growth
- in a nacelle's inlet and exhaust ducts p 631 A85-39697 [AIAA PAPER 85-1281] DUMPING
- Calculation of the flow in a dump combustor p 668 A85-39716 [AIAA PAPER 85-1309] DURABILITY
- Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664
- DUST COLLECTORS Development of an advanced vaneless inlet particle eparator for helicopter engines
- [AIAA PAPER 85-1277] n 666 A85-39694 DYNAMIC CHARACTERISTICS
- Dynamic charactenstics of the STARS aerostat (AIAA PAPER 85-0880) p 674 A85 p 674 A85-38795 DYNAMIC LOADS
- An assessment of the suitability of the BHGA structural test rig for aerodynamic testing of hang gliders p 652 N85-27853 (CA-8505)
- DYNAMIC PRESSURE Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle
- (SAE PAPER 8415401 n 627 A85-39064 DYNAMIC PROGRAMMING
- A missile duel between two aircraft p 703 A85-39563 DYNAMIC RESPONSE
- Control response measurements of the Skyship-500 airship
- [AIAA PAPER 85-0881] p 649 A85-38796 Controller requirements for uncoupled aircraft motion, volume 1
- p 675 N85-27878 [AD-A153173] DYNAMIC STRUCTURAL ANALYSIS
- Nonstationary deformation of structural elements and p 696 A85-39450 their optimization Turbulence structure in the boundary layers of an oscillatino airfoil [AD-A153631] p 637 N85-28926

E

- ECONOMIC ANALYSIS Ultralights break the rules p 615 A85-38439 FDGES
- The isolated nature of solutions with a strong attached shock wave at the edges of a conical wing and wing and a wedge p 623 A85-38488
- EFFICIENCY Flow characteristics of a partially submerged liquid nickup
- [DE85-008744] p 699 N85-28276 EJECTION SEATS
- The development of the generalized escape system simulation program ASME PAPER 84-WA/DSC-20] p 651 A85-39869
- EJECTORS Recent developments in ejector design for V/STOL
- aurcraft [SAE PAPER 841498] p 663 A85-39206
- Performance characteristics of rectangular and circular thrust augmenting ejectors [AIAA PAPER 85-1344] p 631 A85-39736
- An investigation of high performance, short thrust augmenting electors
- [ASME PAPER 84-WA/FE-10] p 697 A85-39873 ELASTIC BODIES
- Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177
- Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies p 618 A85-37197
- ELASTIC BUCKLING

A program for computerized structural resizing of aircraft structure subject to strength and local panel buckling p 693 A85-37187 criteria under multiple loading

- FLASTIC PROPERTIES
- Gust load alleviation of a cantilevered rectangular elastic Wind tunnel experiment and analysis p 681 N85-28950 [NAK-TR-86]
- FLASTIC WAVES
- A system of shock and rarefaction waves in flows past bodies with complex shapes p 618 A85-37330 ELASTOMERS
- Electro-expulsive separation system [NASA-CASE-ARC-11613-1] p 700 N85-29150
- ELECTRIC CURRENT
- Electro-expulsive separation system p 700 N85-29150 [NASA-CASE-ARC-11613-1] FI FOTRIC FIFLDS
 - Further observations of X-rays inside thunderstorms p 701 A85-37720
- ELECTRIC GENERATORS
- Auxiliary and emergency power system [SAE PAPER 841572] p 6
- p 662 A85-39162 Secondary power generation system considerations for
- advanced aircraft [SAE PAPER 841604] p 650 A85-39164 Test flight of IL-76TD long-range transport variant
- p 641 N85-27842 ELECTRIC IGNITION
- Electric direct current starter motors for gas turbine enaines [SAE PAPER 841569] p 663 A85-39167
- ELECTROMAGNETIC FIELDS
- Lift and thrust of a linear synchronous engine with a solid-conductor stator winding p 658 A85-37550 ELECTROMECHANICAL DEVICES
- Electro-expulsive separation system
- [NASA-CASE-ARC-11613-1] p 700 N85-29150 ELECTRONIC CONTROL
- The development of a hardware-in-the-loop engine mulation facility
- p 682 A85-39706 [AIAA PAPER 85-1293] ELECTRONIC EQUIPMENT TESTS The Avionics Flight Evaluation System (AFES) of
- DEVLR [DFVLR-MITT-85-01] p 657 N85-27864
- **ELEVATORS (CONTROL SURFACES)** Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed range [DFVLR-FB-84-52]
- p 676 N85-27882 ELLIPTICAL CYLINDERS
- The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 ENERGY CONSERVATION
- On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory INAL-TR-8471 p 684 N85-28953
- ENERGY DISSIPATION
- Dissipative properties of inhomogeneous materials and systems --- Russian book p 687 A85-38874 ENERGY POLICY
- Navy geothermal plan [AD-4152478]
- p 702 N85-28450 ENERGY TRANSFER Flow characteristics of a partially submerged liquid
- DICKUP [DE85-008744] p 699 N85-28276
- ENGINE ANALYZERS The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 engines
- The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion chambers p 661 A85-39122
- DEAN A program for dynamic engine analysis [NASA-TM-87033] p 673 N85 p 673 N85-28945
- ENGINE CONTROL Modernizing engine displays p 658 A85-38956 The development of a hardware-in-the-loop engine simulation facility
- [AIAA PAPER 85-1293] p 682 A85-39706 Development and evaluation of an integrated flight and propulsion control system
- [AIAA PAPER 85-1423] p 669 A85-39771 Integrated flight/propulsion control - Adaptive engine control system mode [AIAA PAPER 85-1425]
- p 669 A85-39772 ENGINE COOLANTS
- Companison of advanced cooling concepts using color thermography --- for high temperature-rise gas combustors
- AIAA PAPER 85-1289] p 667 A85-39702 ENGINE DESIGN
- Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 A generalization of experimental data on heat transfer from the working medium to the housing components of the compressor of a gas-turbine engine
 - p 660 A85-39112

SUBJECT INDEX

A comparison of experimental characteristics of porous p 660 A85-39120 and blade impellers Determination of the blade height of the last compressor stage for a refined thermodynamic design analysis of p 661 A85-39126 turbofan engines Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 (SAF SP-5981 p 661 A85-39151 Electric direct current starter motors for gas turbine ingines ISAE PAPER 8415691 p 663 A85-39167 Model test results of the split-fan cross-ducted propulsion system concept for medium speed V/STOL aucraft [SAE PAPER 841495] p 663 A85-39203 Advanced single-rotation propfan drive system p 663 A85-39577 Future prop-fans - Tractor or pusher [AIAA PAPER 85-1189] p 664 A85-39647 The unducted fan engine [AIAA PAPER 85-1190] p 665 A85-39648 Prospects and problems of advanced open rotors for commercial aircraft [AIAA PAPER 85-1191] p 665 A85-39649 Engine design for maintenance and support [AIAA PAPER 85-1204] p 665 A85-39654 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39655 Application of 3-D flow computations to gas turbine aerodynamic design [AIAA PAPER 85-1216] p 630 A85-39659 Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 Aircraft preliminary design comparison of advanced compound engines with advanced turbine engines for helicopter applications p 666 A85-39693 [AIAA PAPER 85-1276] Variable cycle turboshaft technology for rotor-craft of the 90's [AIAA PAPER 85-1278] p 666 A85-39695 Technology for the design of high temperature rise combustors [AIAA PAPER 85-1292] p 668 A85-39705 Derivative T56 engine development experience p 670 A85-39790 [AIAA PAPER 85-1459] The conception and development of a family of small engines for the 1990's [AIAA PAPER 85-1460] p 670 A85-39791 Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28109 ENGINE FAILURE United States Air Force engine damage tolerance requirements [AIAA PAPER 85-1209] p 665 A85-39657 Modeling post-stall operation of aircraft gas turbine engines [AIAA PAPER 85-1431] p 669 A85-39775 ENGINE INLETS Engine inlet interaction with a prop-fan propulsion system [SAE PAPER 841478] p 627 A85-39058 Performance of a new nose-lip hot-air anti-icing concept [AIAA PAPER 85-1117] p 664 A85-39614 Substantiation of the applicability of VSAERO panel method to subsonic inlet design [AIAA PAPER 85-1119] p 629 A85-39615 ENGINE MONITORING INSTRUMENTS p 658 A85-38956 Modernizing engine displays Instrumentation for gas turbine research in short-duration facilities [SAE PAPER 841504] p 695 A85-39062 Usage monitoring - A milestone in engine life management [AIAA PAPER 85-1206] p 665 A85-39656 ENGINE NOISE Meeting the 1985 FAA noise regulations with old engines and modern acoustic technology [AIAA PAPER 85-1120] p 651 A85-39616 Fan noise suppression in turbofan engines [B8580076] p 671 N85-27872 ENGINE PARTS Reliability assessment from small sample inspection data for gas turbine engine components p 659 A85-39069 [SAE PAPER 841599] A study of the thermal inertia of a thermocouple exposed to short temperature pulses at high Reynolds numbers p 695 A85-39117 Smart'-engine-components - A micro-in every blade?

Spacer structure [AD-D011641] o 670 N85-27866

[AIAA PAPER 85-1296] p 668 A85-39707

SOBJECT INDEX
Ceramic applications in turbine engines
[NASA-CR-174715] p 690 N85-28109
Ceramic turbochargers A case study of a near-term
application of high-strength ceramics
[DE85-006495] p 700 N85-28379 Future of ceramic turbochargers Promises and
pitfalls
[DE85-006209] p 700 N85-28380
Ceramic Technology for Advanced Heat Engines
Project
[DE85-008755] p 691 N85-29052 ENGINE STARTERS
An investigation of the autorotation of gas-turbine
engines under startup conditions p 659 A85-39104
Starting systems technology, Proceedings of the
Aerospace Congress and Exposition, Long Beach, CA,
October 15-18, 1984 [SAE SP-598] p 661 A85-39151
Computer-aided start-system design and ventication
[SAE PAPER 841508] p 661 A85-39152
Air turbine starter sizing for a proper bleed source
match
[SAE PAPER 841509] p 661 A85-39153
Control of fuel during starting of a gas turbine [SAE PAPER 841511] p 661 A85-39155
Air turbine starter turbine wheel containment
[SAE PAPER 841546] p 661 A85-39156
Lubrication systems for air turbine starters
[SAE PAPER 841547] p 662 A85-39157
Starter-engine interface concepts [SAE PAPER 841548] p 662 A85-39158
F-20 air turbine cartridge start system
[SAE PAPER 841570] p 662 A85-39160
Pressurized Air Start System (PASS) for small gas turbine
engines [SAE PAPER 841571] p 662 A85-39161
Critical speed testing of the Grumman X-29A power
take-off shaft subsystem
[SAE PAPER 841603] p 662 A85-39163
B-1B secondary power subsystem [SAE PAPER 841607] p 662 A85-39166
[3AE FAFER 64160/] p 662 A85-59100
Electric direct current starter motors for das turbine
Electric direct current starter motors for gas turbine engines
engines [SAE PAPER 841569] p 663 A85-39167
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty
engines p. 663 A85-39167 [SAE PAPER 841569] p. 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-390767
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39067 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms o their thrust characteristics and fuel efficiency
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39067 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine arcraft engine p 660 A85-39106
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms o their thrust characteristics and fuel efficiency [Instable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39116 [Accelerated testing of gas-turbine aircraft engine using
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39116
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85.1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39066 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39116 Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measuremen
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39066 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine he 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39245
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39067 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine he 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 Supportability considerations for advanced engine
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39067 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39107 Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39115 From measurement uncertainty to measurement communications, credibility, and cost control in propulsior ground test facilities p 682 A85-39245 Supportability considerations for advanced engine
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 660 A85-39106 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39165
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39067 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39107 Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39115 From measurement uncertainty to measurement communications, credibility, and cost control in propulsior ground test facilities p 682 A85-39245 Supportability considerations for advanced engine
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39165 Dynamic engine behavior during post surge operation of a turbing engine p 669 A85-39176
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39066 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine Accelerated testing of gas-turbine aircraft engines using for softening method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 862 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39655 Dynamic engine behavior during post surge operation of a turbofan engine [AIAA PAPER 85-1430] p 669 A85-39774 Derivative T56 engine development expensence [AIAA PAPER 85-1430] p 669 A85-39774
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39165 Dynamic engine behavior during post surge operation of a turbing engine p 669 A85-39176
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine Accelerated testing of gas-turbine aircraft engines using or ground test facilities p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion of a turbofan engine p A65 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39655 Dynamic engine behavior during post surge operator of a turbofan engine [AIAA PAPER 85-1430] p 669 A85-39772 Derwative T56 engine development expenence [AIAA PAPER 85-1459] p 670 A85-39790 Ceramic applications in turbine engines [NASA-CR-174715] p 680 N85-28105 p 680 A85-397
engines [SAE PAPER 841569]p 663A85-39167ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404]p 669A85-39765ENGINE TESTS Temperature distortion generator for turboshaft engine testingp 659A85-39065Engine system field experience simulation program [SAE PAPER 841541]p 659A85-39065Engine system field experience simulation programsimulation program (SAE PAPER 841601)p 659A85-39071A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660A85-39106Unstable combustion in the combustion chamber of a gas-turbine aircraft engine communications, credibility, and cost control in propulsion ground test facilitiesp 660A85-39116From measurement uncertainty to unstability considerations for advanced engine developmentp 663A85-39245Supportability considerations for advanced engine elavability considerations for advanced engine elavability engine behavior during post surge operator of a turbofan engine [AIAA PAPER 85-1459]p 663A85-39774Derivative T56 engine development expenence [AIAA PAPER 85-1459]p 670A85-39774Ceramic applications in turbine engines [INSA-CR-174715]p 690N85-28105ENTHALPYENTHALPYENTHALPYENTHALPY
engines p 663 A85-39167 [SAE PAPER 841569] p 669 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39075 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 665 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39765 Dynamic engine behavior during post surge operator of a turbofan engine p 660 A85-39774 Dervative 756 engine development expenence [AIAA PAPER 85-1430] p 669 A85-39760 Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28105
engines p 663 A85-39167 [SAE PAPER 841569] p 669 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85.1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Linstable combastion in the combustion chamber of a gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39116 Vinstable combustion in the combustion chamber of a gas-turbine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39242 Supportability considerations for advanced engine development [AIAA PAPER 85-1420] p 669 A85-39747 Derivative T56 engine development expenence [AIAA PAPER 85-1420] p 669 A85-39740 Ceramic applications in turbine eng
engines p 663 A85-39167 [SAE PAPER 841569] p 669 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39076 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 665 A85-39655 Dynamic engine behavior during post surge operator of a turbofan engine p 664 A85-39774 Derivative T56 engine development expenence [AIAA PAPER 85-1430] p 669 A85-39760 Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28105 ENTHALPY Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39066 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39076 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39076 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39076 Unstable combustion in the combustion chamber of a gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39245 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39456 Dynamic engine behavior during post surge operator of a turbofan engine [AIAA PAPER 85-1459] p 670 A85-39770 Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28105 ENTHALPY Stagnation point heat transfer in hypersonic higf enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37622 ENVIRONMENT EFFECTS Investigation of air pollution impact in Eastern Bavana
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85.1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39116 Accelerated testing of gas-turbine aircraft engines using p 660 A85-39116 Accelerated testing of gas-turbine aircraft engines using ground test facilities From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities ground test facilities p 663 A85-39243 Supportability considerations for advanced engine [AIAA PAPER 85-1205] p 665 A85-39655 Dynamic engine behavior during post surge operator of a turbofan engine [AIAA PAPER 85-1459] p 660 A85-39770 Derivative T56 engine development exp
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 650 A85-39076 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engines using the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 663 A85-39243 Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 663 A85-39760 Ceramic applications in turbine engines [NASA-CR-174715] p 660 A85-39760 Ceramic applications in turbine engines [NASA-CR-174715] p 620 A85-39760 [AIAA PAPER 85-1459] p 670 A85-39760 Ceramic applications in turbine engines [NASA-CR-174715] p 680 N85-287730 Cerami
engines p 663 A85-39167 [SAE PAPER 841569] p 663 A85-39167 Engine thrust measurement uncertainty [AIAA PAPER 85.1404] p 669 A85-39765 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39116 Accelerated testing of gas-turbine aircraft engines using p 660 A85-39116 Accelerated testing of gas-turbine aircraft engines using ground test facilities From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities ground test facilities p 663 A85-39243 Supportability considerations for advanced engine [AIAA PAPER 85-1205] p 665 A85-39655 Dynamic engine behavior during post surge operator of a turbofan engine [AIAA PAPER 85-1459] p 660 A85-39770 Derivative T56 engine development exp
engines [SAE PAPER 841569] p 663 A85-39167 ENGINE TESTING LABORATORIES Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39766 ENGINE TESTS Temperature distortion generator for turboshaft engine testing [SAE PAPER 841541] p 659 A85-39065 Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39077 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106 Unstable combustion in the combustion chamber of a gas-turbine aircraft engine the 'softening' method p 660 A85-39116 From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39245 Supportability considerations for advanced engine development [AIAA PAPER 85-1430] p 669 A85-39740 Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28105 ENTALPY Stagnation point heat transfer in hypersonic higf enthalpy flow [AIAA PAPER 85-03] p 620 A85-39762 ENVIRONMENT EFFECTS Investigation of air pollution impact in Eastern Bavana Measurement results from August and September, 1964 [DFVLR-F8-85-03] p 702 N85-28471 ENVIRONMENT SIMULATION

ENVIRONMENTAL MONITORING

Investigation of air pollution impact in Eastern Bavana Measurement results from August and September, 1984 p 702 N85-28471 [DFVLR-FB-85-03] EPOXY RESINS

Improved resins for wet layup repair of advanced p 686 A85-37381 composite structure Fracture toughness of adhesively bonded joints

p 688 A85-39492 EQUATIONS OF MOTION Use of quaternions in flight mechanics p 675 N85-27875 [AD-A152616] Extraction of aerodynamic parameters for aircraft at extreme flight conditions [NASA-TM-86730] n 704 N85-29686 EQUATORIAL ATMOSPHERE Stratosphenc flights with large polyethylene balloons from equatorial latitudes p 639 A85-38304 EROSION High-temperature erosion of plasma-sprayed, yttna-stabilized zirconia in a simulated turbine

. environment [AIAA PAPER 85-1219] p 689 A85-39662 ERROR ANALYSIS

Engine thrust measurement uncertainty [AIAA PAPER 85-1404]

AIAA PAPER 85-1404] p 669 A85-39765 Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-28941

ESCAPE SYSTEMS The development of the generalized escape system

simulation program [ASME PAPER 84-WA/DSC-20] p 651 A85-39869

EULER EQUATIONS OF MOTION Computation of three-dimensional flow using the Fuler

equations and a multiple-gnd scheme p 627 A85-39200

Upwind-difference methods for aerodynamic problems governed by the Euler equations

p 635 N85-27834 [REPT-84-23] Unsteady flow in multistage turbines

p 698 N85-27946 EUROPE

Turboshaft truce in Europe p 658 A85-38436 Rotterdam Airport and the Common Market p 641 N85-27840

EUROPEAN AIRBUS Lightning-safe carbon fiber composite for Airbus tail

p 692 N85-29100 unit EUROPEAN SPACE PROGRAMS p 681 A85-37491 European transonic wind tunnel

EVAPORATION Research test facility for evaporation and combustion

of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073 EVAPORATIVE COOLING

The transpired turbulent boundary layer in various pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698 A85-39899

EVASIVE ACTIONS First-order feedback strategies for vanable speed planar

p 703 A85-37198 pursuit-evasion dames EXHAUST DIFFUSERS

An investigation of high performance, short thrust augmenting ejectors

[ASME PAPER 84-WA/FE-10] p 697 A85-39873 Strutless diffuser for gas turbine engine

p 672 N85-28943 (AD-D011662) EXHAUST EMISSION

Pitot pressure and heat transfer measurements in hydrazine thruster plumes [AIAA PAPER 85-0934] p 685 A85-37599

EXHAUST FLOW SIMULATION

A new technique to break diaphragms electrically in a double-tube short duration jet simulation facility p 682 A85-38975

Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles p 632 A85-39738

[AIAA PAPER 85-1346] p 632 A85-39738 A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers p 633 A85-39792 [AIAA PAPER 85-1463]

EXHAUST GASES Loss in turbofan thrust caused by boundary layer growth

in a nacelle's inlet and exhaust ducts [AIAA PAPER 85-1281] p 631 A85-39697

EXHAUST NOZZLES

Integration of vectoring nozzles in a STOL transonic tactical aircraft [AIAA PAPER 85-1285] p 667 A85-39699

Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles

[AIAA PAPER 85-1346] p 632 A85-39738 Summary of nonaxisymmetric nozzle internal performance from the NASA Langley Static Test Facility AIAA PAPER 85-1347] p 668 A85-39739 EXHAUST SYSTEMS

Dynamic gas temperature measurement system

[AIAA PAPER 85-1466]

A85-37706 p 694 An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft p 660 A85-39121 system Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft

p 670 A85-39794

FIBER REINFORCED COMPOSITES

EXPLOSIVE FORMING

Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape EXPULSION

Electro-expulsive separation system

[NASA-CASE-ARC-11613-1] p 700 N85-29150 **EXTERNAL STORE SEPARATION**

- Perturbed motion of airplane and safe store senaration p 674 A85-38168 EXTERNAL STORES
- Flight thals of a modified gulfstream commander carrying external stores

[AD-A1533761 p 653 N85-27859 F

F-111 AIRCRAFT

- Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 ission adaptive wing aircraft F-15 AIRCRAFT
- Color CRT in the F-15 p 656 A85-38954 Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft
- p 649 A85-39066 [SAE PAPER 841543] F-16 AIRCRAFT
- Application of AFTI/F-16 task-tailored control modes in advanced multirole fighters p 677 N85-27888 F-18 AIRCRAFT

Pictorial format program - Past, present, and future p 656 A85-38958

F-20 AIRCRAFT

- F-20 air turbine cartridge start system p 662 A85-39160 [SAE PAPER 841570]
- FAIL-SAFE SYSTEMS Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 mission adaptive wing aircraft
- FAILURE ANALYSIS Recent materials problems relating to catastrophic

balloon failures p 647 A85-38303 ACT applied to helicopter flight control

- p 678 N85-27891 FAILURE MODES
- Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p p 659 A85-39069
- FASTENERS Fasteners for composite structures examined

p 692 A85-37074

FATIGUE LIFE

Influence of fighter aircraft load spectrum vanations on fatique crack initiation and growth p 693 A85-37181 Fatigue life evaluation program for the Kfir aircraft p 645 A85-37182

Reducing the effects of rivet holes on fatigue life by p 693 A85-37472 adhesive bonding

- Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567
- The effect of coatings on the thermomechanical fatigue life of a single crystal turbine blade material
- p 689 A85-39744 [AIAA PAPER 85-1366] Further investigations to improve the fatigue life of the Mirage 1110 wing main span [ARL-STRUC-TM-397]
- p 654 N85-28938 FATIGUE TESTS

Assessment of damage tolerance in composites p 688 A85-39598

FAULT TOLERANCE

Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-28941

FEASIBILITY ANALYSIS

Feasibility studies of 'Polar Patrol Balloon' p 647 A85-38321

- North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A p 640 A85-38777
- Feasibility study of the welding of SiC p 688 A85-39339

FEEDBACK CONTROL

- First-order feedback strategies for variable speed planar pursuit-evasion dames ursuit-evasion games p 703 A85-37198 New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control
- p 703 A85-39551 A multiloop robust controller design study using singular value gradients p 703 A85-39564
- 'Smart' engine components A micro in every blade? [AIAA PAPER 85-1296] p 668 A85-39707
- FIBER COMPOSITES Lightning-safe carbon fiber composite for Airbus tail

p 692 N85-29100 unit FIBER REINFORCED COMPOSITES

Dissipative properties of inhomogeneous materials and systems --- Russian book p 687 A85-38874

FIBER STRENGTH

Advanced secondary power system for transport

Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874

(BMFT-FB-T-84-302) p 672 N85-27874 DFVLR research in aluminum-lithium alloys p 692 N85-29105

FIBER STRENGTH Fibers for structurally reliable metal and ceramic composites p 687 A85-37484

FIGHTER AIRCRAFT Influence of fighter arcraft load spectrum variations on

fatigue crack initiation and growth p 693 A85-37181 Mirage 2000 fighter combines acceleration, low-speed stability p 646 A85-38243 Airplane mounted accessory gearbox design

[SAE PAPER 841605] p 696 A85-39165 Usage monitoring - A milestone in engine life management (AIAA PAPER 85-12061) p 665 A85-39656

Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 Secondary power unit options for advanced fighter

aircraft [AIAA PAPER 85-1280] p 666 A85-39696

The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698

Combustion technology - A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763 Propulsion influences on air combat

[AIAA PAPER 85-1457] p 651 A85-39789 Operational and developmental expenence with the F/A-18A digital flight control system

p 678 N85-27895 Flight testing and development of the F/A-18A digital flight control system p 678 N85-27896 The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft

p 680 N85-27908

Advanced liner-cooling techniques for gas turbine combustors [AIAA PAPER 85-1290] p 667 A85-39703

[AIAA PAPER 85-1290] p 667 A85-39703 FINITE DIFFERENCE THEORY Simplified implicit block-bidiagonal finite difference

method for solving the Navier-Stokes equations p 695 A85-39003

External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

A further assessment of numerical annular dump diffuser flow calculations [AIAA PAPER 85-1440] p 633 A85-39779

A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850] p 638 N85-28930

FINITE ELEMENT METHOD The finite element formulation of airflow around a deformable wing by using the incremental finite element method p 621 A85-37879

Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element p 696 A85-39170

Two-dimensional turbulent flow analysis in turbomachinery by the finite element method [ASME PAPER 84-WA/FM-2] p 633 A85-39874 Structural Analysis

[DFVLR-MITT-84-21] p 701 N85-29313 FINITE VOLUME METHOD

Unsteady flow in multistage turbines

p 698 N85-27946

Aerodynamics of a new aerostat design with inverted-Y fins

[AIAA PAPER 85-0867] p 624 A85-38783 Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins

p 626 A85-38984 Vertical plate fin with conjugated forced convection-conduction turbulent flow

[ASME PAPER 84-WA/HT-8] p 698 A85-39878 Subsonic and transonic aerodynamics of a wraparound

fin configuration (AD-A153646) p 637 N85-28927 FIRE PREVENTION

Examination of fire safety of commercial aircraft cabins p 639 A85-37693 FLAME SPECTROSCOPY

Flame radiation and liner heat transfer in a tubular-can combustor p 663 A85-39580 FLAPERONS

Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel p 679 N85-27903 FLAPS (CONTROL SURFACES)

Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock tunnel p 695 A85-38973

Study of an asymmetric flap nozzle as a thrust-vectoring device p 629 A85-39582 FLAT PLATES

A supersonic panel method based on the triplet singularity p 617 A85-37191 Critical flutter parameters of orthotropic rectangular flat

panels with in-plane loads p 693 A85-37192 Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock tunnel p 695 A85-38973 Heat transfer investigation in the junction region of

[ASME PAPER 84-WA/HT-70] p 698 A85-39898 [ASME PAPER 84-WA/HT-70] p 698 A85-39898

Flow-field matrix solution for flow along arbitrarily twisted S1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927 FL FXIBILITY

Pretwist and shear flexibility in the vibrations of turbine blades p 657 A85-37233 FLEXIBLE BODIES

Addition of flexible body option to the TOLA computer program, part 1

[NASA-CR-132732-1] p 652 N85-27855 Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation [NASA-CR-132732-2] p 652 N85-27856

FLEXIBLE WINGS

The finite element formulation of airflow around a deformable wing by using the incremental finite element method p 621 A85-37879

FLIGHT CHARACTERISTICS Fundamentals of the flight operations of helicopters

Aerodynamics --- Russian book p 649 A85-38875 In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft [DFVLR-FB-84-12] p 676 N85-27880

Helicopter Aeromechanics [AGARD-LS-139] p 617 N85-28913

Helicopter aeromechanics Introduction and historical review p 653 N85-28914 FLIGHT CONDITIONS

LIGHT CONDITIONS Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 Model of the wind field in a downburst

p 701 A85-39218 Extraction of aerodynamic parameters for aircraft at extreme flight conditions

[NASA-TM-86730] p 704 N85-29686 FLIGHT CONTROL

Design of digital flight control systems for helicopters p 673 A85-37195 Minimum-time path through wind fields

p 647 A85-38358 Description and test methods for a frequency output accelerometer p 694 A85-38536 Development and evaluation of an integrated flight and

[AIAA PAPER 85-1423] p 669 A85-39771

Integrated flight/propulsion control - Adaptive engine control system mode

[AIAA PAPER 85-1425] p 669 A85-39772 Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness

[AD-Å152627] p 675 N85-27876 Design of robust controllers for a multiple input-multiple output control system with uncertain parameters application to the lateral and longitudinal modes of the

 KC-135 transport aircraft
 p 675
 N85-27877

 [AD-A153100]
 p 675
 N85-27877

 Controller requirements for uncoupled aircraft motion, volume 1
 p 675
 N85-27878

 [AD-A153173]
 p 675
 N85-27878

 [AD-A153173]
 p 675
 N85-27878

 Active Control Systems
 Review, Evaluation and

 Projections
 p 676
 N85-27883

 [AGARD-CP-384]
 p 676
 N85-27883

 The state-of-the-art and future of flight control systems
 p 677
 N85-27885

 A perspective on superaugmented flight control advantages and problems
 p 677
 N85-27885

ACT applied to helicopter flight control p 678 N85-27891 Some flight test results with redundant digital flight control systems p 678 N85-27892

The aerodynamics of control p 679 N85-27901 The STOL and maneuver technology program integrated control system development p 680 N85-27910 The evolution of active control technology systems for the 1990's helicopter p 680 N85-27911

aircraft [NASA-TP-2463] p 673 N85-28944 Piloted simulation of an algorithm for onboard control of time-optimal intercept p 681 N85-28949 [NASA-TP-2445] Extraction of aerodynamic parameters for aircraft at extreme flight conditions p 704 N85-29686 [NASA-TM-86730] FLIGHT HAZARDS Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847 Contributions on the subject of longitudinal movements of aircraft in wind shears [NASA-TM-77837] p 702 N85-29432 FLIGHT INSTRUMENTS A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot p 652 N85-27857 [NBC-24173] FLIGHT MANAGEMENT SYSTEMS Design of digital flight control systems for helicopters p 673 A85-37195 Advanced avionics management system prevents pilots from being swamped by information overload p 655 A85-38401 Integrated flight/propulsion control - Adaptive engine control system mode [AIAA PAPER 85-1425] p 669 A85-39772 FLIGHT MECHANICS Discussions on the regular behavior of the longitudinal dynamic response of aircraft during variable sweep p 674 A85-38974 flights Slow and fast state variables for three-dimensional flight p 675 A85-39567 dynamics Use of quaternions in flight mechanics p 675 N85-27875 [AD-A152616] Active Control Systems Review, Evaluation and Projections [AGARD-CP-384] o 676 N85-27883 FLIGHT OPTIMIZATION An evading path against 3 D obstacles p 674 A85-38357 Minimum-time path through wind fields p 647 A85-38358 Classical and neo-classical cruise-dash optimization p 650 A85-39212 FLIGHT PATHS Instationary dolphin flight - The optimal energy exchange between a salplane and vertical currents in the atmosphere p 646 A85-37488 Numerical solution of the minimum-time flight of a glider through a thermal by use of multiple shooting methods p 638 A85-37489 Observation of birds in the flight path of aircraft - An important stage in the prevention of bird strikes p 639 A85-37544 An evading path against 3 D obstacles p 674 A85-38357 Minimum-time path through wind fields p 647 A85-38358 The Command Flight Path Display - All weather, all missions p 656 A85-38959 FLIGHT SAFETY Advanced techniques for health and usage monitoring helicopter transmissions p 617 A85-39621 [AIAA PAPER-85-1142] Lightning-safe carbon fiber composite for Airbus tail nit p 692 N85-29100 นกเt FLIGHT SIMULATION Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data p 621 A85-37661 [AIAA PAPER 85-1028] An alternate approach to very long duration ballooning

in the northern hemisphere p 640 A85-38316 Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208 Dynamic engine behavior during post surge operation of a turbofan engine [AIAA PAPER 85-1430] p 669 A85-39774 Adding computationally efficient realism to Monte Carlo turbulence simulation [NASA-TP-2469] p 704 N85-28708 Helicopter Aeromechanics [AGARD-LS-139] p 617 N85-28913 FLIGHT SIMULATORS The role of simulation p 684 N85-28919 The use of flight simulators in measuring and improving training effectiveness [AD-A153817] p 684⁻⁻⁻N85-28954 FLIGHT STABILITY TESTS

An experimental determination of the longitudinal stability properties of the LTA 20-1 airship [AIAA PAPER 85-0879] p 674 A85-38794

Identification of gust input and gust response charactenstics from Do 28 TNT flight test data [DFVLR-FB-84-48] p 676 N85-27881

Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed

range [DFVLR-FB-84-52] p 676 N85-27882

FLIGHT TESTS A companson of several digital map-aided navigation techniques p 642 A85-37829

Evaluation of radionavigation systems p 643 A85-37831 Natural frequencies and flight loads of composite main rotor blade for helicopter p 647 A85-38361

Study on the comfortability of helicopter - Flight test of acoustic noise level p 647 A85-38365 Helicopter flight test of a ring laser gyro Attitude and

- Heading Reference System p 643 A85-38529 The Command Flight Path Display - All weather, all missions p 656 A85-38959
- Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle [SAE PAPER 841540] p 627 A85-39064
- Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft
- [SAE PAPER 841543]
 p 649
 A85-39066

 Applications of state estimation in aircraft flight-data analysis
 p 650
 A85-39211
- USSR report Transportation [JPRS-UTR-84-025] p 641 N85-27841 Test flight of IL-76TD long-range transport variant
- p 641 N85-27842 A preliminary investigation of handling qualities requirements for helicopter instrument flight during
- requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot [NRC-24173] p 652 N85-27857
- Flight trails of a modified gulfstream commander carrying external stores [AD-A153376] p 653 N85-27859
- Parameter identification results of tests in nonsteady symmetric flight with the Hawker Hunter Mk 7
- [NLR-TR-83042-U] p 653 N85-27860 The Avionics Flight Evaluation System (AFES) of DFVLR
- [DFVLR-MITT-85-01] p 657 N85-27864 In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statucally unstable transport aircraft
- [DFVLR-FB-84-12]
 p 676
 N85-27880

 Some flight test results with redundant digital flight control systems
 p 678
 N85-27892

 ACT flight research expenence
 p 678
 N85-27892
- Flight testing and development of the F/A-18A digital flight control system p 678 N85-27896 QI GA As seen less suit ellevents.
- OLGA An open loop gust alleviation system p 678 N85-27897 Flight testing for performance and flying qualities
- p 654 N85-28920
- Numencal solution of the minimum-time flight of a glider through a thermal by use of multiple shooting methods p 638 A85-37489
- Minimum-time path through wind fields p 647 A85-38358
- FLIGHT TRAINING The use of flight simulators in measuring and improving
- training effectiveness [AD-A153817] p 684 N85-28954
- FLOW CHARACTERISTICS Fuel injection characterization and design methodology to improve lean stability
- [AIAA PAPER 85-1183] p 664 A85-39644 FLOW DEFLECTION
- A system of shock and rarefaction waves in flows past bodies with complex shapes p 618 A85-37330 A numencal investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of
- attack
 p 619
 A85-37333

 A supersonic inhomogeneous flow of an ideal gas around blunted bodies
 p 619
 A85-37335
- Investigation of three-dimensional separated flows p 619 A85-37338 The separation of a turbulent boundary layer within a
- two-face angle before an obstruction p 619 A85-37340 Simulation of wake passing in a stationary turbine rotor cascade p 629 A85-39589
- cascade FLOW DISTRIBUTION
- The finite element formulation of airflow around a deformable wing by using the incremental finite element method p 621 A85-37879 Flow-field matrix solution for flow along arbitrarily twisted
- S1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927

- The computation of transonic nozzle flow-field by a time-dependent method p 625 A85-38963 Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage [SAE PAPER 841555] p 663 A85-39207
- [SAE PAPER 841555] p 663 A85-39207 Modelling vortex flowfields by supercomputers with super-size memory p 628 A85-39242 Similarly properties in the problem of flow from a
- supersonic source past a spherical bluntness p 629 A85-39445 Calculation of the flow in a dump combustor
- [AIAA PAPER 85-1309] p 668 A85-39716 Numerical investigation of internal high-speed viscous
- flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768 Flowfield and performance measurements in a vaned radial diffuser
- [ASME PAPER 84-WA/FM-7] p 634 A85-39876 Static and dynamic pressure measurements on a NACA 0012 aurfoli in the Ames High Reynolds Number Facility [NASA-TP-2485] p 634 N85-27823 User's manual for airfoil flow field computer code SRAIR
- [NASA-CR-172585] p 634 N85-27825 Predictions and measurements of isothermal flowfields
- In axisymmetric combustor geometries [NASA-CR-174916] p 671 N85-27867 The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany [DFVLR-FB-85-04] p 684 N85-27920
- Unsteady flow in multistage turbines p 698 N85-27946 Proceedings of the 9th US Air Force and the Federal
- Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects [AD-A153020] p 699 N85-28266 FLOW GEOMETRY
- Interaction of twin turbulent circular jet
- A supersonic inhomogeneous flow of an ideal gas around blunted bodies p 619 A85-37335 Gas flow in nozzles and jets p 619 A85-37337
- Investigation of three-dimensional separated flows p 619 A85-37338 A study of the critical flow rate through cascades of
- thin slightly bent airfoils using the large-particle method p 624 A85-38562 Dynamic overshoot of the static stall angle
- p 628 A85-39225 A computational study of the unsteady shock-wave
- structure in a two-dimensional transonic rotor p 629 A85-39578
- Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion
- [AIAA PAPER 85-1441] p 697 A85-39780 FLOW MEASUREMENT
- A study of the cntical flow rate through cascades of thin slightly bent airfoils using the large-particle method p 624 A85-38562
- FLOW REGULATORS
- Development of an active laminar flow nacelle [AIAA PAPER 85-1116] p 629 A85-39613 FLOW STABILITY
- The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 Interaction between acoustics and subsonic ducted flow
- In a ramjet configuration p 704 A85-37209 A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic flow p 619 A85-37336
- Determination of aerodynamic characteristics of bodies in weakly perturbed gas flows p 619 A85-37341
- Local instability charactenstics and frequency determination of self-excited wake flows p 623 A85-38430
- Instability of plane-parallel supersonic gas flows in the linear approximation p 623 A85-38551 Stability of the thin-jet model of the unsteady jet flap
- p 626 A85-38997
 - On the modelling of a fully-relaxed propeller slipstream [AIAA PAPER 85-1262] p 630 A85-39685
- FLOW VELOCITY
- Density and velocity profiles in non-equilibrium laminar boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626
- [AIAA PAPER 85-0976]
 p 620
 A85-37626

 Experiment of turbulent round jet parallel to ground plane
 p 622
 A85-38367
- Supersonic flow around blunt wedge p 636 N85-28158 Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method
- [NAL-TR-842-PT-3] p 684 N85-28952

FRACTURE STRENGTH

FLOW VISUALIZATION Experiment of turbulent round jet parallel to ground p 622 A85-38367 plane Aerodynamics of an aspect ratio 8 wing at low Reynolds numbers p 628 A85-39223 Simulation of wake passing in a stationary turbine rotor p 629 A85-39589 cascade Cantilevered stator vane tip leakage studies p 664 A85-39620 [AIAA PAPER 85-1136] Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study p 668 A85-39718 [AIAA PAPER 85-1313] Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 FLUID DYNAMICS Activities of the Department of Aerospace Engineering p 706 N85-29844 FLUID FLOW Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 FLUID INJECTION Characteristics of a two-dimensional turbulent jet in a bounded slipstream p 695 A85-39131 The transpired turbulent boundary layer in various pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698 p 698 A85-39899 FLUID PRESSURE Experiment of turbulent round jet parallel to ground plane p 622 A85-38367 FLUTTER Winglet effects on the flutter of a twin-engine ansport-type wing p 650 A85-39217 transport-type wing Flight trials of a modified gulfstream commander carrying external stores [AD-A153376] p 653 N85-27859 FLUTTER ANALYSIS Critical flutter parameters of orthotropic rectangular flat panels with in-plane loads p 693 A85-37192 Characteristics of the oscillations of a tail unit in a flow of an incompressible gas p 649 A85-39125 FLY BY WIRE CONTROL Application of AFTI/F-16 task-tailored control modes in advanced multirole fighters p 677 N85-27888 X-29 digital flight control system design p 677 N85-27889 An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893 Operational and developmental experience with the F/A-18A digital flight control system p 678 N85-27895 How to handle failures in advanced flight control systems of future transport aircraft p 679 N85-27905 The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908 FORCE DISTRIBUTION Perturbed motion of airplane and safe store eparation p 674 A85-38168 separation Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part p 654 N85-28939 [IED-1/84-PT-1] FORCED VIBRATION A study of internal and distributed damping for vibrating turbomachiner blades [NASA-CR-175901] p 671 N85-27868 FORGING Precision die forging of blades or gas turbines p 672 N85-28148 FORMAT Pictonal format program - Past, present, and future p 656 A85-38958 A method to calculate the parameters of wings of arbitrary planform [AD-A152689] p 635 N85-27831 Airport and airway system cost allocation model Volume User's manual p 683 N85-27917 AD-A152877 FRACTURE MECHANICS Reducing the effects of rivet holes on fatigue life by adhesive bonding p 693 A85-37472 Low temperature creep and fracture of near alpha titanium alloys p 687 A85-38748 Fracture behavior of glass-cloth/polyester composite p 688 A85-39228 laminate at low temperature FRACTURE STRENGTH

Concepts and application of arcraft damage tolerance analysis p 645 A85-37206 Fracture behavior of glass-cloth/polyester composite laminate at low temperature p 688 A85-39228

FRAGMENTATION

Fracture toughness of adhesively bonded joints p 688 A85-39492 Damage tolerance of composite cylinders p 688 A85-39600 Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874 FRAGMENTATION Francibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431 FREE MOLECULAR FLOW Shading and interference effects during the rotation of plate --- in aerodynamics p 624 A85-38559 p 624 A85-38559 FREE VIBRATION A study of internal and distributed damping for vibrating turbomachiner blades [NASA-CR-175901] p 671 N85-27868 FREEZING

Fuel freeze point investigations [AD-A152801] p 690 N85-28129 The distribution of higher n-alkanes in partially frozen middle distillate fuels [AD-A153940] p 692 N85-29074

FRICTION

Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins [NASA-TM-86418] p 652 N85-27852

FUEL COMBUSTION Combustion studies of metallized fuels for solid fuel

ramjets [AIAA PAPER 85-1177] o 689 A85-39640 Propellant options for long duration, high altitude

unmanned aircraft [AIAA PAPER 85-1326] p 689 A85-39727 Research test facility for evaporation and combustion

- of alternative jet fuels at high air temperatures [AD-A153830] p 691 p 691 N85-29073
- FUEL CONSUMPTION Aerodynamic test results for a wing-mounted turboprop propulsion installation

SAE PAPER 841480] p 627 A85-39060 FUEL CONTROL

Control of fuel during starting of a gas turbine [SAE PAPER 841511] p 661 A85-39155

FUEL INJECTION Fuel droplet size measurements with a laser Doppler interferometer

[AIAA PAPER 85-1182] p 697 A85-39643 Fuel injection characterization and design methodology to improve lean stability

[AIAA PAPER 85-1183] p 664 A85-39644 Small gas turbine combustor study - Fuel injector performance in a transpiration-cooled liner

p 668 A85-39717 [AIAA PAPER 85-1312] Influence of downstream distance on simplex atomizer soray characteristics

- [ASME PAPER 84-WA/HT-25] p 698 A85-39888 Segmented zoned fuel injection system for use with a combustor
- [AD-D011640] p 670 N85-27865 Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures

[AD-A153830] p 691 N85-29073 FUEL SPRAYS

Fuel droplet size measurements with a laser Doppler interferometer

[AIAA PAPER 85-1182] p 697 A85-39643 Influence of downstream distance on simplex atomizer sprav characteristics

[ASME PAPER 84-WA/HT-25] p 698 A85-39888 Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures

p 691 N85-29073 [AD-A153830] FUEL SYSTEMS

Heat management system for aircraft (AD-D011658) p 654 N85-28936 FUEL TANKS

Fuel freeze point investigations [AD-A152801]

- p 690 N85-28129 FUEL TESTS A method for the evaluation of the boundary lubricating
- properties of aviation turbine fuels p 687 A85-37495 Fuel injection characterization and design methodology to improve lean stability [AIAA PAPER 85-1183]

p 664 A85-39644 FUEL-AIR RATIO

Control of fuel during starting of a gas turbine

[SAE PAPER 841511] p 661 A85-39155 Technology for the design of high temperature rise combustors

[AIAA PAPER-85-1292]-~~ ~ p 668 ~ A85-39705 FUSELAGES

Wing optimization and fuselage integration for future generation of supersonic aircraft p 618 A85-37212 Multigrid calculation of transonic flow past wing-tail-fuselage combinations p 628 A85-39216

Development of a fuselage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction [MBB/LFA34/CFK/PUB/008] p 651 N85-27 p 651 N85-27851 A survey of recent development in helicopter aerodynamics p 653 N85-28915 p 653 N85-28915

G

GALERKIN METHOD

A study of internal and distributed damping for vibrating turbomachiner blades p 671 N85-27868 [NASA-CR-175901]

GAME THEORY A missile duel between two aircraft

GAS DENSITY

Density and velocity profiles in non-equilibrium laminar boundary layers in air

p 703 A85-39563

p 619 A85-37337

p 620 A85-37626 [AIAA PAPER 85-0976] GAS DYNAMICS

Dynamic gas temperature measurement system

- p 694 A85-37706 Instability of plane-parallel supersonic gas flows in the p 623 A85-38551 linear approximation The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 enaines
- GAS FLOW Gas flow in nozzles and jets
- Determination of aerodynamic charactenstics of bodies p 619 A85-37341 in weakly perturbed gas flows Low density aerothermodynamics [AIAA PAPER 85-0994]
- p 620 A85-37640 Similarity properties in the problem of flow from a supersonic source past a sphencal bluntness

p 629 A85-39445 Application of 3-D flow computations to gas turbine aerodynamic design

[AIAA PAPER 85-1216] p 630 A85-39659 Flow characteristics of a partially submerged liquid DICKUD

- DE85-0087441 p 699 N85-28276 GAS GENERATORS
- Secondary power unit options for advanced fighter aircraft

[AIAA PAPER 85-1280] p 666 A85-39696 GAS INJECTION

A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic p 619 A85-37336 flow GAS STREAMS

Method of calculating separation flow of subsonic gas p 636 N85-28161 stream around wings GAS TEMPERATURE

Dynamic gas temperature measurement system

p 694 A85.37706 Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas [AIAA PAPER 85-1313]

p 668 A85-39718 GAS TURBINE ENGINES

- Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level p 658 A85-37567 programmed loading
- The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575
- Numerical solution of two- and three-dimensional rotor tip leakage models p 626 A85-38989 Acquisition of detailed heat transfer behavior in complex
- Internal flow passages [SAE PAPER 841503] p 695 A85-39061

Instrumentation for gas turbine research in short-duration facilities

- p 695 A85-39062 [SAE PAPER 841504] Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p 6
- p 659 A85-39069 An investigation of the autorotation of gas-turbine engines under startup conditions p 659 A85-39104 A comparative evaluation of certain promising

gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106

The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine p 660 A85-39107 stage A generalization of experimental data on heat transfer

from the working medium to the housing components of the compressor of a gas-turbine engine p 660 A85-39112

Unstable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39115 Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39118

The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 engines

Starting systems technology, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 [SAE SP-598] p 661 A85-39151 Control of fuel during starting of a gas turbine [SAE PAPER 841511] p 661 At 0 661 A85-39155 Lubrication systems for air turbine starters p 662 A85-39157 [SAE PAPER 841547] Starter-engine interface concepts [SAE PAPER 841548] p 662 A85-39158 Pressurized Air Start System (PASS) for small gas turbine enaines [SĂE PAPER 841571] p 662 A85-39161 Electric direct current starter motors for gas turbine engines [SAE PAPER 841569] engines p 663 A85-39167 Progress in the utilization of an oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284 Influence of the blockage ratio on the efficiency of swirl generation with vane swirlers [AIAA PAPER 85-1103] o 696 A85-39605 Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices [AIAA PAPER 85-1104] p 664 A85-39606 Unsteady blade row interactions in a multi-stage compressor [AIAA PAPER 85-1134] p 630 A85-39618 Fuel droplet size measurements with a laser Doppler interferometer [AIAA PAPER 85-1182] p 697 A85-39643 Fuel injection characterization and design methodology to improve lean stability p 664 A85-39644 [AIAA PAPER 85-1183] Application of 3-D flow computations to gas turbine aerodynamic design [AIAA PAPER 85-1216] p 630 A85-39659 plasma-sprayed, High-temperature erosion of yttna-stabilized zirconia in a simulated turbine nvironment [AIAA PAPER 85-1219] p 689 A85-39662 Military engine durability improvements through innovative advancements in turbine design and materials (AIAA PAPER 85-12211 p 666 A85-39664 Development of an advanced vaneless inlet particle separator for helicopter engines [AIAA PAPER 85-1277] p 666 A85-39694 Secondary power unit options for advanced fighter aircraft [AIAA PAPER 85-1280] p 666 A85-39696 Comparison of advanced cooling concepts using color thermography --for high temperature-rise gas combustors [AIAA PAPER 85-1289] p 667 A85-39702 Advanced liner-cooling techniques for gas turbine combustors p 667 A85-39703 [AIAA PAPER 85-1290] The influence of blade wakes on the performance of outwardly curved combustor pre-diffusers [AIAA PAPER 85-1291] p 667 A85-39704 'Smart' engine components - A micro in every blade? [AIAA PAPER 85-1296] p 668 A85-39707 Quantitative evaluation of transient heat transfer on axial flow compressor stability [AIAA PAPER 85-1352] p 697 A85-39742 Modeling post-stall operation of aircraft gas turbine enaines p 669 A85-39775 [AIAA PAPER 85-1431] Noncontact engine blade vibration measurements and analysis [AIAA PAPER 85-1473] p 670 A85-39798 Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade (ASME PAPER 84-WA/HT-69) p 698 A85-39897 The transpired turbulent boundary layer in various pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698 p 698 A85-39899 An investigation into the soot production processes in gas turbine engine p 690 N85-27992 [AD-A152710] Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28109 Strutless diffuser for gas turbine engine [AD-D011662] p 672 N85-28943 GAS TURBINES Radiative transfer in a gas turbine combustor [AIAA PAPER 85-1072] p 658 A85-37682 Small gas turbine combustor study - Fuel injector performance in a transpiration-cooled liner p 668 A85-39717 [AIAA PAPER 85-1312] Future fundamental combustion research for aeropropulsion systems [NASA-TM-87049] p 671 N85-27870

SUBJECT INDEX
Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874 Precision die forging of blades or gas turbines
p 672 N85-28148 Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149 Research test facility for evaporation and combustion
of atternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073 GEARS Starter-engine interface concepts
[SAE PAPER 841548] p 662 A85-39158 Critical speed testing of the Grumman X-29A power take-off shaft subsystem [SAE PAPER 841603] p 662 A85-39163
Airplane mounted accessory gearbox design [SAE PAPER 841605] p 696 A85-39165 Advanced single-rotation proptan drive system p 663 A85-39577
GENERAL AVIATION AIRCRAFT Ultralights break the rules p 615 A85-38439 GEOMETRY
A study of aerodynamic control in stalled flight leading-edge vortex formation analysis
[AD-A153758] p 638 N85-28928 GEOTHERMAL RESOURCES Navy geothermal plan
[AD-A152478] p 702 N85-28450 GLASS FIBER REINFORCED PLASTICS Fracture behavior of glass-cloth/polyester composite
laminate at low temperature p 688 A85-39228 GLIDERS
Instationary dolphin flight - The optimal energy exchange between a sailplane and vertical currents in the atmosphere p 646 A85-37488
Numerical solution of the minimum-time flight of a glider through a thermal by use of multiple shooting methods p 638 A85-37489
Three powered satiplanes as meteorological instrumentation for atmospheric boundary layer studies at DFVLR
[DFVLR-FB-84-50] p 653 N85-27862 Proposals for the determination of necessary elevator
handling characteristics of sailplanes in high speed range
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM
range [DFVLR-FB-84-52] p 676 N85-27882
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by trangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by trangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation aids in the National Airspace System
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by trangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation aids in the National Airspace System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintanability [AD-A153792] p 706 N85-29841
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by tnangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation and in the National Airspace System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintainability [AD-A153792] p 706 N85-29841 GOVERNMENTS A 5-year research plan, 1985-1990 Wind energy
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by tnangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation ands in the National Airspace System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintainability [AD-A153792] p 706 N85-29841 GOVERNMENTS A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463 GRAPHITE-EPOXY COMPOSITES
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by tnangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation aids in the National Airspace System p 644 A85-38541 Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintainability [AD-A153792] p 706 N85-29841 GOVERNMENTS A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463 GRAPHITE-EPOXY COMPOSITES Repair procedures for composite sinewave substructure p 686 A85-37300
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by tnangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation aids in the National Airspace System p 644 A85-38541 Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintainability [AD-A153792] p 706 N85-29841 GOVERNMENTS A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463 GRAPHITE-EPOXY COMPOSITES Repair procedures for composite sinewave substructure p 686 A85-37380 Material evaluation of second-generation composites for transport wing application [SAE PAPER 841520] p 688 A85-39291 Damage tolerance of composite cylinders
range [DFVLR-FB-84-52] p 676 N85-27882 GLOBAL POSITIONING SYSTEM GPS-based certification for the microwave landing system p 642 A85-37825 Passive navigation by trangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 Evaluation of radionavigation systems p 643 A85-37831 Global positioning system as a sole means for civil air navigation p 643 A85-37832 Commercial aviation GPS Navigation Set architecture p 644 A85-38538 Program to support the approval of supplemental navigation aids in the National Airspace System (OAS) with the Global Positioning System (GPS) p 685 A85-38545 Simulation and analysis of differential GPS p 685 A85-38546 GOVERNMENT PROCUREMENT Using incentives to improve maintainability [AD-A153792] p 706 N85-29841 GOVERNMENTS A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463 GRAPHITE-EPOXY COMPOSITES Repair procedures for composite sinewave substructure p 686 A85-37300 Material evaluation of second-generation composites for transport wing application [SAE PAPER 841520] p 688 A85-39291

p 692 N85-29105 GROUND EFFECT (AERODYNAMICS) Dynamic ground effects on a two-dimensional flat plate p 628 A85-39226

- GROUND EFFECT MACHINES Hovercraft skirt design and manufacture
 - p 694 A85-38233

GROUND HANDLING Thrust vectored take-off, landing and ground handling of an airship [AIAA PAPER 85-0877] p 641 A85-38792 GROUND RESONANCE Aerodynamic performance of a wing in ground effect using the PANAIR program [AD-A153303] p 635 N85-27832 GROUND TESTS Experimental research on the effect of separation flow on ablation in supersonic turbulent flow p 694 A85-37625 [AIAA PAPER 85-0975] From measurement uncertainty to measurement communications, credibility, and cost control in propulsion around test facilities p 682 A85-39243 Efficiencies of multiple-input techniques for aircraft ground vibration testing [SAE PAPER 841575] p 682 A85-39274 GRUMMAN AIRCRAFT Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208 GUIDE VANES The influence of blade wakes on the performance of outwardly curved combustor pre-diffuse [AIAA PAPER 85.1291] p 667 A85-39704 Spacer structure (AD-D0116411 p 670 N85-27866 GUST ALLEVIATORS OLGA An open loop gust alleviation system p 678 N85-27897 Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis (NAK-TR-86) p 681 N85-28950 GUST LOADS Identification of gust input and gust response characteristics from Do 28 TNT flight test data p 676 N85-27881 [DFVLR-FB-84-48] OLGA An open loop gust alleviation system p 678 N85-27897

Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis [NAK-TR-86] p 681 N85-28950 GUSTS

The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany [DFVLR-FB-85-04] p 684 N85-27920 GYROSCOPIC PENDULUMS

Description and test methods for a frequency output accelerometer p 694 A85-38536

GYROSCOPIC STABILITY Spectral analysis of optimal and suboptimal gyro monitoring filters p 696 A85-39459

Н

HANDBOOKS

The battle against noise in industry p 705 A85-39349

HANG GLIDERS An assessment of the suitability of the BHGA structural test ng for aerodynamic testing of hang gliders [CA-8505] p 652 N85-27853

HARDENING (MATERIALS) Heat resistant Carbon Fiber Reinforced Plastics (CFRP)

[MBB/LFA33/CFK/PUB/007] p 690 N85-27976

HARMONIC CONTROL

Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data acquisition and processing system

[DFVLR-MITT-85-03] p 684 N85-27921 HARMONIC OSCILLATION

Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds

[DFVLR-FB-84-49] p 636 N85-27837 HARRIER AIRCRAFT AV-8B-mean Marine V/STOL machine

p 648 A85-38437 Computer study of a jet flap ASTVOL 'Harrier'

[SAE PAPER 841457] p 650 A65-39202 HEAT BALANCE

Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles [AD-A153039] p 699 N85-28328

HEAT EXCHANGERS Heat management system for aircraft

[AD-D011658] p 654 N85-28936 Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073

HEAVY LIFT HELICOPTERS

HEAT FLUX

Vertical plate fin with conjugated forced convection-conduction turbulent flow PAPER 84-WA/HT-8] p 698 A85-39878

Heat TRAST RESURTED

Transient technique for measuring heat transfer coefficients on stator airfoids in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796 HEAT RESISTANT ALLOYS

Precision die forging of blades or gas turbines p 672 N85-28148

HEAT SHIELDING

The problems ansing in testing of carbon-based materials for structural components of airframes p 686 A85-37339

HEAT TRANSFER

Shock tunnel measurements of heat transfer in a model scramet

- [AIAA PAPER 85-0908] p 658 A85-37582 Hypersonic gas dynamics
- [AIAA PAPER 85-0999] p 621 A85-37643 Instrumentation for gas turbine research in short-duration facilities

[SAE PAPER 841504] p 695 A85-39062 A generalization of experimental data on heat transfer

from the working medium to the housing components of the compressor of a gas-turbine engine p 660 A85-39112

Similarity properties in the problem of flow from a supersonic source past a spherical bluntness

p 629 A85-39445 Flame radiation and liner heat transfer in a tubular-can combustor p 663 A85-39580

Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking [AIAA PAPER 85-1288] p 667 A85-39760

[AIAA PAPER 85-1288] p 667 A85-39701 Advanced liner-cooling techniques for gas turbine combustors

[AIAA PAPER 85-1290] p 667 A85-39703

Transient technique for measuring heat transfer coefficients on stator airfoits in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796

Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location

[ASME PAPER 84-WA/HT-70] p 698 A85-39898 Future fundamental combustion research for

aeropropulsion systems [NASA-TM-87049] p 671 N85-27870

Investigation of heat transfer to a turbine blade cascade using a shock tube

 [AD-A153090]
 p 671
 N85-27871

 Fuel freeze point investigations
 [AD-A152801]
 p 690
 N85-28129

[AD-A152801] p 690 N85-28129 Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles

[AD-A153039] p 699 N85-28328 Heat management system for aircraft

[AD-D011658] p 654 N85-28936 HEAT TRANSFER COEFFICIENTS

IEAT TRANSPER COEFFICIENTS Acquisition of detailed heat transfer behavior in complex internal flow bassages

[SAE PAPER 841503] p 695 A85-39061 Time resolved measurements of a turbine rotor

Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field

[AIAA PAPER 85-1220] p 666 A85-39663 Quantitative evaluation of transient heat transfer on axial

flow compressor stability [AIAA PAPER 85-1352] p 697 A85-39742

Vertical plate fin with conjugated forced convection-conduction turbulent flow

[ASME PAPER 84-WA/HT-8] p 698 A85-39878 Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade [ASME PAPER 84-WA/HT-69] p 698 A85-39897

HEAVY LIFT AIRSHIPS

An aerodynamic performance model for hybrid heavy lift systems

[AIAA PAPER 85-0865] p 648 A85-38781 The Cyclo-Crane - A new concept to heavy vertical lift

[AIAA PAPER 85-0871] p 648 A85-38786 An investigation into the hovering behaviour of the LTA 20.1 archive in celm and turbulent air

20-1 arship in calm and turbulent air [AIAA PAPER 85-0878] p 641 A85-38793 An experimental determination of the longitudinal

An experimental determination of the longitudinal stability properties of the LTA 20-1 airship

- [AIAA PAPER 85-0879] p 674 A85-38794 A new concept of hybrid airship
- [AIAA PAPER 85-0868] p 649 A85-38798 HEAVY LIFT HELICOPTERS

A new concept of hybrid airship [AIAA PAPER 85-0868] p 649 A85-38798

HELICOPTER CONTROL

HELICOPTER CONTROL	hame for belicontare
Design of digital flight control syste	p 673 A85-37195
Terrain/wire and wirelike obstacles helicopters	p 655 A85-38363
Automatic flight control system (
using an optical control algorithm	p 674 A85-38364
A preliminary investigation of requirements for helicopter instru	
decelerating approach maneuvers ar	
[NRC-24173]	p 652 N85-27857
The evolution of ACS for helic simulation studies to preliminary desi	opters: Conceptual
sinulation studies to pretinitially deal	p 677 N85-27890
ACT applied to helicopter flight co.	ntrol
The evolution of active control tec	p 678 N85-27891
the 1990's helicopter	p 680 N85-27911
Data processing on the rotor test	
 Brunswick. Microprogrammable in processor as key components in a P 	
acquisition and processing system	I
{DFVLR-MITT-85-03}	p 684 N85-27921
Helicopter Aeromechanics [AGARD-LS-139]	p 617 N85-28913
The role of simulation	p 684 N85-28919 I
HELICOPTER DESIGN	
Development of the BK 117 helico	p 674 A85-38369
LHX - A giant leap	p 648 A85-38438
Aircraft preliminary design com	
compound engines with advanced helicopter applications	wome engines for
[AIAA PAPER 85-1276]	p 666 A85-39693
HELICOPTER ENGINES Turboshaft truce in Europe	p 658 A85-38436
Development of an advanced va	
separator for helicopter engines	
[AIAA PAPER 85-1277] HELICOPTER PERFORMANCE	p 666 A85-39694
Rotary-wing aerodynamics Volum	e 1 - Basic theories
of rotor aerodynamics (With application	
 Volume 2 Performance prediction (revised and enlarged edition) Boo 	
	p 617 A85-36996
Research trend in advanced techr	
Development of the BK 117 helico	p 0 11 1.00 00000
	p 674 A85-38369
Helicopter flight test of a ring las Heading Reference System	er gyro Attitude and p 643 A85-38529 I
Advanced techniques for health a	
of helicopter transmissions	
[AIAA PAPER-85-1142] Wind-tunnel evaluation of a 21-pe	p 617 A85-39621 ercent-scale powered
model of a prototype advanced scou	rt helicopter
[NASA-TP-2420] HELICOPTER TAIL ROTORS	p 637 N85-28923
Rotorcraft research testing in the	> National Full-Scale
Aerodynamics Complex at NAS	
Center [NASA-TM-86687]	p 652 N85-27854
HELICOPTER WAKES	
A new unsteady prescribed w	
aerodynamic behavior of a rotor in f	p 617 A85-37178
HELICOPTERS	-
Study on the comfortability of heli	
acoustic noise level Advanced avionics management s	p 647 A85-38365 ystem prevents pilots
from being swamped by information	overload
Fundamentals of the disht	p 655 A85-38401
Fundamentals of the flight opera Aerodynamics Russian book	p 649 A85-38875
Investigation of imaging and fligh	t guidance concepts
for rotorcraft zero visibility approach [NASA-CR-166571]	and landing p 644 N85-27843
Helicopter Aeromechanics	P 0 1100-21040
[AGARD-LS-139]	p 617 N85-28913
Helicopter aeromechanics Introc review	p 653 N85-28914
A survey of recent develop	
aerodynamics	p 653 N85-28915
Rotorcraft noise	p 705 N85-28916
Recent developments in the dynam systems	p 653 N85-28917
	p 000 1100-2031/
Mission requirements and handlin	g qualities
Mission requirements and handlin	g qualities p 680 N85-28918
Mission requirements and handlin The role of simulation Elight testing for performance and	p 680 N85-28918 p 684 N85-28919

p 654 N85-28920 HELMHOLTZ VORTICITY EQUATION

An introduction to vortex breakdown and vortex core bursting

[NAE-AN-28] p 635 N85-27829 HERCULES ENGINE Review of empirical and analytical specific impulse methodologie p 669 A85-39776 [AIAA PAPER 85-1434] GH ALTITUDE Starduster - A solar powered high altitude airplane [AIAA PAPER 85-1449] p 651 A85-39786 IGH ALTITUDE BALLOONS Balloon system and balloon-borne experiments in China p 640 A85-38310 IGH ASPECT RATIO Computer study of a jet flap ASTVOL 'Harner' [SAE PAPER 841457] p 650 A85-39202 Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles [AIAA PAPER 85-1346] o 632 A85-39738 IGH SPEED High speed compressor ng as a stall recovery research tooi [AIAA PAPER 85-1428] p 682 A85-39773 IGH TEMPERATURE Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073 IGH TEMPERATURE AIR Performance of a new nose-lip hot-air anti-icing concept [AIAA PAPER 85-1117] p 664 A85-39614 IGH TEMPERATURE GASES Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage [SAE PAPER 841555] p 663 A85-39207 IGH TEMPERATURE RESEARCH Technology for the design of high temperature rise combustors [AIAA PAPER 85-1292] p 668 A85-39705 ISTORIES Propulsion influences on air combat [AIAA PAPER 85-1457] p 651 A85-39789 Air traffic Instruments, airports, companies, post, cargo p 641 N85-28932 and passengers OLE GEOMETRY (MECHANICS)

Reducing the effects of rivet holes on fatigue life by dhesive bonding p 693 A85-37472 adhesive bonding ORIZONTAL ORIENTATION Wake effects on the aerodynamic performance of

horizontal axis wind turbines [NASA-CR-174920] p 702 N85-29364

- OT PRESSING The substitution of nickel for cobalt in hot isostatically
- pressed powder metallurgy UDIMET 700 alloys p 686 A85-37415 OVERING
- The evaluation of aerodynamic coefficients for projectiles fired from a hovering helicopter p 618 A85-37203
- An investigation into the hovering behaviour of the LTA 20-1 airship in calm and turbulent air [AIAA PAPER 85-0878] p 641 A85-38793

UMAN FACTORS ENGINEERING Display technology and the role of human factors

p 656 A85-38957 YDRAULIC EQUIPMENT

- Active control landing gear for ground load alleviation p 679 N85-27902 YDRAZINE ENGINES
- Pitot pressure and heat transfer measurements in hydrazine thruster plumes
- AIAA PAPER 85-09341 p 685 A85-37599 YDROCARBON COMBUSTION An improved procedure for calculating the
- aerothermodynamic properties of a vitiated air test medium [AIAA PAPER 85-0913] p 704 A85-37583
- YDRODYNAMICS Multi-ducted inlet combustor research and

development [AD-A153753] p 673 N85-28946

- YDROGEN The need to return to hydrogen in airships [AIAA PAPER 85-0873] p 648 p 648 A85-38788
- YDROGEN OXYGEN ENGINES A new technique to break diaphragms electrically in a
- double-tube short duration jet simulation facility p 682 A85-38975 YPERBOLAS
- Hyperbolic phenomena in the flow of viscoelastic fluids
- [AD-A153533] p 700 - N85-29186 HYPERSONIC BOUNDARY LAYER
- Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects (AD-A153020) p 699 N85-28266

HYPERSONIC FLOW

- A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of p 619 A85-37333 attack Investigation of three-dimensional separated flows p 619 A85-37338 Computational methods for hypersonic viscous flow over finite ellipsoid-cones at incidence [AIAA PAPER 85-0925] p 620 A85-37594 The effects of surface discontinuities on convective hear transfer in hypersonic flow [AIAA PAPER 85-0971] p 620 A85-37621 Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623 The drag of simple shaped bodies in the rarefied hypersonic flow regime [AIAA PAPER 85-0998] p 621 A85-37642 The effect of the bluntness shape on the drag coefficient of a body in hypersonic flow of a rarefied gas p 624 A85-38564 PNS predicted shock location and jump conditions at supersonic and hypersonic speeds --- Parabolized Navier-Stokes [AIAA PAPER 85-1407] p 632 A85-39766 HYPERSONIC HEAT TRANSFER Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623 HYPERSONIC REENTRY Stagnation point heat transfer in hypersonic high nthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623 Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661 HYPERSONIC VEHICLES Transition measurements heat-transfer instrumentation on a 0 5 bluntness 9 75-deg cone at Mach 7 with and without mass addition AIAA PAPER 85-10041 p 621 A85-37645 HYPERSONIC WIND TUNNELS Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film techniqu p 681 A85-37622 [AIAA PAPER 85-0972] Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels [AIAA PAPER 85-1003] p 681 A85-37644 Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10 (AIAA PAPER 85-1061) p 621 A85-37675 HYPERVELOCITY WIND TUNNELS Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661 ICE FORMATION Ice shapes and the resulting drag increase for a NACA 0012 autoil [NASA-TM-83556] p 641 N85-27839 ICE PREVENTION
- Performance of a new nose-lip hot-air anti-icing concept [AIAA PAPER 85-1117] p 664 A85-39614 IDEAL GAS A supersonic inhomogeneous flow of an ideal gas around p 619 A85-37335 blunted bodies IMAGE PROCESSING Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 images IMPACT DAMAGE Assessment of damage tolerance in composites p 688 A85-39598 IMPACT TOLERANCES Assessment of damage tolerance in composites p 688 A85-39598 INCOMPRESSIBLE BOUNDARY LAYER A method of determining the suction velocity for laminar flow control of two-dimensional airfoil in incompressible flow [NAL-TR-845] p 637 N85-28925 INCOMPRESSIBLE FLOW Charactenstics of the oscillations of a tail unit in a flow
- of an incompressible gas p 649 A85-39125 A method of determining the suction velocity for laminar
- flow control of two-dimensional airfoil in-incompressible flow [NAL-TR-845] p 637 N85-28925
- A computational method for wings of arbitrary planform [AD-A153788] p 638 N85-28929

SUBJECT INDEX INDICATING INSTRUMENTS Advanced Aircrew Display Symposium, 6th, Patuxent River, MD, May 15, 16, 1984, Proceedings p 655 A85-38951 An argument for standardization in modern aircraft crew p 657 A85-38961 stations INDUSTRIAL PLANTS The battle against noise in industry p 705 A85-39349 INERTIAL NAVIGATION Autocalibration of a laser gyro strapdown inertial iference/navigation system p 642 A85-37808 reference/navigation system Integrated Inertial Sensor Assembly program status p 642 A85-37810 Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings p 643 A85-38526 Spectral analysis of optimal and suboptimal gyro ionitoring filters p 696 A85-39459 monitoring filters A system for take-off and landing measurements (STALINS) (B8580072) p 645 N85-27849 The AFTI/F16 terrain-aided navigation system [DE85-008411] p 645 N85-28935 INERTIAL REFERENCE SYSTEMS Autocalibration of a laser gyro strapdown inertial reference/navigation system p 642 A85-37808 The ARINC 704 ring laser gyro Inertial Reference System p 643 A85-38528 Helicopter flight test of a ring laser gyro Attitude and Heading Reference System p 643 A85-38529 INFORMATION RETRIEVAL Avionics Data Base users manual [AD-A153810] p 657 N85-28942 INFORMATION SYSTEMS The interactive generation of specifications for an onboard software senes (GISELE) p 679 N85-27906 p 679 N85-27906 Avionics Data Base users manual [AD-A153810] p 657 N85-28942 INFRARED RADIATION Long-duration flights using MIR (infrared balloon system) p 639 A85-38307 --- for stratospheric study First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) --- balloon p 639 A85-38308 INGESTION (ENGINES) Temperature distortion generator for turboshaft engine testina [SAE PAPER 841541] p 659 A85-39065 Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage [SAE PAPER 841555] p 663 A85-39207 INJECTORS Segmented zoned fuel injection system for use with a combustor [AD-D011640] p 670 N85-27865 INLET FLOW Investigation of transonic inlet drag characteristics [SAE PAPER 841\$39] p 627 A85-39 p 627 A85-39063 Effects of inlet pressure fluctuations on axial flow compressors - Some experimental and theoretical results [AIAA PAPER 85-1135] p 696 A85-39619 Numerical simulation of a supercritical inlet flow [AIAA PAPER 85-1214] p 630 A85 p 630 A85-39658 Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts [AIAA PAPER 85-1281] AIAA PAPER 85-1281] p 631 A85-39697 The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698 Stall transients of axial compression systems with inlet distortion [AIAA PAPER 85-1348] p 632 A85-39740 INLET NOZZLES Performance characteristics of rectangular and circular thrust augmenting ejectors [AIAA PAPER 85-1344] p 631 A85-39736 Investigation of heat transfer to a turbine blade cascade using a shock tube [AD-A153090] p 671 N85-27871 INLET PRESSURE Investigation of heat transfer to a turbine blade cascade using a shock tube [AD-A153090] INLET TEMPERATURE Instrumentation for gas turbine research short-duration facilities [SAE PAPER 841504] at the conceptual design stage [SAE PAPER 841555]

p 671 N85-27871 p 695 A85-39062 Estimation of hot gas reingestion for a VTOL aircraft p 663 A85-39207 Technology for the design of high temperature rise combustors [AIAA PAPER 85-1292] p 668 A85-39705

INSPECTION Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p o 659 A85-39069 INSTRUMENT COMPENSATION Dynamic gas temperature measurement system p 694 A85-37706 INTAKE SYSTEMS Multi-ducted inlet combustor research and development p 673 N85-28946 [AD-A153753] INTERACTIONAL AERODYNAMICS Interaction of twin turbulent circular jet p 617 A85-37049 Wind tunnel investigation of the interaction of an airship configuration with lifting rotors p 625 A85-38790 [AIAA PAPER 85-0875] Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins p 626 A85-38984 Engine inlet interaction with a prop-fan propulsion system [SAE PAPER 841478] p 627 A85-39058 Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft [SAE PAPER 841543] p 649 A85-39066 Unsteady blade row interactions in a multi-stage compressor p 630 A85-39618 [AIAA PAPER 85-1134] The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698 Propulsion efficiency of vibrating bodies in subsonic gas p 699 N85-28159 INTERFEROMETRY Fuel droplet size measurements with a laser Doppler nterferometer p 697 A85-39643 [AIAA PAPER 85-1182] INTERNATIONAL COOPERATION Turboshaft truce in Europe p 658 A85-38436 Construction 1976-1980 Design, manufacturing, p 658 A85-38436 calibration of the German-Dutch wind tunnel (DNW) p 683 N85-27913 INTERPOLATION A study of aerodynamic control in stalled flight leading-edge vortex formation analysis (AD-A153758) p 638 N85-28928 INVISCID FLOW The finite element formulation of airflow around a deformable wing by using the incremental finite element method p 621 A85-37879 Aerodynamic characteristics of the Weis-Footh p 623 A85-38370 mechanism An investigation of lift augmentation of tandem 29her2er [ASME PAPER 84-WA/FM-3] p 633 A85-39875 IONIZING RADIATION Further observations of X-rays inside thunderstorms p 701 A85-37720 IRON Effect of superconducting solenoid model cores on spanwise iron magnet roll control [NASA-TM-86378] p 683 N85-27915 ISOSTATIC PRESSURE The substitution of nickel for cobalt in hot isostatically pressed powder metallurgy UDIMET 700 alloys p 686 A85-37415 Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape ISOTHERMAL FLOW Predictions and measurements of isothermal flowfields in axisymmetric combustor geometries [NASA-CR-174916] p 671 N85-27867 ITERATION A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928 J JAGUAR AIRCRAFT An update of expenence on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893 JET AIRCRAFT Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle [SAE PAPER 841540] p 627 A85-39064 Rationalizing the choice of an actuating mechanism for p 661 A85-39124 jet drive Flight trials of a modified gulfstream commander carrying external stores [AD-A153376] p 653 N85-27859

KINETICS The AFTI/F16 terrain-aided navigation system p 645 N85-28935 JET AIRCRAFT NOISE Power spectral density of subsonic jet noise p 704 A85-37898 Noise of counter-rotation propellers p 705 A85-39220 Fan noise suppression in turbofan engines p 671 N85-27872 JET ENGINE FUELS Jet fuel instability mechanisms [NASA-CR-175856] p 690 N85-28127 Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures p 691 N85-29073 The distribution of higher n-alkanes in partially frozen middle distillate fuels [AD-A153940] p 692 N85-29074 Explosive forming of low carboon steel sheet into a stepped disc shape p 694 A85-38169 Repairing commercial aircraft jet engine nacelle composite structures [SAE PAPER 841567] p 616 A85-39068 Testing of materials and coatings for jet engine components under simulated operational conditions p 672 N85-27873 A new technique to break diaphragms electrically in a double-tube short duration jet simulation facility p 682 A85-38975 A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers [AIAA PAPER 85-1463] p 633 A85 p 633 A85-39792 Stability of the thin-jet model of the unsteady jet flap p 626 A85-38997 Computer study of a jet flap ASTVOL 'Harner' [SAE PAPER 841457] p 650 A8 p 650 A85-39202 Subsonic multiple-jet aerodynamic window p 693 A85-37216 p 619 A85-37337 Gas flow in nozzles and jets Experiments in dilution jet mixing -Effects of multiple rows and non-circular orifices [AIAA PAPER 85-1104] p 664 A85-39606 Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion [AIAA PAPER 85-1441] p 697 A85-39780 Background noise measurements from jet exit vanes designed to reduced flow pulsations in an open-jet wind [NASA-TM-86383] p 683 N85-27916 JET MIXING FLOW Experiments in dilution jet mixing - Effects of multiple ows and non-circular orifices [AIAA PAPER 85-1104] p 664 A85-39606 Evaluation of nozzle throat materials for ramjet p 686 A85-37201 Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts p 631 A85-39697 [AIAA PAPER 85-1281] An investigation of high performance, short thrust augmenting ejectors [ASME PAPER 84-WA/FE-10] p 697 A85-39873 Background noise measurements from let exit vanes designed to reduced flow pulsations in an open-jet wind tunnel [NASA-TM-86383] p 683 N85-27916 JOINTS (JUNCTIONS) Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600 Fracture toughness of adhesively bonded joints p 688 A85-39492

[DE85-008411]

[B8580076]

[AD-A153830]

JET ENGINES

[B8580073]

JET EXHAUST

JET FLAPS

JET FLOW

tunnel

JET NOZZLES

engines JET THRUST

JET VANES

Further investigations to improve the fatigue life of the Mirage 1110 wing main span [ARL-STRUC-TM-397] p 654 N85-28938 Κ

KALMAN FILTERS Simulation and analysis of differential GPS

p 685 A85-38546 Spectral analysis of optimal and suboptimal gyro ponitoring filters p 696 A85-39459 monitoring filters KINETICS

- Future fundamental combustion research for aeropropulsion systems
 - p 671 N85-27870 [NASA-TM-87049]

LABORATORIES

L

- LABORATORIES Technical services at NLR
- [B8561898] p 705 N85-28871 LAGRANGE COORDINATES Users manual for coordinate generation code CRDSRA
- p 634 N85-27824 [NASA-CR-172584] LAMINAR BOUNDARY LAYER
- The effects of surface discontinuities on convective hear transfer in hypersonic flow p 620 A85-37621 [AIAA PAPER 85-0971]
- Density and velocity profiles in non-equilibrium laminar boundary layers in air
- [AIAA PAPER 85-0976] o 620 A85-37626 Development of an active laminar flow nacelle p 629 A85-39613 [AIAA PAPER 85-1116]
- Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects
- [AD-A153020] p 699 N85-28266 LAMINAR FLOW
- Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack
- p 620 A85-37593 [AIAA PAPER 85-0924] Families of variational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow p 622 A85-37930 turbomachines
- A method of determining the suction velocity for laminar flow control of two-dimensional airfoil in incompressible flow [NAL-TR-845] p 637 N85-28925
- A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850] p 638 N85-28930
- LAMINAR FLOW AIRFOILS A method of determining the suction velocity for laminal flow control of two-dimensional airfoil in incompressible
- flow [NAL-TR-845] p 637 N85-28925 LAMINATES
- Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element p 696 A85-39170
- Fracture behavior of glass-cloth/polyester composite p 688 A85-39228 laminate at low temperature LANDING GEAR
- Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600
- Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors [AIAA PAPER 84-0933] p 616 A85-39214
- Active control landing gear for ground load alleviation p 679 N85-27902 LANDING LOADS
- Active control landing gear for ground load alleviation p 679 N85-27902
- LANDING RADAR

A-20

- Investigation of imaging and flight guidance concepts for rotorcraft zero visibility approach and landing [NASA-CR-166571] p 644 N85-27843 LASER APPLICATIONS
- Optical system for measuring shadowgraph data [AD-D011642] p 705 N85-28784
- LASER GYROSCOPES Autocalibration of a laser gyro strapdown inertial reference/navigation system p 642 A85-37808 The ARINC 704 ring laser gyro Inertial Reference System p 643 A85-38528 Helicopter flight test of a ring laser gyro Attitude and Heading Reference System p 643 A85-38529 Redundancy management in strapdown navigation
- systems p 644 A85-38530 LASER WINDOWS Subsonic multiple-jet aerodynamic window
- p 693 A85-37216 LATERAL CONTROL
- A multiloop robust controller design study using singular p 703 A85-39564 value gradients LATERAL STABILITY
- CI Beta of unswept flat wings in sideslip II
- p 623 A85-38371 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling-motion -Part-2- Theoretical-investigations for calculation of the lateral wind
- [IFD-1/84-PT-2] p 654 N85-28940 LAY-UP
- improved resins for wet layup repair of advanced p 686 A85-37381 composite structure

- LEADING EDGES
- Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film technique p 681 A85-37622 AIAA PAPER 85-09721
- Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow
- Modelling vortex flowfields by supercomputers with p 628 A85-39242 super-size memory Some effects of sweep direction and strakes for wings
- th sharp leading edges p 634 N85-27826 (CA-84211
- On the effect of wing taper and sweep direction on leading edge transition (CA-8435) p 634 N85-27827
- A study of aerodynamic control in stalled flight leading-edge vortex formation analysis (AD-A153758) p 638 N85-28928
- LEAKAGE
- Cantilevered stator vane tip leakage studies [AIAA PAPER 85-1136] p 664 A85-39620 LIFE CYCLE COSTS.
- Supportability considerations for advanced engine development
- p 665 A85-39655 [AIAA PAPER 85-1205] LIFT
- Lift and drag of airfoils in nonuniform supersonic stream p 618 A85-37200 Dynamic ground effects on a two-dimensional flat p 628 A85-39226 plate Aerodynamic performance of a wing in ground effect
- using the PANAIR program [AD-A153303] p 635 N85-27832 Method of calculating separation flow of subsonic g stream around wings p 636 N85-28161
- LIFT AUGMENTATION Circulation control technology applied to propulsive high
- lift systems [SAE PAPER 841497] p 627 A85-39205 An investigation of lift augmentation of tandem cascades
- [ASME PAPER 84-WA/FM-3] p 633 A85-39875 LIFT DEVICES
- A computational method for wings of arbitrary planform AD-A1537881 p 638 N85-28929
- LIFT DRAG RATIO
- Lift and thrust of a linear synchronous engine with a p 658 A85-37550 solid-conductor stator winding Aerodynamic performance of a wing in ground effect using the PANAIR program
- (AD-A1533031 n 635 N85-27832 LIFTING BODIES
- Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies p 618 A85-37197
- Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles
- p 646 A85-37323 A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355
- LIGHT AIRCRAFT The integration of a new concept in VTOL aircraft ropulsion
 - [AIAA PAPER 85-1448] p 651 A85-39785 Starduster - A solar powered high altitude airplane AIAA PAPER 85-1449] p 651 A85-39786
- LIGHTHILL GAS MODEL Aerodynamic characteristics of the Weis-Foat
- p 623 A85-38370 LIGHTNING
- Further observations of X-rays inside thunderstorms p 701 A85-37720 Lightning-safe carbon fiber composite for Airbus tail
- p 692 N85-29100 បករៅ LINEAR PROGRAMMING
- Operations research (B8561897)
- LINEAR SYSTEMS
- Time-domain stability robustness measures for linear regulators p 703 A85-39565 LININGS

p 704 N85-28712

- Advanced liner-cooling techniques for gas turbine combustors
- (AIAA PAPER 85-1290) p 667 A85-39703 LINKAGES
- Vibrations of rotors connected through couplings with hacklash p 672 N85-28147 LIQUID ATOMIZATION
- Boron slurry fuel atomization evaluation p 689 A85-39645 [AIAA PAPER 85-1184]
- LIQUID FUELS
- Boron slurry fuel atomization evaluation [AIAA PAPER 85-1184] p 689 A85-39645

LOAD DISTRIBUTION (FORCES)

Crack growth analysis in multiple load path structure p 693 A85-37186 LOAD TESTS

SUBJECT INDEX

- Crack growth analysis in multiple load path structure p 693 A85-37186
- LOADS (FORCES)
- Influence of fighter aircraft load spectrum variations on fatique crack initiation and growth p 693 A85-37181 A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling p 693 A85-37187 criteria under multiple loading LONG DURATION SPACE FLIGHT
- Propellant options for long duration, high altitude unmanned aircraft
- p 689 A85-39727 [AIAA PAPER 85-1326] LONGITUDINAL CONTROL
- In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft [DFVLR-FB-84-12] p 676 M p 676 N85-27880
- LONGITUDINAL STABILITY An experimental determination of the longitudinal
- stability properties of the LTA 20-1 airship p 674 A85-38794 (AIAA PAPER 85-0879)
- Discussions on the regular behavior of the longitudinal dynamic response of aircraft during variable sweep p 674 A85-38974 flights
 - Realisation of relaxed static stability on a commercial ansport p 679 N85-27899 transport
- Contributions on the subject of longitudinal movements of aircraft in wind shears
- [NASA-TM-77837] p 702 N85-29432
- LORAN C

Evaluation of radionavi	gation systems	
	p 643	A85-37831
LOUVERS		
Advanced Floatwall	combustor liner	technology
eliminates TF30-P-100	transition duct fatig	ue cracking
[AIAA PAPER 85-1288]	p 667	A85-39701
LOW ALTITUDE		
The sale of survivations	÷ 604	NOE 00010

- p 684 N85-28919 LOW ASPECT RATIO WINGS
- Computational/experimental pressure distributions on a transonic, low-aspect-ratio wing p 628 A85-39210
- LOW CARBON STEELS Explosive forming of low carboon steel sheet into a p 694 A85-38169
- stepped disc shape LOW DENSITY FLOW
- Low density aerothermodynamics AIAA PAPER 85-0994] p 620 A85-37640
- LOW LEVEL TURBULENCE
- Adding computationally efficient realism to Monte Carlo turbulence simulation [NASA-TP-2469]
- p 704 N85-28708 LOW SPEED STABILITY
- Mirage 2000 fighter combines acceleration, low-speed p 646 A85-38243 stability
- LOW SPEED WIND TUNNELS
- An integral method of wall interference correction for low speed wind tunnel p 682 A85-38962 Construction 1976-1980. Design, manufacturing, calibration of the German-Dutch wind tunnel (DNW)
 - p 683 N85-27913

p 695 A85-38600

p 662 A85-39157

p 684 N85-28953

p 683 N85-27915

p 626 - A85-38981

p 686 A85-37381

sinewave p 686 A85-37380

Background noise measurements from let exit vanes designed to reduced flow pulsations in an open-jet wind tunnel [NASA-TM-863831 p 683 N85-27916

Determination of the optimum lubricant change period

Μ

wind tunnel at the National Aerospace Laborator

Repair procedures for composite

On power effecient operation of the 2m x 2m transonic

Effect of superconducting solenoid model cores on

Computations of projectile Magnus effect at transonic

Improved resins for wet layup repair of advanced

for the joints of the landing gear of aircraft

Lubrication systems for air turbine starters [SAE PAPER 841547] p 662

LUBRICANTS

MACH NUMBER

[NAL-TR-847]

MAGNETIC SUSPENSION

[NASA-TM-86378]

MAGNUS EFFECT

velocities

MAINTENANCE

substructure

composite structure

spanwise iron magnet roll control

LUBRICATION SYSTEMS

SUBJECTINDEX		
The use of flight simulators in meas	unng an	d improving
training effectiveness		
[AD-A153817] Automated maintenance system tes	p 684 t program	N85-28954
VI production scheduling	i piograi	in a for former in
[AD-A153694]	p 706	N85-29838
A systematic program for the	develo	oment and
evaluation of airborne color display s		
	p 655	A85-38952
Airborne electronic color displays - A since 1981		A85-38953
Toward a unifying theory for aircra		
	p 651	A85-39554
Controller requirements for uncour volume 2	pied airc	ran motion,
[AD-A153300]	p 676	N85-27879
MAN POWERED AIRCRAFT	- 615	A85-38353
Man-powered aircraft review MANAGEMENT METHODS	p 615	A65-36353
Automated maintenance system te	st program	m increment
VI production scheduling [AD-A153694]	n 706	N85-29838
MANAGEMENT SYSTEMS	p /00	1103-23030
Application of technology to achi	eve valu	ie - Added
in-service support of jet engines [SAE PAPER 841566]	p 659	A85-39067
MANEUVERS	p 000	A03-03007
Design of robust controllers for a n		
output control system with un application to the lateral and longit		
KC-135 transport aircraft	JJI	
[AD-A153100]	p 675	N85-27877
MANUAL CONTROL Toward a unifying theory for aircra	ft handlu	na qualities
	p 651	A85-39554
MANUFACTURING	- D	
Future of ceramic turbocharger pitfalls	s Pro	omises and
[DE85-006209]	p 700	N85-28380
A companison of several digital n	nan-aidai	d novembor
techniques	p 642	A85-37829
MAPPING		
Microwave responses of the we [NASA-CR-175888]	p 699	N85-28191
MARINE ENVIRONMENTS	p 000	
Tethered aerostat operations	•	he marine
Tethered aerostat operations environment	ın t	he marine
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A	יח ti 10,040 ור (HELT	he marine A85-38778 TA) Program
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861]	יח ti 10,040 ור (HELT	he marine A85-38778
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A	יח ti 10,040 ור (HELT	he marine A85-38778 TA) Program
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER	n ti p640 ır (HEL1 p640 p615	he marine A85-38778 (A) Program A85-38779 A85-38439
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin	, p640 ır (HEL1 p640 p615 gofca	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER	n th p640 ir (HEL1 p640 p615 g of ca	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE	IN 1 IN 1 IN 640 IN (HELT P 640 IN 615 IN 615 IN 615 IN 686	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based nes A85-37339
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge	in ti p 640 ir (HELT p 640 p 615 g of ca p 686 ineous m	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based nes A85-37339 matenals and
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE	in ti p 640 ir (HELT p 640 p 615 g of ca p 686 ineous m	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based nes A85-37339
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in	In ti p 640 Ir (HELT p 640 p 615 g of ca of arfran p 686 ineous m p 687 p 687 p 687	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based hes A85-37339 matenals and A85-38874 for ramjet
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS	In ti p 640 Ir (HELT p 640 p 615 g of ca of aufran p 686 neous m p 687 p 687 p 686	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 materials and A85-38874 for ramjet A85-37201
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application	in ti p 640 ir (HELT p 640 p 615 g of ci of airfran p 686 ineous m p 687 tatenals p 686 ration co	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 matenals and A85-38874 for ramjet A85-37201 mposites for
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520]	in ti p 640 ir (HELT p 640 p 615 g of ci of airfran p 686 ineous m p 687 tatenals p 686 ration co	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 materials and A85-38874 for ramjet A85-37201
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application	In ti p 640 Ir (HELT p 640 p 615 g of ca of aufran p 686 ineous m p 687 vaternals p 686 ration co	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 natenais and A85-37807 for ramjet A85-37201 mposites for A85-39291
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdo bursting	In the product of the	A85-38778 (A) Program A85-38779 A85-38439 arbon-based hes A85-37339 matenals and A85-37201 mposites for A85-37201 mposites for A85-39291 vortex core
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdo bursting [NAE-AN-28]	In the period of	A85-38778 (A) Program A85-38779 A85-38439 arbon-based as A85-37339 natenals and A85-37801 for ramjet A85-37201 mposites for A85-39291 vortex core N85-27829
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdo bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu	In the period of	A85-38778 (A) Program A85-38779 A85-38439 arbon-based hes A85-37339 matenals and A85-37201 mposites for A85-32201 vortex core N85-27829 n nonsteady 7
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdo bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U]	IN T IN THE IN THE INT THE IN THE INT THE IN THE IN THE IN THE IN THE IN THE IN THE IN THE IN	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenais and A85-37339 for ramjet A85-38874 for ramjet A85-39291 vortex core N85-27829 nonsteady N85-27860
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdo bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu	IN the second se	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenais and A85-37339 for ramjet A85-38874 for ramjet A85-39291 vortex core N85-27829 nonsteady N85-27860
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakde bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING	IN 11 P 640 IF (HELT P 640 P 615 g of ca of airfran P 686 neous m P 686 ration co P 688 ration co P 688 wwn and P 635 f tests in neter Mk P 653 Use of P 701	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenais and A85-373201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness	IN the second se	A85-38778 (A) Program A85-38779 A85-38439 arbon-based hes A85-37339 hatenais and A85-37339 hatenais and A85-37201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325 as for linear
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakde bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING	IN the second se	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenais and A85-373201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para	IN 11 P 640 IF (HELT P 640 P 615 g of ca of airfran P 686 neous m P 686 ration co P 688 wwn and P 688 wwn and P 635 f tests in nter Mk P 653 Use of P 701 measurr P 703	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenals and A85-37339 for ramjet A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325 es for linear A85-39565
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzie throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform	IN the product of the	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 materials and A85-37339 materials and A85-37201 mposites for A85-39291 vortex core N85-27860 CRACKS IV N85-29325 as for linear A85-39555 of wings of
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para	In the period of	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenals and A85-37339 for ramjet A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325 es for linear A85-39565
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin materials for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzie throat in engines Material evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXINUM LIKELIHOOD ESTIMATES	IN THE INTERNATION	A85-38778 (A) Program A85-38779 A85-38439 arbon-based as A85-37339 arbon-based as A85-37339 (A85-37339 (A85-37339) (A85-37201 (A85-37201) vortex core N85-27829 (A85-27829) vortex core N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27850 (A85-39565) of wings of N85-27831
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXINUM LIKELIHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions	In the period of the period o	A85-38778 (A) Program A85-38779 A85-38439 arbon-based as A85-37339 arbon-based as A85-37339 (A85-37339 (A85-37339) (A85-37201 (A85-37201) vortex core N85-27829 (A85-27829) vortex core N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27860 CRACKS IV N85-27850 (A85-39565) of wings of N85-27831
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzie throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXINUM LIKELIHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions [NASA-TM-86730] MEASURING INSTRUMENTS	In the period of the second se	A85-38778 (A) Program A85-38779 A85-38439 arbon-based hes A85-37339 hatenals and A85-37201 mposites for A85-37201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-27860 CRACKS IV N85-29325 as for linear A85-39565 of wings of N85-27831 or aircraft at N85-29686
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXINUM LIKELIHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions [NASA-TM-86730] MEASURING INSTRUMENTS Development of a norinterfere	In the period of the second s	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenals and A85-37339 for ramjet A85-37201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325 as for linear A85-39565 of wings of N85-27831 or aircraft at N85-29686 chnique for
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzie throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXINUM LIKELIHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions [NASA-TM-86730] MEASURING INSTRUMENTS	IN the stresses of the stresse	he marine A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 hatenals and A85-37339 for ramjet A85-37201 mposites for A85-39291 vortex core N85-27829 nonsteady N85-27860 CRACKS IV N85-29325 as for linear A85-39565 of wings of N85-27831 or aircraft at N85-29686 chnique for
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testim matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXIMUM LIKELHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions [NASA-TM-86730] MEASURING INSTRUMENTS Development of a noninterferen measuring turbine engine rotor bladd [AIAA PAPER 85-1472] MECHANICAL DRIVES	In the period of the period o	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 arbon-based tes A85-37339 arbon-based tes A85-37339 (A85-37339 (A85-38874 for ramjet A85-39291 vortex core N85-27860 CRACKS IV N85-29325 as for linear A85-39565 of wings of N85-27831 or aircraft at N85-29686 chinique for S A85-39797
Tethered aerostat operations environment [AIAA PAPER 85-0860] High Endurance Lighter Than A [AIAA PAPER 85-0861] MARKETING Ultralights break the rules MASS TRANSFER The problems ansing in testin matenals for structural components MATERIALS SCIENCE Dissipative properties of inhomoge systems Russian book MATERIALS TESTS Evaluation of nozzle throat in engines Matenal evaluation of second-gene transport wing application [SAE PAPER 841520] MATHEMATICAL MODELS An introduction to vortex breakdd bursting [NAE-AN-28] Parameter identification results o symmetric flight with the Hawker Hu [NLR-TR-83042-U] Description and illustration of the [AD-A153543] MATHEMATICAL PROGRAMMING Time-domain stability robustness regulators MATRICES (MATHEMATICS) A method to calculate the para arbitrary planform [AD-A152689] MAXIMU LIKELIHOOD ESTIMATES Extraction of aerodynamic parar extreme flight conditions [NASA-TM-86730] MEASURING INSTRUMENTS Development of a noninterferr measuning turbine engine rotor blade [AIAA PAPER 85-1472]	IN THE PERSON OF CONTROL ON CONTROL OF CONTR	A85-38778 (A) Program A85-38779 A85-38439 arbon-based tes A85-37339 arbon-based tes A85-37339 arbon-based tes A85-37339 (A85-37339 (A85-38874 for ramjet A85-39291 vortex core N85-27860 CRACKS IV N85-29325 as for linear A85-39565 of wings of N85-27831 or aircraft at N85-29686 chinique for S A85-39797

MECHANICAL PROPERTIES New materials and techniques for aircraft structures (B85800741 p 653 N85-27861 MELTING POINTS Acquisition of detailed heat transfer behavior in complex internal flow passages

- [SAE PAPER 841503] Fuel freeze point investigations
- METAL CRYSTALS

titanium allovs p 687 A85-38748 METAL FATIGUE

structures p 695 A85-38918 The effect of coatings on the thermomechanical fatigue

- p 689 A85-39744 Reaction-bonded and fiber-reinforced SiC static and
- p 672 N85-27874
- composites p 687 A85-37484

Combustion studies of metallized fuels for solid fuel ramjets

p 689 A85-39640 [AIÁA PAPER 85-1177] METAL SURFACES

Repair procedures for composite sinewave p 686 A85-37380 substructure METAL WORKING

Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors

[AIAA PAPER 84-0933] p 616 A85-39214 METEOROLOGICAL BALLOONS

Long-duration flights using MIR (infrared balloon system) --- for stratospheric study p 639 A85-38307 First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) --- balloon p 639 A85-38308

The University of Wyoming's small scientific balloon program p 639 A85-38309 METEOROLOGICAL FLIGHT

Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 **METEOROLOGICAL INSTRUMENTS**

Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket p 685 A85-38608 system Solution of certain technical problems connected with

the development of the MMR-06M meteorological rocket p 685 A85-38610 METEOROLOGICAL PARAMETERS

Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984

[DFVLR-FB-85-03] p 702 N85-28471 Contributions on the subject of longitudinal movements

of aircraft in wind shears [NASA-TM-778371 p 702 N85-29432 METEOROLOGICAL RESEARCH AIRCRAFT

Three powered salplanes as meteorological instrumentation for atmospheric boundary layer studies at DEVI B

[DFVLR-FB-84-50] p 653 N85-27862 METEOROLOGY

Developments in the area of air traffic control systems and the relation with meteorology [NLR-MP-84029-U] p 645 N85-27848

MICROCOMPUTERS Deployable Core Automated Maintenance System

(DCAMS) [AD-A153695] p 706 N85-29839

MICROPROCESSORS

The AFTI/F16 terrain-aided navigation system p 645 N85-28935 [DE85-008411] MICROSTRUCTURE

The influence of microstructure on the temperature-dependent flow properties of Ti-6AI-4V

p 687 A85-38749 Feasibility study of the welding of SiC

p 688 A85-39339 **MICROWAVE IMAGERY**

Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191 MICROWAVE LANDING SYSTEMS

GPS-based certification for the microwave landing ystem p 642 A85-37825 system Developments in the area of air traffic control systems

and the relation with meteorology [NLR-MP-84029-U] p 645 N85-27848 Evaluation of a fault tolerant system for an integrated

avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-28941 MICROWAVES

Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191 MIGRATION

The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas in order to prevent bird-aircraft collisions

p 638 A85-37542 MILITARY AIRCRAFT

- Tweety-bird replacement --- from T-37B to Fairchild p 646 A85-37945 T-46A trainer aircraft Secondary power generation system considerations for advanced aircraft
- [SAE PAPER 841604] p 650 A85-39164 United States Air Force engine damage tolerance
- requirements [AIAA PAPER 85-1209] p 665 A85-39657 Integration of vectoring nozzles in a STOL transonic tactical aircraft
- [AIAA PAPER 85-1285] p 667 A85-39699 The development of the generalized escape system
- simulation program [ASME PAPER 84-WA/DSC-20] p 651 A85-39869
- Operations research p 704 N85-28712 [B85618971 MILITARY HELICOPTERS

The evaluation of aerodynamic coefficients for projectiles fired from a bovering belicopter

projection and a contra notoring new	opici	
	p 618	A85-37203
LHX - A giant leap	p 648	A85-38438

MILITARY OPERATIONS Future of V/STOL aircraft systems A survey of

- opinions (NASA-TM-86689) p 654 N85-28937 MILITARY TECHNOLOGY
- Color CRT in the F-15 p 656 A85-38954 MILLING MACHINES
 - The application of numerical control (NC) in manufacturing wind tunnel models
- (B85800781 p 699 N85-28140 MIRAGE AIRCRAFT
- Mirage 2000 fighter combines acceleration, low-speed stability p 646 A85-38243 MIRAGE 3 AIRCRAFT

Further investigations to improve the fatigue life of the Mirage 1110 wing main span

[ARL-STRUC-TM-397] p 654 N85-28938 MISSILE CONTROL

- An evading path against 3 D obstacles p 674 A85-38357 MISSILE TRAJECTORIES
 - A missile duel between two aircraft p 703 A85-39563

MISSION PLANNING Mission requirements and handling qualities

- p 680 N85-28918 MODELS
- Airport and airway system cost allocation model Volume User's manual
- [AD-A152877] p 683 N85-27917 MOLECULAR PHYSICS

The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101

MOMENTUM THEORY

- Families of variational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow urbomachine p 622 A85-37930
- MONOCOQUE STRUCTURES Fatigue-crack propagation in aircraft Duralumin shell
- p 695 A85-38918 structures MONTE CARLO METHOD
 - Simulation and analysis of differential GPS

p 685 A85-38546 Adding computationally efficient realism to Monte Carlo

turbulence simulation [NASA-TP-2469] p 704 N85-28708 MOUNTING

- Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing
- [AIAA PAPER 85-1286] p 631 A85-39700 MULTIVARIATE STATISTICAL ANALYSIS

Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness [AD-A152627] p 675 N85-27876

Ν

NACELLES

Repairing commercial aircraft jet engine nacelle composite structures

[SAE PAPER 841567] p 616 A85-39068 Development of an active laminar flow nacelle [AIAA PAPER 85-1116] p 629 A85-39613

- p 695 A85-39061
- p 690 N85-28129 (AD-A152801)
- Low temperature creep and fracture of near alpha
- Fatigue-crack propagation in aircraft Duralumin shell
- life of a single crystal turbine blade material [AIAA PAPER 85-1366] p 689
- dynamic gas turbine components [BMFT-FB-T-84-302]
- METAL MATRIX COMPOSITES Fibers for structurally reliable metal and ceramic
- METAL PROPELLANTS

NATIONAL AIRSPACE SYSTEM

Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts [AIAA PAPER 85-1281] p 631 A85-39697 NATIONAL AIRSPACE SYSTEM

National airspace review, change 1 [AD-A152369] p 644 N85-27844

NATIONAL AVIATION SYSTEM Program to support the approval of supplemental navigation aids in the National Airspace System p 644 A85-38541

NAVIER-STOKES EQUATION

Simplified implicit block-bidiagonal finite difference method for solving the Navier-Stokes equations p 695 A85-39003

External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

PNS predicted shock location and jump conditions at supersonic and hypersonic speeds --- Parabolized Navier-Stokes [AIAA PAPER 85-1407] p 632 A85-39766

- Users manual for coordinate generation code CRDSRA
- [NASA-CR-172584] p 634 N85-27824 User's manual for airfoil flow field computer code SRAIR

 [NASA-CR-172585]
 p 634
 N85-27825

 Use of quaternions in flight mechanics

 {AD-A152616}
 p 675
 N85-27875

Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects [AD-A153020] p 699 N85-28266

[AD-A153020] p 699 N85-28266 NAVIGATION Avionics data base

[AD-A152415] p 657 N85-27863 NAVIGATION AIDS

- A companson of several digital map-aided navigation techniques p 642 A85-37829 Global positioning system as a sole means for civil air
- navigation p 643 A85-37832 Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings

p 643 A85-38526 Program to support the approval of supplemental

navigation aids in the National Airspace System p 644 A85-38541 Avionics data base

[AD-A152415] p 657 N85-27863

The AFTI/F16 terrain-aided navigation system [DE85-008411] p 645 N85-28935 NAVIGATION INSTRUMENTS

Spectral analysis of optimal and suboptimal gyro monitoring filters p 696 A85-39459 NAVSTAR SATELLITES

Commercial aviation GPS Navigation Set architecture p 644 A85-38538

NAVY Combustion technology - A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763

 Navy geothermal plan

 [AD-A152478]
 p 702
 N85-28450

 NEAR WAKES
 P 702
 N85-28450

A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic flow p 619 A85-37336 NETHERI ANDS

Rotterdam Airport and the Common Market

p 641 N85-27840 OWEMA report A project study concerning the possibilities and the desirability of a east-west runway for Maastncht Airport (Netherlands) as a Euro-regional air freight center [B8476490] p 685 N85-28955

NICKEL post not sostatically

pressed powder metallurgy UDIMET 700 alloys p 686 A85-37415

NICKEL ALLOYS Progress in the utilization of an oxide-dispersion-strengthened alloy for small engine

turbine blades [SAE PAPER 841512] p 688 A85-39284

NIGHT SKY Nighttume observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526

NOISE PREDICTION (AIRCRAFT) Noise of counter-rotation propellers p 705 A85-39220

NOISE REDUCTION

Study-on the comfortability of helicopter- Flight test of acoustic noise level p 647 A85-38365 Investigation on reducing the flow noise of the 0.6 m x

0 6 m trisonic wind tunnel p 682 A85-38968 Approach to interior noise control I - Damped trim panels p 650 A85-39221 p 633 A85-39793

p 698 A85-39888

The battle against noise in industry p 705 A85-39349

Meeting the 1985 FAA noise regulations with old engines and modern acoustic technology [AIAA PAPER 85-1120] p 651 A85-39616

[AIAA PAPER 85-1120] p 651 A85-39616 Fan noise suppression in turbofan engines

[B8580076] p 671 N85-27872 NOISE SPECTRA

Power spectral density of subsonic jet noise p 704 A85-37898 NONEQUILIBRIUM FLOW

Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies

p 618 A85-37197 Density and velocity profiles in non-equilibrium laminar boundary layers in air

boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626 NONLINEAR SYSTEMS

Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-28941

NONLINEARITY

Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161 Hyperbolic phenomena in the flow of viscoelastic fluids

[AD-A153533] p 700 N85-29186 NONSTABILIZED OSCILLATION

Nonstationary deformation of structural elements and their optimization p 696 A85-39450 NONUNIFORM FLOW

Lift and drag of airfoils in nonuniform supersonic stream p618 A85-37200 A supersonic inhomogeneous flow of an ideal gas around blunted bodies p619 A85-37335

NORTHERN HEMISPHERE An alternate approach to very long duration ballooning

in the northern hemisphere p 640 A85-38316 NOSE INLETS Performance of a new nose-lip hot-air anti-icing

concept [AIAA PAPER 85-1117] p 664 A85-39614

NOSE TIPS

The wind tunnel investigation for obtaining rolling moment with small asymmetry p 674 A85-38970 NOSES (FOREBODIES)

Development of a fuselage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction [MBB/LFA34/CFK/PUB/008] p 651 N85-27851

NOZZLE DESIGN External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

Study of an asymmetric flap nozzle as a thrust-vectoring device p 629 A85-39582

Performance charactenstics of rectangular and circular thrust augmenting ejectors [AIAA PAPER 85-1344] p 631 A85-39736

Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles

[AIAA PAPER 85-1346] p 632 A85-39738 Summary of nonaxisymmetric nozzle internal performance from the NASA Langley Static Test Facility [AIAA PAPER 85-1347] p 668 A85-39739 NOZZLE EFFICIENCY

Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle

[SAE PAPER 841540] p 627 A85-39064 The effect of the pitch of axsymmetric nozzles on the efficiency of the nozzle assembly and of the turbine stage p 660 A85-39107

NOZZLE FLOW

Interaction of twin turbulent circular jet p 617 A85-37049 Gas flow in nozzles and jets p 619 A85-37337

Computation of the thrust performance of axisymmetric nozzles p 622 A85-37332 Experiment of turbulent round jet parallel to ground

plane p 622 A85-38367 The computation of transonic nozzle flow-field by a time-dependent method p 625 A85-38963

Investigation of the effect of two endwall contours on the performance of an annular nozzle cascade [AIAA PAPER 85-1218] p 630 A85-39661

Numencal solutions of ramjet nozzle flows [AIAA PAPER 85-1270] p 631 A85-39689

The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698

 [AIAA PAPER 85-1284]
 p 651
 A85-39698

 - Performance characteristics of rectangular and circular thrust augmenting ejectors
 [AIAA PAPER 85-1344]
 p 631
 A85-39736

[AIAA PAPER 65-1344] p 631 A65-39730 Summary of nonaxisymmetric nozzle internal performance from the NASA Langley Static Test Facility [AIAA PAPER 65-1347] p 668 A85-39739

[SAE PAPER 841498] p 663 A85-39206 Development of a pneumatic thrust deflector p 663 A85-39209 [SAE PAPER 841558] NOZZLE THRUST COEFFICIENTS Study of an asymmetric flap nozzle as a thrust-vectoring p 629 A85-39582 device Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 Review of empirical and analytical specific impulse methodologies [AIAA PAPER 85-1434] p 669 A85-39776 NUMERICAL ANALYSIS Instationary dolphin flight - The optimal energy exchange between a sailplane and vertical currents in the

Results of AGARD assessment of prediction capabilities

Influence of downstream distance on simplex atomizer

Recent developments in ejector design for V/STOL

atmosphere p 646 A85-37488 Numerical solution of the minimum-time flight of a glider through a thermal by use of multiple shooting methods p 638 A85-37489

NUMERICAL CONTROL

[AD-A153811]

for nozzle afterbody flows

[AIAA PAPER 85-1464]

spray charactenstics [ASME PAPER 84-WA/HT-25]

NOZZLE GEOMETRY

aurcraft

The application of numerical control (NC) in manufacturing wind tunnel models [B8580078] p 699 N85-28140

NUMERICAL STABILITY Stability of a stationary solution to the ablation

equation p 623 A85-38555 Compressor and turbine models - numerical stability and other aspects

p 673 N85-28948

0

OBSERVATION AIRCRAFT

Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984 p 702 N85-28471 [DFVLR-FB-85-03] ONBOARD DATA PROCESSING Piloted simulation of an algorithm for onboard control of time-optimal intercept [NASA-TP-2445] p 681 N85-28949 **ONE DIMENSIONAL FLOW** Accurate and efficient solutions of transonic internal flows AIAA PAPER 85-13341 p 631 A85-39729 **OPERATING TEMPERATURE** Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149 **OPERATIONS RESEARCH** Operations research (B85618971 p 704 N85-28712 **OPTICAL HETERODYNING** Terrain/wire and wirelike obstacles warning system for helicopters p 655 A85-38363 OPTICAL MEASURING INSTRUMENTS

OPTICAL MEASURING INSTRUMENTS Noncontact engine blade vibration measurements and analysis

[AIAA PAPER 85-1473] p 670 A85-39798 Optical system for measuring shadowgraph data [AD-D011642] p 705 N85-28784

OPTICAL TRACKING

Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution images p 642 A85-37830 OPTIMAL CONTROL

OPTIMAL CONTROL

Instationary dolphin flight - The optimal energy exchange between a sailplane and vertical currents in the atmosphere p 646 A85-37488 Rationalizing the choice of an actuating mechanism for

a jet drive p 661 A85-39124

New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control p 703 A85-39551

OPTIMIZATION

Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323

ORBIT TRANSFER VEHICLES

Measured and predicted vortex-in	duced lee	ward heating
on a biconic at Mach 6 and 10		•
[AIAA PAPER 85-1061]	p 621	A85-37675

ORIFICE FLOW Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices

[AIAA PAPER 85-1104] p 664 A85-39606 ORTHOTROPIC PLATES

Critical flutter parameters of orthotropic rectangular flat panels with in-plane loads p 693 A85-37192

OSCILLATIONS

- Wing tunnel investigation of dynamic stall of an NACA 0018 airfoil oscillating in pitch
- [NAE-AN-27] p 635 N85-27830 Turbulence structure in the boundary layers of an
- oscillating airfoil p 637 N85-28926 [AD-A1536311 OUTLET FLOW
- The influence of blade wakes on the performance of outwardly curved combustor pre-diffusers
- p 667 A85-39704 [AIAA PAPER 85-1291] OXYGENATION
- Jet fuel instability mechanisms
- [NASA-CR-175856] p 690 N85-28127

Ρ

P-3 AIRCRAFT

Efficiencies of multiple-input techniques for aircraft ground vibration testing

- [SAE PAPER 841575] p 682 A85-39274 P-531 HELICOPTER
- Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter [NASA-TP-2420] p 637 N85-28923

PANEL FLUTTER

- Critical flutter parameters of orthotropic rectangular flat PANEL METHOD (FLUID DYNAMICS) A supersona
- A supersonic panel method based on the triplet p 617 A85-37191 singularity Substantiation of the applicability of VSAERO panel
- method to subsonic inlet design
- [AIAA PAPER 85-1119] p 629 A85-39615 A study of aerodynamic control in stalled flight leading-edge vortex formation analysis p 638 N85-28928 [AD-A153758] p 63 PARABOLIC DIFFERENTIAL EQUATIONS
- Numerical investigation of internal high-speed viscous
- flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768 PARACHUTES
- Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket p 685 A85-38608 system

PARALLEL FLOW

- Instability of plane-parallel supersonic gas flows in the p 623 A85-38551 Inear approximation
- Parameter identification results of tests in nonsteady mmetric flight with the Hawker Hunter Mk 7
- Synametric ingrit with the nawker Hunter Mk /

 [NLR-TR-83042-U]

 p 653

 N85-27860

 Identrication of gust input and gust response

 charactenistics from Do 28 TNT flight test data

 [DFVLR-FB-84-48]
 p 676

 N85-27881
- [DFVLR-FB-84-48] p 676 M85-27881 Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles (AD_45202)
- p 699 N85-28328 [AD-A153039] PARAMETERIZATION
- The static aeroelasticity of a composite wing p 701 N85-29321 PARTICLE SIZE DISTRIBUTION
- An investigation into the soot production processes in a gas turbine engine
- p 690 N85-27992 [AD-A152710] PARTICLE TRAJECTORIES
- Development of an advanced vaneless inlet particle
- eparator for helicopter engines p 666 A85-39694 [AIAA PAPER 85-1277]

PASSENGER AIRCRAFT

Who needs advanced-technology airliners? p 647 A85-38434

PASSENGERS

- Air traffic Instruments, airports, companies, post, cargo p 641 N85-28932 and passengers
- Assuring payload security in flight and recovery Design approaches and flight experience p 640 A85-38315
- PDP 11 COMPUTER Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data
- acquisition and processing system [DFVLR-MITT-85-03] p 684 N85-27921
- PERFORMANCE PREDICTION
- Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level p 658 A85-37567 programmed loading Hovercraft skirt design and manufacture
- p 694 A85-38233
- Redundancy management in strapdown navigation vstems p 644 A85-38530 systems An aerodynamic performance model for hybrid heavy
- lift systems [AIAA PAPER 85-0865] p 648 A85-38781

- Performance of a new nose-lip hot-air anti-icing concept
- [AIAA PAPER 85-1117] p 664 A85-39614 Performance characteristics of rectangular and circular thrust augmenting ejectors
- [AIAA PAPER 85-1344] p 631 A85-39736 Modeling post-stall operation of aircraft gas turbine engines
- [AIAA PAPER 85-1431] p 669 A85-39775 Mission requirements and handling qualities

p 680 N85-28918

- PERFORMANCE TESTS
 - Instrumentation for gas turbine research in short-duration facilities
- p 695 A85-39062 [SAE PAPER 841504] Drive system development for Propfan Test Assessment
- [AIAA PAPER 85-1188] p 664 A85-39646 An assessment of the suitability of the BHGA structural test ng for aerodynamic testing of hang gliders [CA-8505] p 652 N85-27853
- [CA-85051 Rotorcraft research testing in the National Full-Scale Aerodynamics Complex at NASA Ames Research Center
- [NASA-TM-86687] p 652 N85-27854 Testing of materials and coatings for jet engine components under simulated operational conditions
- [B8580073] p 672 N85-27873 Field test report of the Department of Energy's 100-kW vertical axis wind turbine
- [DE85-008475] p 702 N85-28458 PERTURBATION
- Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness [AD-A152627] p 675 N85-27876
- Supersonic flow around blunt wedge p 636 N85-28158
- PERTURBATION THEORY
- First-order feedback strategies for variable speed planar p 703 A85-37198 pursuit-evasion games PESTICIDES
- Chemical preparations for protecting aircraft against p 638 A85-37541 birds PIEZOELECTRIC TRANSDUCERS
- Description and test methods for a frequency output p 694 A85-38536 accelerometer
- PILOT PERFORMANCE The Command Flight Path Display - All weather, all missions p 656 A85-38959 Toward a unifying theory for aircraft handling qualities
- p 651 A85-39554 The use of flight simulators in measuring and improving raining effectiveness
- p 684 N85-28954 (AD-A1538171 PILOTLESS AIRCRAFT
- Propellant options for long duration, high altitude unmanned aircraft
- [AIAA PAPER 85-1326] p 689 A85-39727 PILOTS (PERSONNEL)
- Aspects of application of ACT systems for pilot workload alleviation p 677 N85-27887 PIPES (TUBES)
- Computer aided tube routing design in aircrafts p 615 A85-37183
- PITCH (INCLINATION)
- Dynamic overshoot of the static stall angle p 628 A85-39225 Wing tunnel investigation of dynamic stall of an NACA
- 0018 arrioil oscillating in pitch (NAE-AN-27) p 635 N85-27830 Proposals for the determination of necessary elevator
- handling characteristics of sailplanes in high speed range (DFVLR-FB-84-521
- p 676 N85-27882 PITOT TUBES
- Pitot pressure and heat transfer measurements in hydrazine thruster plumes [AIAA PAPER 85-0934] p 685 A85-37599
- PLANE STRAIN
- Critical flutter parameters of orthotropic rectangular flat panels with in-plane loads p 693 A85-37192 PLANE WAVES
- Diffraction of a single plane wave by a conical wing p 623 A85-38483
- PLASMA SPRAYING
- erosion of High-temperature plasma-spraved. yttria-stabilized zirconia in a simulated turbine Innorment [AIAA PAPER 85-1219] p 689 A85-39662
- PLASTIC AIRCRAFT STRUCTURES Improved resins for wet layup repair of advanced
- p 686 A85-37381 composite structure Natural frequencies and flight loads of composite main p 647 A85-38361 rotor blade for helicopter Wind tunnel experiments of the high-performance rotor
- blades p 622 A85-38362

POWERED LIFT AIRCRAFT

PLUMES

- Pitot pressure and heat transfer measurements in hydrazine thruster plumes
- [AIAA PAPER 85-0934] p 685 A85-37599 PNEUMATIC CONTROL
- Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A85-39209
- PNEUMATIC EQUIPMENT Air turbine starter sizing for a proper bleed source
- match [SAE PAPER 841509] p 661 A85-39153
- POLLUTION CONTROL
 - The battle against noise in industry p 705 A85-39349
- POLYCARBONATES

The limits of stratofilm

POROUS MATERIALS

and blade impellers

[NASA-TM-86713]

PORTABLE EQUIPMENT

POSTFLIGHT ANALYSIS

[AIAA PAPER 85-0874]

wing-tail-fuselage combinations

laminar separation bubble analysis

POROUS WALLS

wall

(DCAMS)

analysis

[AD-A153695]

POSITION ERRORS

POTENTIAL FLOW

AD-A1538501

POWDER METALLURGY

[BMFT-FB-T-84-303]

helicopter applications

[AIAA PAPER 85-1276]

POWERED LIFT AIRCRAFT

[SAE PAPER 841497]

[SAE PAPER 841498]

[NASA-TM-86689]

POWER EFFICIENCY

[NAL-TR-847]

POWER SPECTRA

lift systems

aucraft

oninions

[ASME PAPER 84-WA/HT-71]

POROUS BOUNDARY LAYER CONTROL

pressure gradients and the blow-off condition

- Laminated thermoplastic radome FAD-D0116641 p 691 N85-29045 POLYESTERS
- Fracture behavior of glass-cloth/polyester composite p 688 A85-39228 laminate at low temperature
- POLYETHYLENES Stratosphenc flights with large polyethylene balloons
- from equatorial latitudes p 639 A85-38304 POLYMER MATRIX COMPOSITES
- Fracture behavior of glass-cloth/polyester composite laminate at low temperature p 688 A85-39228 POLYMERIC FILMS

The transpired turbulent boundary layer in various

A companson of experimental characteristics of porous

Numerical study of porous airfoils in transonic flow

The free interaction in a supersonic flow over a porous

Deployable Core Automated Maintenance System

Applications of state estimation in aircraft flight-data

The stability of symmetrical vortices in the wake of

elliptical cylinders in confined flow p 618 A85-37194 A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors I - Axial flow,

stream function formulation p 622 A85-37931 An application of source-panel and vortex methods for

A second-order approximate method for transonic

small-disturbance potential flow and its application to the

analysis of flows over airfoils p 625 A85-38922 Multigrid calculation of transonic flow past

A study of aerodynamic control in stalled flight long

The substitution of nickel for cobalt in hot isostatically

Aircraft preliminary design comparison of advanced

compound engines with advanced turbine engines for

On power effectent operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory

Circulation control technology applied to propulsive high

Recent developments in ejector design for V/STOL

Future of V/STOL aircraft systems A survey of

Power spectral density of subsonic let noise

Preparation of sinteractive silicon nitride powders

aerodynamic solutions of airship configurations

pressed powder metallurgy UDIMET 700 alloys

Simulation and analysis of differential GPS

p 646 A85-38302

p 698 A85-39899

p 660 A85-39120

p 635 N85-27828

p 626 A85-39021

p 706 N85-29839

p 685 A85-38546

p 650 A85-39211

p 624 A85-38789

p 628 A85-39216

p 638 N85-28930

p 686 A85-37415

p 691 N85-29066

p 666 A85-39693

p 684 N85-28953

p 704 A85-37898

p 627 A85-39205

p 663 A85-39206

p 654 N85-28937

A-23

PRECIPITATION HARDENING PRECIPITATION HARDENING utilization of Progress the an ហ oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284 PREDICTION ANALYSIS TECHNIQUES The effects of surface discontinuities on convective hear transfer in hypersonic flow p 620 A85-37621 [AIAA PAPER 85-0971] Correlation and prediction of rotating stall inception by divergence method p 629 A85-39245 Predictions and measurements of isothermal flowfields in axisymmetric combustor geometries p 671 N85-27867 [NASA-CR-174916] Improved statistical analysis method for prediction of maximum inlet distortion [AD-A153767] p 673 N85-28947 PREPARATION Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-2 p 691 N85-29066 PREPROCESSING A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928 PRESSURE A study of aerodynamic control in stalled flight leading-edge vortex formation analysis p 638 N85-28928 [AD-A153758] PRESSURE DISTRIBUTION The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966 Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft [SAE PAPER 841543] p 649 A85-39066 Computational/experimental pressure distributions on a transonic, low-aspect-ratio wing ansonic, low-aspect-ratio wing p 628 A85-39210 The flow past two cylinders having different diameters p 696 A85-39240 Aerodynamic research in preparation for a new Dutch transport aircraft with supercritical wings p 636 N85-27836 [B8580077] Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects p 699 N85-28266 [AD-A153020] PRESSURE MEASUREMENT Pitot pressure and heat transfer measurements in hydrazine thruster plumes [AIAA PAPER 85-0934] p 685 A85-37599 Approximate relationships for determining pressure at the surface of a sphere or a cylinder for free-stream Mach numbers p 624 A85-38563 Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39663 Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds [DFVLR-FB-84-49] p 636 p 636 N85-27837 PRESSURE OSCILLATIONS Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle [SAE PAPER 841540] p 627 A85-39064 Effects of inlet pressure fluctuations on axial flow compressors - Some experimental and theoretical results [AIAA PAPER 85-1135] p 696 A85-39619 State of the art and research needs of pulsating combustion [ASME PAPER 84-WA/NCA-19] p 690 A85-39913 PRESSURIZED CABINS Crack propagation analysis of longitudinal skin cracks p 645 A85-37188 in a pressurized cabin PRESTRESSING Pretwist and shear flexibility in the vibrations of turbine p 657 A85-37233 blades PRODUCT DEVELOPMENT Derivative T56 engine development experience [AIAA PAPER 85-1459] p 670 A8 p 670 A85-39790

- Development of a fusetage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction p 651 N85-27851 [MBB/LFA34/CFK/PUB/008] Ceramic turbochargers A case study of a near-term application of high-strength ceramics [DE85-006495] p 700 N85-28379
- PRODUCTION ENGINEERING Methods for the assembly of aircraft structures p 616 A85-38641 Russian book
- Integral profile method for production of carbon fiber [MBB/LFA34/CFK/PUB/006] p 690 N85-27975

Automated maintenance system test program increment VI production scheduling p 706 N85-29838 [AD-A153694]

p 705 N85-28871

PROJECT MANAGEMENT

Technical services at NLR

(B8561898)

PROJECT PLANNING High Endurance Lighter Than Air (HELTA) Program [AIAA PAPER 85-0861] p 640 A85-38779

PROJECTILES The evaluation of aerodynamic coefficients for

projectiles fired from a hovering helicopter p 618 A85-37203 **PROP-FAN TECHNOLOGY**

Engine inlet interaction with a prop-fan propulsion system

- [SAE PAPER 841478] p 627 A85-39058 Noise of counter-rotation propellers p 705 A85-39220
- Advanced single-rotation propfan drive system p 663 A85-39577

Drive system development for Propfan Test Assessment Program

[AIAA PAPER 85-1188] p 664 A85-39646 Future prop-fans - Tractor or pusher

(AIAA PAPER 85-1189) p 664 A85-39647 PROPANE

Propellant options for long duration, high altitude unmanned aircraft

[AIAA PAPER 85-1326] p 689 A85-39727 **PROPELLANT PROPERTIES**

Propellant options for long duration, high altitude unmanned aircraft p 689 A85-39727

[AIAA PAPER 85-1326] PROPELLER DRIVE

Advanced single-rotation propfan drive system p 663 A85-39577

Drive system development for Propfan Test Assessment Program

[AIAA PAPER 85-1188] p 664 A85-39646 PROPELLER EFFICIENCY

Drive system development for Propfan Test Assessment Program

[AIAA PAPER 85-1188] p 664 A85-39646

Future prop-fans - Tractor or pusher [AIAA PAPER 85-1189] p 664 A85-39647 Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing

[AIAA PAPER 85-1286] p 631 A85-39700 PROPELLER FANS

- Advanced single-rotation propfan drive system p 663 A85-39577
- PROPELLER SLIPSTREAMS On the modelling of a fully-relaxed propeller slipstream
- [AIAA PAPER 85-1262] p 630 A85-39685 PROPELLERS

A review of some recent U K propeller developments (AIAA PAPER 85-1261) p 666 A85-39684 PROPULSION SYSTEM CONFIGURATIONS

Advances in aerospace propulsion, Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 p 659 A85-39057

[SAE SP-594] Engine inlet interaction with a prop-fan propulsion system

p 627 A85-39058 [SAE PAPER 841478] Aerodynamic test results for a wing-mounted turboprop propulsion installation

- [SAE PAPER 841480] p 627 A85-39060 Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aucraft
- [SAE PAPER 841543] p 649 A85-39066 Model test results of the split-fan cross-ducted propulsion system concept for medium speed V/STOL aurcraft
- [SAE PAPER 841495] p 663 A85-39203 Series flow tandem fan - A high-speed V/STOL propulsion concept
- [SAE PAPER 841496] p 650 A85-39204 Future prop-fans - Tractor or pusher

[AIAA PAPER 85-1189] p 664 A85-39647 Supportability considerations for advanced engine development

[AIAA PAPER 85-1205] p 665 A85-39655 Development and evaluation of an integrated flight and propulsion control system

- p 669 A85-39771 [AIAA PAPER 85-1423] The integration of a new concept in VTOL aircraft proputsion
- [AIAA PAPER 85-1448] p 651 A85-39785 Future fundamental combustion research for aeropropulsion systems [NASA-TM-87049]
 - p 671 N85-27870

The STOL and maneuver technology program integrated control system development p 680 N85-27910 PROPULSION SYSTEM PERFORMANCE

- From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p Future prop-fans - Tractor or pusher p 682 A85-39243
- [AIAA PAPER 85-1189] p 664 A85-39647 Supportability considerations for advanced engine development

[AIAA PAPER 85-1205] p 665 A85-39655 Secondary power unit options for advanced fighter

- aucraft [AIAA PAPER 85-1280] p 666 A85-39696 Modeling post-stall operation of aircraft gas turbine
- engines [AIAA PAPER 85-1431] p 669 A85-39775
- Propulsion influences on air combat [AIAA PAPER 85-1457] p 651 A85-39789

Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914

- PROPULSIVE EFFICIENCY
- The unducted fan engine [AIAA PAPER 85-1190] p 665 A85-39648
- Propulsion efficiency of vibrating bodies in subsonic gas p 699 N85-28159 stream PROTECTIVE COATINGS
- The effect of coatings on the thermomechanical fatigue life of a single crystal turbine blade material
- [AIAA PAPER 85-1366] p 689 A85-39744
- Testing of materials and coatings for jet engine components under simulated operational conditions [B8580073] p 672 N85-27873
- Ceramic coatings for heat engine materials Status and future needs
- [DE85-008759] p 691 N85-29053 Ceramic coatings for heat engine materials [DE85-005238] p 691 N85-29054
- PULSEJET ENGINES State of the art and research needs of pulsating
- combustion ASME PAPER 84-WA/NCA-191 p 690 A85-39913
- PUMP IMPELLERS A companson of experimental characteristics of porous
- and blade impellers p 660 A85-39120 PURSUIT TRACKING
- First-order feedback strategies for variable speed planar p 703 A85 37198 pursuit-evasion games .

Q

QUALITY CONTROL

- Aircraft service testing of ultrasonically welded panels p 646 A85-37408
- Application of technology to achieve value Added in-service support --- of jet engines [SAE PAPER 841566]
- p 659 A85-39067 QUARTZ CRYSTALS
- Description and test methods for a frequency output p 694 A85-38536 accelerometer QUATERNIONS
 - Use of quaternions in flight mechanics
- [AD-A152616] p 675 N85-27875

R

- RADAR APPROACH CONTROL
 - Investigation of imaging and flight guidance concepts for rotorcraft zero visibility approach and landing [NASA-CR-166571] p 644 N8
 - p 644 N85-27843
 - for rotorcraft zero visibility approach and landing

RADAR NAVIGATION

(OAS) with the Global Positioning System (GPS)

RADAR TRACKING

Observation of birds in the flight path of aircraft - An important stage in the prevention of bird strikes p 639 A85-37544

Algorithms for improved, heading assisted, maneuver tracking p 644 A85-39458 RADIAL FLOW

Transonic flow in the throat region of radial or nearly p 626 A85-39001 radial supersonic nozzles Flowfield and performance measurements in a vaned adial diffuse

[ASME PAPER 84-WA/FM-7] p 634 A85-39876 RADIANT FLUX DENSITY

Further observations of X-rays inside thunderstorms p 701 A85-37720

- - RADAR IMAGERY Investigation of imaging and flight guidance concepts

[NASA-CR-166571] p 644 N85-27843

Integration of the B-52G Offensive Avionics System p 685 A85-38545

Microwave responses of the we [NASA-CR-175888]		orth Atlantic N85-28191
RADIATION MEASUREMENT		
Flame radiation and liner heat tran combustor RADIATIVE TRANSFER		A85-39580
Radiative transfer in a gas turbine		
[AIAA PAPER 85-1072]	p 658	A85-37682
RADIO ANTENNAS The Tethered Aerostat Antenn	a Progr	am (TAAP)
demonstration phase	_	
[AIAA PAPER 85-0883] RADIO NAVIGATION	p 616	A85-38797
Evaluation of radionavigation syste	ems	
0 · • · • · · · · · · · · · · · · · · ·	p 643	A85-37831
RADIOMETERS Attitude determination in a limit	b-scann	ing balloon
radiometer		A85-38319
RADOME MATERIALS Laminated thermoplastic radome		
[AD-D011664]	p 691	N85-29045
RADOMES		
Laminated thermoplastic radome [AD-D011664]	p 691	N85-29045
RAIN	•	
Laminated thermoplastic radome [AD-D011664]	D 601	N85-29045
RAMJET ENGINES	P 431	
	naterials	for ramjet
engines Interaction between acoustics and	p 686 subsonic	
in a ramjet configuration	p 704	A85-37209
Combustion studies of metallized	l fuels fo	or solid fuel
ramjets [AIAA PAPER 85-1177]	p 689	A85-39640
Numerical solutions of ramjet noz	zle flows	
[AIAA PAPER 85-1270] RANDOM VIBRATION	p 631	A85-39689
Efficiencies of multiple-input te	chniques	s for aircraft
ground vibration testing {SAE PAPER 841575}	n 600	A85-39274
RAREFIED GAS DYNAMICS	h 005	A03-39214
The drag of simple shaped bo	dies in 1	the rarefied
hypersonic flow regime [AIAA PAPER 85-0998]	p 621	A85-37642
Hypersonic gas dynamics		
[AIAA PAPER 85-0999] The effect of the bluntness shape of		A85-37643
of a body in hypersonic flow of a rai		S
REACTION PRODUCTS	p 624	A85-38564
Radiative transfer in a gas turbine		
{AIAA PAPER 85-1072} REAL TIME OPERATION	p 658	A85-37682
Data processing on the rotor tes		
Brunswick Microprogrammable		
processor as key components in a f acquisition and processing system		
[DFVLR-MITT-85-03] REATTACHED FLOW	p 684	N85-27921
Flow separation from the leading	edge of a	an airfoil and
the effect of acoustic perturbation	s on the	e separated
flow RECIRCULATIVE FLUID FLOW	p 094	A85-38510
Influence of the blockage ratio on	the effic	iency of swirl
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103]		iency of swirl A85-39605
Influence of the blockage ratio on generation with vane swirters [AIAA PAPER 85-1103] RECTANGULAR PANELS	p 696	A85-39605
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads	p 696	A85-39605
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS	р 696 tropic re р 693	A85-39605 ctangular flat A85-37192
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s	p 696 tropic ree p 693 iideslip li p 623	A85-39605 ctangular flat A85-37192 A85-38371
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilever	p 696 stropic re- p 693 sideslip 1 p 623 red recta	A85-39605 ctangular flat A85-37192 A85-38371
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s	p 696 tropic re- p 693 ideslip 1 p 623 red recta analysis	A85-39605 ctangular flat A85-37192 A85-38371
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilever wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY	p 696 htropic rei p 693 htdeslip li p 623 red recta analysis p 681	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilever wing Wind tunnel experiment and [NAK-TR-86]	p 696 tropic rei p 693 ideslip li p 623 red recta analysis p 681 strapdow	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of orthon panels with in-plane loads RECTANGULAR WINGS Cf Beta of unswept flat wings in s Gust load alleviation of a cantilever wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS	p 696 tropic rei p 693 tideslip II p 623 red recta analysis p 681 strapdow p 644	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Air transport deregulation - The L	p 696 tropic re- p 693 ideslip li p 623 red recta analysis p 681 strapdow p 644 JS exper	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 ence and its
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of orthon panels with in-plane loads RECTANGULAR WINGS Cf Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Arr transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula	p 696 htropic rea p 693 ideslip I p 623 red recta analysis p 681 strapdow p 644 JS exper p 705	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 eence and its A85-39369
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Air transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula and modern acoustic technology	p 696 tropic re- p 693 tideslip li p 623 red recta analysis p 681 strapdow p 644 JS exper p 705 ations wit	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 hence and its A85-39369 h old engines
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of orthon panels with in-plane loads RECTANGULAR WINGS Cf Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Air transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula and modern acoustic technology [AIAA PAPER 85-1120] REGULATORS	p 696 stropic rei p 693 ideslip li p 623 red recta analysis p 681 strapdow p 644 JS exper p 705 ations wit p 651	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 Hence and its A85-39616
Influence of the blockage ratio on generation with vane swirfers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of orthop panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilever wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Air transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula and modern acoustic technology [AIAA PAPER 85-1120] REGULATORS Time-domain stability robustness	p 696 tropic rei p 693 ideslip li p 623 red recta analysis p 681 Strapdow p 644 JS exper p 705 ations wit p 651 s measur	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 Hence and its A85-39369 h old engines A85-39616 es for linear
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of orthon panels with in-plane loads RECTANGULAR WINGS Cf Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and of [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Arr transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula and modern acoustic technology [AIAA PAPER 85-1120] REGULATORS Time-domain stability robustness regulators REINFORCING FIBERS	p 696 tropic red p 693 sideslip li p 623 red recta analysis p 681 Strapdow p 644 US exper p 705 ations wit p 651 s measur p 703	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 Hence and its A85-39369 h old engines A85-39616 es for linear A85-39565
Influence of the blockage ratio on generation with vane swirlers [AIAA PAPER 85-1103] RECTANGULAR PANELS Critical flutter parameters of ortho panels with in-plane loads RECTANGULAR WINGS CI Beta of unswept flat wings in s Gust load alleviation of a cantilevel wing Wind tunnel experiment and [NAK-TR-86] REDUNDANCY Redundancy management in systems REGULATIONS Air transport deregulation - The L applicability to Europe Meeting the 1985 FAA noise regula and modern acoustic technology [AIAA PAPER 85-1120] REGULATORS Time-domain stability robustness regulators	p 696 stropic rei p 693 sideslip li p 623 red rectai analysis p 681 strapdow p 644 JS exper p 705 ations wit p 651 s measur p 703 metal a	A85-39605 ctangular flat A85-37192 A85-38371 ngular elastic N85-28950 m navigation A85-38530 Hence and its A85-39369 h old engines A85-39616 es for linear A85-39565

composites p 687 A85-37484
RELIABILITY ANALYSIS

The ARINC 704 ring laser gyro Inertial Reference System p 643 A85-38528

Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p (p 659 A85-39069 Engineering significance of fatigue thresholds and short fatigue cracks for structural design p 700 N85-28430 [NLR-MP-84001-U] REMOTE SENSING Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 p 683 N85-27914 REMOTELY PILOTED VEHICLES Teledyne Ryan focuses R & D effort on new RPVs, target p 646 A85-38245 versions REPORTS USSR report Transportation [JPRS-UTR-84-025] p 641 N85-27841 REQUIREMENTS USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B p 652 N85-27858 [AD-A153161] **RESEARCH AIRCRAFT** X-29 digital flight control system design p 677 N85-27889 The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908 RESEARCH AND DEVELOPMENT Teledyne Ryan focuses R & D effort on new RPVs, target ersions p 646 A85-38245 Man-powered aircraft --- review p 615 A85-38353 versions Research trend in advanced technology helicopter p 647 A85-38360 The conception and development of a family of small engines for the 1990's [AIAA PAPER 85-1460] p 670 A85-39791 Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 RESEARCH MANAGEMENT Research on structural analysis at the DFVLR, runswick p 701 N85-29314 Brunswick RESISTANCE THERMOMETERS Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film technique p 681 A85-37622 [AIAA PAPER 85-0972] Dynamic behaviour of cold wires in heated airflows (T in the range from 300 to 600 K) p 694 A85-38069 p 694 A85-38069 RESONANT FREQUENCIES Local instability characteristics and frequency determination of self-excited wake flows p 623 A85-38430 RESOURCES MANAGEMENT Navy geothermal plan (AD-A152478) p 702 N85-28450 RESPONSES Controller requirements for uncoupled aircraft motion, volume 2 [AD-A153300] p 676 N85-27879 REVERSED FLOW Small gas turbine combustor study - Fuel injector performance in a transpiration-cooled liner AIAA PAPER 85-1312] p 668 A85-39717 RING LASERS The ARINC 704 nng laser gyro Inertial Reference p 643 A85-38528 System Helicopter flight test of a nng laser gyro Attitude and eading Reference System p 643 A85-38529 Heading Reference System Redundancy management in strapdown navigation systems p 644 A85-38530 RITZ AVERAGING METHOD A study of internal and distributed damping for vibrating turbomachiner blades [NASA-CR-175901] p 671 N85-27868 RIVETS Reducing the effects of rivet holes on fatigue life by adhesive bonding p 693 A85-37472 ROBOTICS Robotic dnlling of acrylic windshields and canopies for p 703 A85-37396 fighter aircraft **ROBUSTNESS (MATHEMATICS)** A multiloop robust controller design study using singular p 703 A85-39564 value gradients Time-domain stability robustness measures for linear regulators p 703 A85-39565 **ROCKET-BORNE INSTRUMENTS** Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket

system for the MMR-06-DAH i meteorological rocket system p 685 A85-38608 Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket p 685 A85-38610 ROLLING MOMENTS

The wind tunnel investigation for obtaining rolling moment with small asymmetry p 674 A85-38970

ROTOR BLADES (TURBOMACHINERY)

ROTOR BLADES (TURBOMAC	HINERY)
Experimental and theoretical determin wing-induced lateral wind on the tail surfaces	in oscillating
rolling motion Part 1 Application of the Mobi Derivatives (MOD) on an experimental part	le Oscillating
[IFD-1/84-PT-1] p 654 ROTARY WING AIRCRAFT	N85-28939
Rotorcraft research testing in the Nation Aerodynamics Complex at NASA Ame	
Center [NASA-TM-86687] p 652 ROTARY WINGS	N85-27854
Rotary-wing aerodynamics Volume 1 - B	asic theories
of rotor aerodynamics (With application to Volume 2 Performance prediction of helic revised and enlarged edition) Book	copters (2nd
p 617 A new unsteady prescribed wake m	
aerodynamic behavior of a rotor in forward 1 p 617	
Natural frequencies and flight loads of co	mposite main
rotor blade for helicopter p 647 Wind tunnel experiments of the high-perfo	
blades p 622	A85-38362
Helicopter Aeromechanics	A85-38875
[AGARD-LS-139] p 617 Rotorcraft noise p 705	
Recent developments in the dynamics of a	dvanced rotor
systems p 653 ROTATING BODIES	N85-28917
Shading and interference effects during t	he rotation of A85-38559
Correlation and prediction of rotating stall	
divergence method p 629 Stall transients of axial compression syste	A85-39245 ams with inlet
distortion [AIAA PAPER 85-1348] p 632	A85-39740
Axial-flow compressor stage post-stall an	alysis
[AIAA PAPER 85-1349] p 632 ROTATION Use of quaternions in flight mechanics	2 A85-39741
[AD-A152616] p 675 ROTOR AERODYNAMICS	N85-27875
Rotary-wing aerodynamics Volume 1 - E of rotor aerodynamics (With application to Volume 2 Performance prediction of hel	helicopters)
Wind tunnel investigation of the interaction	A85-36996 n of an airship
configuration with lifting rotors [AIAA PAPER 85-0875] p 625	
Fundamentals of the flight operations o Aerodynamics Russian book p 649	
Numerical solution of two- and three-dim	ensional rotor
tip leakage models p 626 A computational study of the unstead	A85-38989 shock-wave
structure in a two-dimensional transonic rot p 625	or A85-39578
Prospects and problems of advanced or commercial aircraft	pen rotors for
[AIAA PAPER 85-1191] p 665	5 A85-39649
The influence of blade wakes on the pe outwardly curved combustor pre-diffusers	
[AIAA PAPER 85-1291] p 667 Helicopter Aeromechanics	7 A85-39704
[AGARD-LS-139] p 617	N85-28913
A survey of recent development aerodynamics p 653	
Rotorcraft noise p 705 Recent developments in the dynamics of a	
systems p 653 ROTOR BLADES	
Natural frequencies and flight loads of co	
rotor blade for helicopter p 643 Wind tunnel experiments of the high-perfi	7 A85-38361 ormance rotor
	2 A85-38362
Quasi-three-dimensional blade design co	
p 622 Development in UK rotor blade technolog p 615	у
Time resolved measurements of a stationary tip casing pressure and heat tran	turbine rotor
[AIAA PAPER 85-1220] p 666	6 A85-39663
Stall transients of axial compression syst distortion	ems with inlet
[AIAA PAPER 85-1348] p 632	
Calculation of three-dimensional, viscous turbomachinery blade passages by parat	
	2 A85-39767

Development of a noninterference technique for measuring turbine engine rotor blade stresses [AIAA PAPER 85-1472] p 697 A85-39797

A-25

Ice shapes and the resulting drag increase for a NACA 0012 airfoil [NASA-TM-83556] p 641 N85-27839

- A survey of recent development in helicopter aerodynamics p 653 N85-28915
- ROTORCRAFT AIRCRAFT Vanable cycle turboshaft technology for rotor-craft of the 90's
- [AIAA PAPER 85-1278] p 666 A85-39695 ROTORS
- Vibrations of rotors connected through couplings with backlash p 672 N85-28147 RUNGE-KUTTA METHOD
- Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines [AIAA PAPER 85-1332] p 631 A85-39728
- RUNWAYS OWEMA report. A project study concerning the possibilities and the desirability of a east-west runway for Maastricht Airport (Netherlands) as a Euro-regional air freight center
- [B8476490] p 685 N85-28955

S

S-61 HELICOPTER

- Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364 SCALE MODELS
- Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter [NASA-TP-2420] p 637 N85-28923
- SCANNERS Attitude determination in a limb-scanning balloon
- radiometer p 655 A85-38319 SCHEDULING
- Automated maintenance system test program increment VI production scheduling [AD-A153694] p 706 N85-29838
- Stats (STOPPERS)
 p roor noscoso

 High-temperature
 erosion
 of plasma-sprayed,

 yttma-stabilized
 zirconia
 in
 a simulated
 turbine

 environment
 [AIAA PAPER 85-1219]
 p 689
 A85-39662
- Spacer structure
 p 670
 N85-27666
- SECONDARY RADAR Developments in the area of air traffic control systems and the relation with meteorology
- [NLR-MP-84029-U] p 645 N85-27848 SELF EXCITATION
- Local instability characteristics and frequency determination of self-excited wake flows p 623 A85-38430
- SELF OSCILLATION Charactenstics of the oscillations of a tail unit in a flow of an incompressible gas p 649 A85-39125
- SENSORS Integration of sensor and display subsystems p 656 A85-38955
- SEPARATED FLOW Investigation of three-dimensional separated flows p 619 A85-37338 Experimental research on the effect of separation flow
- on ablation in supersonic turbulent flow [AIAA PAPER 85-0975] p 694 A85-37625 CI Beta of unswept flat wings in sideslip II
- p 623 A85-38371 The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966
- Numerical and experimental determination of secondary separation on delta wings in subsonic flow p 628 A85-39219
- Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161 Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects
- [AD-A153020] p 699 N85-28266 SEPARATORS Development of an advanced vaneless inlet particle
- Separator for helicopter engines [AIAA PAPER 85-1277] p 666 A85-39694
- SERVICE LIFE Determination of the optimum lubricant change period for the joints of the landing gear of aircraft
- p 695 A85-38600 Acquisition of detailed heat transfer behavior in complex internal flow passages
- [SAE PAPER 841503] - p 695 A85-39061 Usage monitoring - A milestone in engine life management
- [AIAA PAPER 85-1206] p 665 A85-39656

- SHADOWGRAPH PHOTOGRAPHY
- Optical system for measuring shadowgraph data [AD-D011642] p 705 N85-28784
- SHAFTS (MACHINE ELEMENTS) Critical speed testing of the Grumman X-29A power
- take-off shaft subsystem [SAE PAPER 841603] p 662 A85-39163 SHARP LEADING EDGES
- The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966
- SHEAR STRESS Pretwist and shear flexibility in the vibrations of turbine blades p 657 A85-37233
- SHOCK DISCONTINUITY Configuration of shock waves closing a local supersonic
- zone p 623 A85-38481 Characteristics of steady-state hypersonic flow about blunted bodies with discontinuities in generators
- p 636 NB5-2B155 SHOCK TUBES
- Investigation of heat transfer to a turbine blade cascade using a shock tube [AD-A153090] p 671 N85-27871
- (ALA153090) p 671 N65-27671 Charactenstics of steady-state hypersonic flow about blunted bodies with discontinuities in generators p 636 N85-28155
- SHOCK TUNNELS
- Shock tunnel measurements of heat transfer in a model scramjet
- [AIAA PAPER 85-0908] p 658 A85-37582 Hypersonic gas dynamics
- [AIAA PAPER 85-0999] p 621 A85-37643 Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock tunnel p 695 A85-38973
- SHOCK WAVE INTERACTION Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins
- p 626 A85-38984 Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location [ASME PAPER 84-WA/HT-70] p 698 A85-39898
- SHOCK WAVE PROFILES Configuration of shock waves closing a local supersonic
- zone p 623 A85-38481 SHOCK WAVE PROPAGATION
- Supersonic flow around blunt wedge
- p 636 N85-28158
- A system of shock and rarefaction waves in flows past bodies with complex shapes p 618 A85-37330 The isolated nature of solutions with a strong attached
- shock wave at the edges of a conical wing and a wedge p 623 A85-38488 A computational study of the unsteady shock-wave
- structure in a two-dimensional transonic rotor 0 629 A85-39578
- Accurate and efficient solutions of transonic internal flows
- [AIAA PAPER 85-1334] p 631 A85-39729 Charactenstics of steady-state hypersonic flow about blunted bodies with discontinuities in generators
- p 636 N85-28155 SHORT TAKEOFF AIRCRAFT
 - Development of a pneumatic thrust deflector
 - [SAE PAPER 841558] p 663 A85-39209 Integration of vectoring nozzles in a STOL transonic tactical aircraft
 - [AIAA PAPER 85-1285] p 667 A85-39699 Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness
 - [AD-A152627] p 675 N85-27876 The STOL and maneuver technology program integrated
- control system development p 680 N85-27910 SHROUDED TURBINES Time resolved measurements of a turbine rotor
- stationary tip casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39663 SIDESLIP
- An extension of the generalized vortex-lattice method of supersonic sideslipping wings p 626 A85-38972 SIGNAL DETECTION
- Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191 SILICON CARBIDES
- Fibers for structurally reliable metai and ceramic composites p 687 A85-37484 Feasibility study of the welding of SiC
- p 688 A85-39339 Reaction-bonded and fiber-reinforced SiC static and
- dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874 SILICON NITRIDES
- Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066

SIMILARITY THEOREM

- Similarity properties in the problem of flow from a supersonic source past a spherical bluntness p 629 A85-39445 SIMULATION Simulation of wake passing in a stationary turbine rotor p 629 A85-39589 cascade The evolution of ACS for helicopters Conceptual simulation studies to preliminary design p 677 N85-27890 Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 SIMULATORS The gust simulation apparatus of the 3m x 3m low speed and tunnel of the DFVLR in Goettingen, West Germany IDEVLR-FB-85-041 p 684 N85-27920 SINGLE CRYSTALS The effect of coatings on the thermomechanical fatigue life of a single crystal turbine blade material [AIAA PAPER 85-1366] p 689 A85-39744 SINGULARITY (MATHEMATICS) A supersonic panel method based on the triplet singularity p 617 A85-37191 An investigation of lift augmentation of tandem [ASME PAPER 84-WA/FM-3] p 633 A85-39875 SINTERING Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874 SIZE (DIMENSIONS) Air turbine starter sizing for a proper bleed source match [SAE PAPER 841509] p 661 A85-39153 SKIN (STRUCTURAL MEMBER) Crack propagation analysis of longitudinal skin cracks p 645 A85-37188 in a pressurized cabin Finction and wear behavior of aluminum and composite I-beam stiffened airplane skins p 652 N85-27852 [NASA-TM-86418] Laminated thermoplastic radome [AD-D011664] p 691 N85-29045 SKIRTS Hovercraft skirt design and manufacture p 694 A85-38233 SLENDER WINGS The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966 Winglet effects on the flutter of a twin-engine transport-type wing p 650 A85-39217 Aerodynamic performance of a wing in ground effect using the PANAIR program p 635 N85-27832 [AD-A153303] SLIPSTREAMS Characteristics of a two-dimensional turbulent jet in a p 695 A85-39131 bounded slipstream SLOTTED WIND TUNNELS Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds p 628 A85-39241 SLURRY PROPELLANTS Boron slurry fuel atomization evaluation [AIAA PAPER 85-1184] p 689 A85-39645 SMALL PERTURBATION FLOW Determination of aerodynamic characteristics of bodies in weakly perturbed gas flows p 619 A85-37341 A second-order approximate method for transonic small-disturbance potential flow and its application to the p 625 A85-38922 analysis of flows over airfoils SOFTWARE TOOLS The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 engines The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion p 661 A85-39122 chambers The interactive generation of specifications for an onboard software series (GISELE) p 679 N85-27906 SOLAR POWERED AIRCRAFT Starduster - A solar powered high altitude airplane [AIAA PAPER 85-1449] p 651 A85-39786 SOLENOIDS Effect of superconducting solenoid model cores on spanwise iron magnet roll control [NASA-TM-86378] p 683 N85-27915
- SOOT An investigation into the soot production processes in
- a gas turbine engine [AD-A152710] p 690 N85-27992
- SOUND GENERATORS

Aerodynamic sound generation caused by viscous processes p 705 A85-38432

- SUBJECT INDEX SOUNDING ROCKETS Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket system p 685 A85-38608 Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket p 685 A85-38610 SOUTH KOREA Korea's air transport - Planned expansion p 681 A85-37949 SPACE SHUTTLES Heating parameter estimation usina coaxial thermocouple gages in wind tunnel test articles p 699 N85-28328 [AD-A1530391 SPACECRAFT CONTROL New concepts in control theory, 1959-1984 (Dryden Lectureship in Research) --- for aerospace flight control p 703 A85-39551 SPACERS Spacer structure p 670 N85-27866 [AD-D011641] SPECIFIC IMPULSE Review of empirical and analytical specific impulse methodologies [AIAA PAPER 85-1434] p 669 A85-39776 SPECIFICATIONS Avionics data base [AD-A152415] p 657 N85-27863 The interactive generation of specifications for an onboard software series (GISELE) p 679 N85-27906 SPECTRUM ANALYSIS Power spectral density of subsonic let noise p 704 A85-37898 Spectral analysis of optimal and suboptimal gyro p 696 A85-39459 monitoring filters SPHERES Approximate relationships for determining pressure at surface of a sphere or a cylinder for arbitrary free-stream Mach numbers p 624 A85-38563 SPIN DYNAMICS Use of quaternions in flight mechanics [AD-A152616] p 675 N85-27875 SPRAY CHARACTERISTICS Influence of downstream distance on simplex atomizer spray characteristics p 698 A85-39888 [ASME PAPER 84-WA/HT-25] STABILITY DERIVATIVES Dynamic characteristics of the STARS aerostat [AIAA PAPER 85-0880] p 674 A85-38795 STAGNATION POINT Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623 STALLING Modeling post-stall operation of aircraft gas turbine engines [AIAA PAPER 85-1431] p 669 A85-39775 STANDARDIZATION An argument for standardization in modern aircraft crew p 657 A85-38961 stations STAR TRACKERS An automatic navigation and aspect sensing system for p 643 A85-38314 X-ray astronomy STARTING Control of fuel during starting of a gas turbine (SAE PAPER 841511) p 661 A85-39155 STATE ESTIMATION Applications of state estimation in aircraft flight-data analysis p 650 A85-39211 STATE VECTORS Slow and fast state variables for three-dimensional flight p 675 A85-39567 dynamics STATIC DEFORMATION The static aeroelasticity of a composite wing p 701 N85-29321 STATIC STABILITY Demonstration of relaxed static stability on a commercial transport p 679 N85-27898 Realisation of relaxed static stability on a commercial p 679 N85-27899 transport STATIC TESTS Summary of nonaxisymmetric nozzle internal performance from the NASA Langley Static Test Facility [AIAA PAPER 85-1347] p 668 A85-39739 Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles [NASA-TP-2432] p 637 N85-28924 STATISTICAL ANALYSIS Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p 659 A85-39069
 - Review of empirical and analytical specific impulse nethodologies p 669 A85-39776 (AIAA PAPER 85-14341

Improved statistical analysis method for prediction of maximum inlet distortion

- p 673 N85-28947 [AD-A153767] STATOR BLADES
- Cantilevered stator vane tip leakage studies p 664 A85-39620 [AIAA PAPER 85-1136] STATORS
- Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment p 697 A85-39796 [AIAA PAPER 85-1471] Spacer structure
- p 670 N85-27866 [AD-D011641] STEADY FLOW
- Accurate and efficient solutions of transonic internal flows [AIAA PAPER 85-1334] p 631 A85-39729
- Upwind-difference methods for aerodynamic problems governed by the Euler equations p 635 N85-27834
- [REPT-84-23] Method of calculating separation flow of subsonic gas p 636 N85-28161 stream around wings STIFFNESS
- Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177
- Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins [NASA-TM-86418]
- p 652 N85-27852 STIFFNESS MATRIX
- Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element
- p 696 A85-39170 STRAPDOWN INERTIAL GUIDANCE
- Autocalibration of a laser gyro strapdown inertial reference/navigation system p 642 A85-37808 Institute of Navigation, National Technical Meeting, San Diego, CA, January 17-19, 1984, Proceedings p 643 A85-38526
- Redundancy management in strapdown havigation p 644 A85-38530 systems STRATOSPHERE
 - Stratosphenc flights with large polyethylene balloons from equatorial latitudes p 639 A85-38304 First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) --- balloon
- p 639 A85-38308 The University of Wyoming's small scientific balloon p 639 A85-38309 program A new reeling technique for very long extension scanning p 640 A85-38312 in the stratosphere
- STREAM FUNCTIONS (FLUIDS) Flow-field matrix solution for flow along arbitrarily twisted
- **S1** surface employing non-orthogonal curvilinear p 622 A85-37927 coordinates STRESS CONCENTRATION
- The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 STRESS INTENSITY FACTORS
 - Crack growth analysis in multiple load path structure p 693 A85-37186 The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575
- STRESS MEASUREMENT Development of a noninterference technique for measuring turbine engine rotor blade stresses
- p 697 A85-39797 [AIAA PAPER 85-1472] STRESS RELIEVING External caps - An approach to stress reduction in
- p 647 A85-38306 halloons STRUCTURAL ANALYSIS
- Structural optimization --- in aircraft design p 694 A85-38352 USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft
- structures revision B [AD-A153161] p 652 N85-27858 Structural Analysis [DFVLR-MITT-84-21] p 701 N85-29313 Research on structural analysis at the DFVLR, p 701 N85-29314
- Brunswick STRUCTURAL DESIGN
- Computer aided tube routing design in aircrafts
- p 615 A85-37183 Engineering significance of fatigue thresholds and short
- fatigue cracks for structural design [N] B-MP-84001-U1 p 700 N85-28430
- STRUCTURAL DESIGN CRITERIA Structural optimization --- in aircraft design
 - p 694 A85-38352 Nonstationary deformation of structural elements and
 - their optimization p 696 A85-39450 Frangibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431
- STRUCTURAL ENGINEERING
- at the DFVLR, Research on structural analysis p 701 N85-29314 Brunswick

STRUCTURAL FAILURE

- Low temperature creep and fracture of near alpha titanium alloys p 687 A85-38748 STRUCTURAL STABILITY
- The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 Nonstationary deformation of structural elements and their optimization p 696 A85-39450
- STRUCTURAL VIBRATION
- Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures
- p 692 A85-37177 Pretwist and shear flexibility in the vibrations of turbine blades p 657 A85-37233
- Dissipative properties of inhomogeneous materials and systems --- Russian book p 687 A85-38874
- Unsteady blade row interactions in a multi-stage compressor
- [AIAA PAPER 85-1134] p 630 A85-39618 STRUCTURAL WEIGHT
 - Summary of nonaxisymmetric nozzle internal enformance from the NASA Langley Static Test Facility p 668 A85-39739 [AIAA PAPER 85-1347] SUBSONIC FLOW
 - Interaction between acoustics and subsonic ducted flow in a ramjet configuration p 704 A85-37209 Subsonic multiple-jet aerodynamic window
 - p 693 A85-37216 Power spectral density of subsonic jet noise p 704 A85-37898
 - Quasi-three-dimensional blade design code p 622 A85-37928
 - A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV Computer
 - program SOLST 1 p 622 A85-38355
 - Investigation of transonic inlet drag characteristics [SAE PAPER 841539] p 627 A85-39063
 - Numerical and experimental determination of secondary separation on delta wings in subsonic flow p 628 A85-39219
 - Substantiation of the applicability of VSAERO panel method to subsonic inlet design p 629 A85-39615
 - [AIAA PAPER 85-1119] Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility
 - p 634 N85-27823 [NASA-TP-2485] Propulsion efficiency of vibrating bodies in subsonic gas
 - p 699 N85-28159 stream Method of calculating separation flow of subsonic gas
 - p 636 N85-28161 stream around wings SUBSONIC SPEED
 - Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds
 - p 628 A85-39241 Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing
 - edge flap at subsonic and transonic speeds p 636 N85-27837 [DFVLR-FB-84-49] Subsonic and transonic aerodynamics of a wraparound
 - fin configuration [AD-A153646] p 637 N85-28927 SUBSONIC WIND TUNNELS
 - Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow SUPERCHARGERS
 - Ceramic turbochargers A case study of a near-term application of high-strength ceramics
 - [DE85-006495] Future of ceramic turbochargers p 700 N85-28379 Promises and
 - pitfalls DE85-0062091 p 700 N85-28380
 - SUPERCOMPUTERS Modelling vortex flowfields by supercomputers with
 - p 628 A85-39242 super-size memory SUPERCONDUCTING MAGNETS
 - Effect of superconducting solenoid model cores on spanwise iron magnet roll control
 - p 683 N85-27915 [NASA-TM-86378] SUPERCRITICAL FLOW
 - Numerical simulation of a supercritical inlet flow
 - p 630 A85-39658 [AIAA PAPER 85-1214] Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility
 - p 634 N85-27823 [NASA-TP-2485] Methods for design aerodynamics of modern transport
 - aircraft [DFVLR-FB-85-05] p 636 N85-27838
 - SUPERCRITICAL WINGS Companison of advanced turboprop installation on swept
 - and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686
 - Aerodynamic research in preparation for a new Dutch transport aircraft with supercritical wings p 636 N85-27836 (B85800771

SUPERCRITICAL WINGS

Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds p 636 N85-27837 [DFVLR-FB-84-49] SUPERPLASTICITY

Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors p 616 A85-39214 [AIAA PAPER 84-0933]

Precision die forging of blades or gas turbines p 672 N85-28148

SUPERSONIC AIRCRAFT Wing optimization and fuselage integration for future p 618 A85-37212 generation of supersonic aircraft V/STOL. An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984 [SAE SP-591] p 616 A85-39201

SUPERSONIC AIRFOILS

Diffraction of a single plane wave by a conical wing p 623 A85-38483 An extension of the generalized vortex-lattice method of supersonic sideslipping wings p 626 A85-38972

SUPERSONIC BOUNDARY LAYERS The separation of a turbulent boundary laver within a two-face angle before an obstruction

p 619 A85-37340 SUPERSONIC COMBUSTION RAMJET ENGINES

Shock tunnel measurements of heat transfer in a model scramiet [AIAA PAPER 85-0908] p 658 A85-37582

Numerical investigation of internal high-speed viscous flows using a parabolic technique TAIAA PAPER 85-1409] p 632 A85-39768

SUPERSONIC CRUISE AIRCRAFT RESEARCH Supersonic cruise technology

[NASA-SP-472] p 617 N85-28912 SUPERSONIC DIFFUSERS

Simplified implicit block-bidiagonal finite difference method for solving the Navier-Stokes equations p 695 A85-39003

SUPERSONIC FLIGHT Supersonic cruise technology p 617 N85-28912 (NASA-SP-472)

SUPERSONIC FLOW A supersonic panel method based on the triplet

sincularity p 617 A85-37191 Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies

o 618 A85-37197 Lift and drag of airfoils in nonuniform supersonic p 618 A85-37200 stream A system of shock and rarefaction waves in flows past

p 618 bodies with complex shapes A85-37330 A supersonic inhomogeneous flow of an ideal gas around A85-37335 blunted bodies p 619

Investigation of three-dimensional separated flows p 619 A85-37338 Determination of aerodynamic characteristics of bodies p 619 A85-37341

in weakly perturbed gas flows Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attac

[AIAA PAPER 85-0924] n 620 A85-37593 Experimental research on the effect of separation flow on ablation in supersonic turbulent flow

[AIAA PAPER 85-0975] p 694 A85-37625 Transition measurements heat-transfer instrumentation on a 0 5 bluntness 9 75-deg cone at Mach 7 with and without mass addition

- [AIAA PAPER 85-1004] p 621 A85-37645 Configuration of shock waves closing a local supersonic p 623 A85-38481 zone The isolated nature of solutions with a strong attached
- shock wave at the edges of a conical wing and a wedge p 623 A85-38488 Instability of plane-parallel supersonic gas flows in the
- p 623 A85-38551 linear approximation An extension of the generalized vortex-lattice method
- p 626 A85-38972 of supersonic sideslipping wings The free interaction in a supersonic flow over a porous p 626 A85-39021 wali

Similarity properties in the problem of flow from a supersonic source past a spherical bluntness

p 629 A85-39445 Numerical simulation of a supercritical inlet flow [AIAA PAPER 85-1214] p 630 A85-39658

PNS predicted shock location and jump conditions at - Parabolized supersonic and hypersonic speeds Navier-Stokes

[AIAA PAPER 85-1407] p 632 A85-39766 Numerical investigation of internal high-speed viscous flows using a parabolic technique

[AIAA PAPER 85-1409] p 632 A85-39768 Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion

[AIAA PAPER 85-1441] p 697 A85-39780

p 636 N85-28158 SUPERSONIC INLETS External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

SUPERSONIC NOZZLES Transonic flow in the throat region of radial or nearly radial supersonic nozzles p 626 A85-39001 SUPERSONIC SPEEDS

Supersonic aerodynamic characteristics of canard, tailiess, and aft-tail configurations for 2 wing planforms [NASA-TP-2434] p 634 N85-27822 Supersonic cruise technology

(NASA-SP-4721 p 617 N85-28912 SUPERSONIC TRANSPORTS

comparative evaluation certain promising of gas-turbine engines of foreign manufacturers in terms of their thrust charactenstics and fuel efficiency

p 660 A85-39106 Supersonic cruise technology p 617 N85-28912

[NASA-SP-472] SUPERSONIC WIND TUNNELS

Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels [AIAA PAPER 85-1003] p 681 A85-37644

SUPERSONICS

Supersonic cruise technology

p 617 N85-28912 (NASA-SP-472) SUPPORT SYSTEMS

Supportability considerations for advanced engine development

[AIAA PAPER 85-1205] p 665 A85-39655 SUBFACE COOLING

Acquisition of detailed heat transfer behavior in complex nternal flow passages

[SAE PAPER 841503] p 695 A85-39061 Unsteady heat transfer due to time-dependent free p 699 N85-27947 stream velocity

SURFACE CRACKS Crack propagation analysis of longitudinal skin cracks o 645 A85-37188 in a pressurized cabin Concepts and application of aircraft damage tolerance p 645 A85-37206 analysis

SURFACE DEFECTS The effects of surface discontinuities on convective hear transfer in hypersonic flow

[AIAA PAPER 85-0971] p 620 A85-37621 SURFACE PROPERTIES

Approximate relationships for determining pressure at

the surface of a sphere or a cylinder for arbitrary -stream Mach numbers p 624 A85-38563 SURFACE REACTIONS

The problems ansing in testing of carbon-based materials for structural components of airframes p 686 A85-37339

The role of surface generated radicals in catalytic mbustior p 671 N85-27869 SURFACE BOUGHNESS

Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels p 681 A85-37644 [AIAA PAPER 85-1003] Proceedings of the 9th US Air Force and the Federal

Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects [AD-A153020] p 699 N85-28266

SURVEILLANCE RADAR Tethered aerostat operations in the marine

environment p 640 A85-38778 [AIAA PAPER 85-0860]

SWEAT COOLING Advanced liner-cooling techniques for gas turbine

combustors [AIAA PAPER 85-1290] p 667 A85-39703

SWEEP EFFECT

Design of a basic profile for a low sweep airfoil Part Experimental investigation on the DFVLR-W1 autoil profile in the Brunswick transonic wind tunnel p 635 N85-27833 [DFVLR-FB-85-01-PT-21

SWEPT FORWARD WINGS Investigation on configurations in longitudinal direction

wind-tunnel testing of forward swept wings p 625 A85-38969 Some effects of sweep direction and strakes for wings

with sharp leading edges [CA-8421] p 634 N85-27826

X-29 digital flight control system design p 677 N85-27889

The static aeroelasticity of a composite wing p-701- N85-29321 SWEPT WINGS

Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins p 626 A85-38984

Companson of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686

On the effect of wing taper and sweep direction on leading edge transition p 634 N85-27827 [CA-8435]

SWEPTBACK WINGS

Some effects of sweep direction and strakes for wings with sharp leading edges [CA-8421]

p 634 N85-27826

SUBJECT INDEX

SWIRLING Influence of the blockage ratio on the efficiency of swirt

generation with vane swirters [AIAA PAPER 85-1103] p 696 A85-39605

Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles p 632 A85-39738 AIAA PAPER 85-1346

SYNCHRONOUS MOTORS

Lift and thrust of a linear synchronous engine with a solid-conductor stator winding p 658 A85-37550 SYSTEM EFFECTIVENESS

An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft p 660 A85-39121 system

SYSTEM FAILURES How to handle failures in advanced flight control systems p 679 N85-27905 of future transport aircraft

SYSTEM IDENTIFICATION Application of system identification techniques to

poststall combustor dynamics p 669 A85-39743 [AIAA PAPER 85-1353]

Identification of gust input and gust response charactenstics from Do 28 TNT flight test data (DEVI B-EB-84-48) p 676 N85-27881 SYSTEMS ENGINEERING

Commercial aviation GPS Navigation Set architecture p 644 A85-38538

Analysis of control system from a viewpoint of desired pole placement and desired degree of robustnes p 675 N85-27876 [AD-A152627] The oust simulation apparatus of the 3m x 3m low speed

wind tunnel of the DFVLR in Goettingen, West Germany DFVLR-FB-85-04] p 684 N85-27920 Evaluation of a fault tolerant system for an integrated [DEVLR-FB-85-04]

vionics sensor configuration with TSRV flight data p 657 N85-28941 [NASA-CB-172589] SYSTEMS INTEGRATION

Integrated CADCAM - An approach for advanced composite primary aircraft structure p 703 A85-37211

Wing optimization and fuselage integration for future generation of supersonic aircraft p 618 A85-37212 Integrated Inertial Sensor Assembly program status

p 642 A85-37810 Integration of the B-52G Offensive Avionics System

(OAS) with the Global Positioning System (GPS) n 685 A85-38545

Integration of sensor and display subsystems p 656 A85-38955

Development and evaluation of an integrated flight and propulsion control system [AIAA PAPER 85-1423]

p 669 A85-39771 The STOL and maneuver technology program integrated ontrol system development p 680 N85-27910 control system development

Т

T-38 AIRCRAFT

T-56 ENGINE

TAKEOFF

of an airshin

(STALÍNS)

B85800721

program, part 1

TAKEOFF RUNS

[NASA-CR-132732-1]

[NASA-CR-132732-2]

take-off shaft subsystem

[SAE PAPER 841603]

TAIL ASSEMBLIES

[AIAA PAPER 85-1459]

of an incompressible gas

[AIAA PAPER 85-0877]

Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors p 616 A85-39214 [AIAA PAPER 84-0933]

Derivative T56 engine development experience

Charactenstics of the oscillations of a tail unit in a flow

Thrust vectored take-off, landing and ground handling

A system for take-off and landing measurements

Addition of flexible body option to the TOLA computer

Addition of flexible body option to the TOLA computer

Critical speed testing of the Grumman X-29A power

program Part 2 User and programmer documentation

p 670 A85-39790

p 649 A85-39125

p 641 A85-38792

p 645 N85-27849

p 652 N85-27855

p 652 N85-27856

p 662 A85-39163

SUBJECT INDEX
TARGET DRONE AIRCRAFT NATCS - Navigation Aided Target Control System for
multiple drone applications p 642 A85-37803 TECHNOLOGICAL FORECASTING
Cockpit of the future? p 655 A85-37925 Who needs advanced-technology airliners?
p 647 A85-38434
Vanable cycle turboshaft technology for rotor-craft of
the 90's [AIAA PAPER 85-1278] p 666 A85-39695
Combustion technology - A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763
TECHNOLOGY ASSESSMENT Man-powered arcraft review p 615 A85-38353
Research trend in advanced technology helicopter
p 647 A85-38360 Lighter-Than-Air Systems Conference, 6th, Nortolk, VA, June 26-28, 1985, Technical Papers
p 616 A85-38776 North warning system airship feasibility study
[AIAA PAPER 85-0858] p 640 A85-38777 The need to return to hydrogen in airships
[AIAA PAPER 85-0873] p 648 A85-38788
A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of
their thrust characteristics and fuel efficiency p 660 A85-39106
Matenal evaluation of second-generation composites for transport wing application
[SAE PAPER 841520] p 688 A85-39291
A review of some recent U K propeller developments [AIAA PAPER 85-1261] p 666 A85-39684
Technology for the design of high temperature rise combustors
[AIAA PAPER 85-1292] p 668 A85-39705 Controller requirements for uncoupled aircraft motion,
volume 1 [AD-A153173] p 675 N85-27878
TECHNOLOGY UTILIZATION Application of technology to achieve value - Added
In-service support of jet engines [SAE PAPER 841566] p 659 A85-39067
Progress in the utilization of an
oxide-dispersion-strengthened alloy for small engine turbine blades
[SAE PAPER 841512] p 688 A85-39284 Aircraft preliminary design comparison of advanced
compound engines with advanced turbine engines for helicopter applications
[AIAA PAPER 85-1276] p 666 A85-39693 New materials and techniques for aircraft structures
[B8580074] p 653 N85-27861 TEMPERATURE CONTROL
Heat management system for aircraft
[AD-D011658] p 654 N85-28936 TEMPERATURE DEPENDENCE
The influence of microstructure on the temperature-dependent flow properties of Ti-6AI-4V
p 687 A85-38749 TEMPERATURE GRADIENTS
Temperature distortion generator for turboshaft engine testing
[SAE PAPER 841541] p 659 A85-39065 TEMPERATURE MEASUREMENT
Shock tunnel measurements of heat transfer in a model scramjet
[AIAA PAPER 85-0908] p 658 A85-37582
Dynamic gas temperature measurement system p 694 A85-37706 TEMPERATURE PROFILES
An investigation into the soot production processes in a gas turbine engine
[AD-A152710] p 690 N85-27992
TERCOM A companson of several digital map-aided navigation techniques p 642 A85-37829
TERRAIN The AFTI/F16 terrain-aided navigation system
[DE85-008411] p 645 N85-28935 TERRAIN FOLLOWING AIRCRAFT
An evading path against 3 D obstacles p 674 A85-38357
TEST FACILITIES High speed compressor ng as a stall recovery research
tool [AIAA PAPER 85-1428] p 682 A85-39773
An assessment of the suitability of the BHGA structural test ng for aerodynamic testing of hang gliders
[CA-8505] p 652 N85-27853
Rotorcraft research testing in the National Full-Scale Aerodynamics Complex at NASA Ames Research
Center [NASA_TM_86697] p.652_N85-27854

[NASA-TM-86687]	D 652	N85-27854
-----------------	-------	-----------

Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A153830] p 691 N85-29073 TEST STANDS Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data

acquisition and processing system [DFVLR-MITT-85-03] p 684 N85-27921 TETHERING

aerostat operations in the marine Tethered environment p 640 A85-38778 [AIAA PAPER 85-0860]

The Tethered Aerostat Antenna Program (TAAP) demonstration phase

[AIAA PAPER 85-0883] p 616 A85-38797 TETHERLINES

A new reeling technique for very long extension scanning p 640 A85-38312 in the stratosphere The Tethered Aerostat Antenna Program (TAAP)

demonstration phase [AIAA PAPER 85-0883] p 616 A85-38797 THERMAL EXPANSION

Acquisition of detailed heat transfer behavior in complex internal flow passages

[SAE PAPER 841503] p 695 A85-39061 THERMAL FATIGUE

Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking p 667 A85-39701 [AIAA PAPER 85-1288] THERMAL INSULATION

Ceramic coatings for heat engine materials Status and future needs

[DE85-008759] p 691 N85-29053 Ceramic coatings for heat engine materials

[DE85-005238] p 691 N85-29054 THERMAL PROTECTION

Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623

THERMAL RESISTANCE Heat resistant Carbon Fiber Reinforced Plastics (CFRP)

hardening equipment p 690 N85-27976 (MBB/LFA33/CFK/PUB/007)

THERMAL STABILITY A study of the thermal inertia of a thermocouple exposed

to short temperature pulses at high Reynolds numbers p 695 A85-39117

THERMAL STRESSES

Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking AIAA PAPER 85-1288] p 667 A85-39701 THERMOCOUPLES

A study of the thermal inertia of a thermocouple exposed to short temperature pulses at high Reynolds numbers

p 695 A85-39117 Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles p 699 N85-28328

[AD-A153039] THERMODYNAMIC PROPERTIES Investigation of heat transfer to a turbine blade cascade

using a shock tube [AD-A153090] p 671 N85-27871

Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066 THERMOGRAPHY

Companson of advanced cooling concepts using color thermography --- for high temperature-rise gas combustors

[AIAA PAPER 85-1289] p 667 A85-39702 THERMOMECHANICAL TREATMENT

The effect of coatings on the thermomechanical fatigue life of a single crystal turbine blade material [AIAA PAPER 85-1366] p 689 A85-39744

THERMOPLASTIC RESINS Laminated thermoplastic radome

[AD-D011664] p 691 N85-29045 THIN AIRFOILS

Lift and drag of airfoils in nonuniform supersonic p 618 A85-37200 stream A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method

p 624 A85-38562 Stability of the thin-jet model of the unsteady jet flap

p 626 A85-38997 THIN BODIES

Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies

p 618 A85-37197 THIN FILMS

Measurement of wing-leading-edge heating rates on and tunnel models using the thin-film technique p 681 A85-37622 [AIAA PAPER 85-0972]

Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element p 696 A85-39170

THIN WALLED SHELLS Crack propagation analysis of longitudinal skin cracks p 645 A85-37188 in a pressurized cabin THIN WINGS

computational method for wings of arbitrary Δ planform

[AD-A153788] p 638 N85-28929 THREE DIMENSIONAL BODIES

An evading path against 3 D obstacles p 674 A85-38357

THREE DIMENSIONAL FLOW

investigation of three-dimensional separated flows p 619 A85-37338

Quasi-three-dimensional blade design code p 622 A85-37928

The solution of transonic flow through three-dimensional turbine blade p 622 A85-37929

A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors 1 - Axial flow, p 622 A85-37931 stream function formulation

Numerical simulation of three-dimensional transonic flow in a turbomachinery p 625 A85-38965

Numerical solution of two- and three-dimensional rotor p 626 A85-38989 tip leakage models

Computation of three-dimensional flow using the Euler equations and a multiple-grid scheme p 627 A85-39200

Multignd calculation of transonic wing-tail-fuselage combinations p 620 sonic flow past p 628 A85-39216

Aerodynamics of an aspect ratio 8 wing at low Reynolds numbers p 628 A85-39223

Application of 3-D flow computations to gas turbine aerodynamic design

p 630 A85-39659 [AIAA PAPER 85-1216] Calculation of three-dimensional, viscous flow through turbomachinery blade passages by parabolic marching [AIAA PAPER 85-1408] p 632 A85-39767

THROATS

Transonic flow in the throat region of radial or nearly p 626 A85-39001 radial supersonic nozzles THRUST

Computation of the thrust performance of axisymmetric nozzles tes p 622 A85-37932 comparative evaluation of certain promising

gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency p 660 A85-39106

THRUST AUGMENTATION Recent developments in ejector design for V/STOL

aircraft p 663 A85-39206

[SAE PAPER 841498] Performance characteristics of rectangular and circular thrust augmenting ejectors

[AIAA PAPER 85-1344] p 631 A85-39736 Combustion technology - A Navy perspective

[AIAA PAPER 85-1400] p 690 A85-39763 An investigation of high performance, short thrust

augmenting ejectors [ASME PAPER 84-WA/FE-10] p 697 A85-39873 THRUST CONTROL

Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497]

p 627 A85-39205 THRUST DISTRIBUTION

Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A p 663 A85-39209 THRUST LOADS

Lift and thrust of a linear synchronous engine with a solid-conductor stator winding p 658 A85-37550 THRUST MEASUREMENT

From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243

Engine thrust measurement uncertainty p 669 A85-39765 [AIAA PAPER 85-1404] THRUST REVERSAL

Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft AIAA PAPER 85-14661 p 670 A85-39794 THRUST VECTOR CONTROL

Thrust vectored take-off, landing and ground handling of an airship

[AIAA PAPER 85-0877] p 641 A85-38792 Study of an asymmetric flap nozzle as a thrust-vectoring

p 629 A85-39582 device Integration of vectoring nozzles in a STOL transonic

tactical aircraft p 667 A85-39699 [AIAA PAPER 85-1285]

Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft p 670 Å85-39794 [AIAA PAPER 85-1466]

THIN PLATES

THRUST VECTOR CONTROL

p 675 A85-39059

p 650 A85-39217

p 688 A85-39291

p 636 N85-27838

p 652 N85-27852

THUNDERSTORMS

Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles [NASA-TP-2432] p 637 N85-28924

THUNDERSTORMS Further observations of X-rays inside thunderstorms

p 701 A85-37720 Model of the wind field in a downburst

p 701 A85-39218 Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526

TILT ROTOR AIRCRAFT Helicopter aeromechanics Introduction and historical p 653 N85-28914 review

TIME Piloted simulation of an algorithm for onboard control of time-optimal intercept

NASA-TP-24451 p 681 N85-28949 TIME DEPENDENCE

The computation of transonic nozzle flow-field by a time-dependent method p 625 A85-38963 TIME MARCHING

Computation of the thrust performance of axisymmetric p 622 A85-37932 nozzles Numerical simulation of three-dimensional transonic flow in a turbomachinery p 625 A85-38965 The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967 Application of Runge Kutta time marching scheme for

the computation of transonic flows in turbomachines [AIAA PAPER 85-1332] p 631 A85-39728 TITANIUM ALLOYS

The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 Low temperature creep and fracture of near alpha p 687 A85-38748 titanium allovs The influence of microstructure the on temperature-dependent flow properties of Ti-6AI-4V

p 687 A85-38749 **TOLERANCES (MECHANICS)** Concepts and application of aircraft damage tolerance

analysis p 645 A85-37206 TRACKING FILTERS

Algorithms for improved, heading assisted, maneuver p 644 A85-39458 tracking TRACKING NETWORKS

balloon tracking system that uses the VHF omidirectional range (VOR) network p 643 A85-38313 TRAINING AIRCRAFT

Tweety-bird replacement --- from T-37B to Fairchild T-46A trainer aircraft p 646 A85-37945 TRAINING EVALUATION

The use of flight simulators in measuring and improving training effectiveness

[AD-A153817] p 684 N85-28954 TRAINING SIMULATORS

The use of flight simulators in measuring and improving training effectiveness

[AD-A153817] p 684 N85-28954 TRAJECTORIES

Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion

[AIAA PAPER 85-1441] p 697 A85-39780 The development of the generalized escape system simulation program

[ASME PAPER 84-WA/DSC-20] p 651 A85-39869 TRAJECTORY OPTIMIZATION

Instationary dolphin flight - The optimal energy exchange between a sailplane and vertical currents in the p 646 A85-37488 atmosphere

Piloted simulation of an algorithm for onboard control of time-optimal intercept [NASA-TP-2445] p 681 N85-28949

TRANSIENT HEATING Quantitative evaluation of transient heat transfer on axial

flow compressor stability [AIAA PAPER 85-1352] p 697 A85-39742

TRANSITION FLOW A nonstationary transition process caused by injection

of a gas into the near wake of a body in a supersonic p 619 A85-37336 flow TRANSMISSIONS (MACHINE ELEMENTS)

Advanced techniques for health and usage monitoring of helicopter transmissions

[AIAA PAPER-85-1142] p 617 A85-39621 TRANSONIC COMPRESSORS

Simplified implicit block-bidiagonal finite difference method for solving the Navier-Stokes equations

p 695 A85-39003 TRANSONIC FLOW The solution of transonic flow through three-dimensional

turbine blade p 622 A85-37929 Configuration of shock waves closing a local supersonic zone p 623 A85-38481

A second-order approximate method for transonic small-disturbance potential flow and its application to the analysis of flows over airfoils p 625 A85-38922 The computation of transonic nozzle flow-field by a

time-dependent method p 625 A85-38963 Numerical simulation of three-dimensional transonic flow in a turbomachinerv p 625 A85-38965 The characteristics compatibility conditions on the

boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967 Computations of projectile Magnus effect at transonic p 626 A85-38981 velocities Transonic flow in the throat region of radial or nearly radial supersonic nozzles p 626 A85-39001 Investigation of transonic inlet drag characteristics p 627 A85-39063 sonic flow past [SAE PAPER 841539]

Multiond calculation of transonic wing-tail-fuselage combinations p 628 A85-39216 A computational study of the unsteady shock-wave structure in a two-dimensional transonic rotor p 629 A85-39578

Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines [AIAA PAPER 85-1332] p 631 A85-39728

Accurate and efficient solutions of transonic internal flows

[AIAA PAPER 85-1334] p 631 A85-39729 A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers [AIAA PAPER 85-1463] p 633 A85-39792

Numerical study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828 Transonic Mach number determination in a blow-down

wind tunnel with solid walls and a downstream throat [VTH-LR-402] p 636 N85-27835 Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting,

Viscous and Interacting Flow Field Effects p 699 N85-28266 [AD-A153020]

Subsonic and transonic aerodynamics of a wraparound fin configuration p 637 N85-28927 [AD-A153646]

Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method

[NAL-TR-842-PT-3] p 684 N85-28952 Hyperbolic phenomena in the flow of viscoelastic fluids

[AD-A153533] p 700 N85-29186 TRANSONIC SPEED

Comparison of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686

Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds [DFVLR-FB-84-49] p 636 N85-27837

Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method NAL-TR-842-PT-31 p 684 N85-28952

TRANSONIC WIND TUNNELS European transonic wind tunnel p 681 A85-37491 Investigation of transonic inlet drag characteristics

[SAE PAPER 841539] p 627 A85-39063 Computational/experimental pressure distributions on a

p 628 A85-39210 transonic, low-aspect-ratio wing p 628 A85-39210 Design of a basic profile for a low sweep autoil Part 2 Experimental investigation on the DFVLR-W1 airfoil profile in the Brunswick transonic wind tunnel

[DFVLR-FB-85-01-PT-2] p 635 N85-27833 Transonic Mach number determination in a blow-down wind tunnel with solid walls and a downstream throat (VTH-LR-402) p 636 N85-27835

Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow urbulence level and measuring method

p 684 N85-28952 [NAL-TR-842-PT-3] On power effectent operation of the 2m x 2m transonic

vind tunnel at the National Aerospace Laboratory [NAL-TR-847] p 684 N85-28953 TRANSPIRATION

Small gas turbine combustor study - Fuel injector performance in a transpiration-cooled liner p 668 A85-39717 [AIAA PAPER 85-1312]

The transpired turbulent boundary layer in various pressure gradients and the blow-off condition

[ASME PAPER 84-WA/HT-71] p 698 A85-39899 TRANSPORT AIRCRAFT p 655 A85-37925 Cockpit of the future?

Soviets tailor cargo transport operations for remote-site p 646 A85-38244 Who needs advanced-technology airliners?

p 647 A85-38434

North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A p 640 A85-38777

p 679 N85-27898 transport Realisation of relaxed static stability on a commercial transport p 679 N85-27899 Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel p 679 N85-27903 How to handle failures in advanced flight control systems of future transport aircraft p 679 N85-27905 Advanced secondary power system for transport arcraft [NASA-TP-24631 p 673 N85-28944 TRANSPORT THEORY

Stability and control results for advanced turboprop

Winglet effects on the flutter of a twin-engine

Material evaluation of second-generation composites for

Methods for design aerodynamics of modern transport

Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins

Demonstration of relaxed static stability on a commercial

Numencal solutions of ramjet nozzle flows [AIAA PAPER 85-1270] p 631 A85-39689 TRANSPORTATION

USSR report Transportation

aft-mount installations

[SAE PAPER 841479]

transport wing application

[SAE PAPER 841520]

transport-type wing

[DFVLR-FB-85-05]

[NASA-TM-86418]

aurcraft

[JPRS-UTR-84-025] p 641 N85-27841

Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 TRISONIC WIND TUNNELS

Investigation on reducing the flow noise of the 0.6 m x 0 6 m trisonic wind tunnel p 682 A85-38968 TU-154 AIRCRAFT

The aerodynamics of the Tu-154B aircraft --- Russian p 649 A85-38850 book TUBES

Flame radiation and liner heat transfer in a tubular-can p 663 A85-39580 combustor TUMBLING MOTION

Shading and interference effects during the rotation of a plate --- in aerodynamics p 624 A85-38559 TURBINE BLADES

Pretwist and shear flexibility in the vibrations of turbine p 657 A85-37233 blades

The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade

Explosive forming of low carboon steel sheet into a stepped disc shape p 694 A85-38169

Determination of the blade height of the last compressor stage for a refined thermodynamic design analysis of turbofan engines p 661 A85-39126

utilization Progress ເກ the of an oxide-dispersion-strengthened alloy for small engine turbine blades

[SAE PAPER 841512] p 688 A85-39284 Simulation of wake passing in a stationary turbine rotor

p 629 A85-39589 cascade Time resolved measurements of a turbine rotor

stationary tip casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39 p 666 A85-39663 The effect of coatings on the thermomechanical fatigue

life of a single crystal turbine blade material [AIAA PAPER 85-1366] p 689 p 689 A85-39744 Noncontact engine blade vibration measurements and

analysis p 670 A85-39798 [AIAA PAPER 85-1473] Application of boundary element method to heat transfer

coefficient measurements around a gas turbine blade [ASME PAPER 84-WA/HT-69] p 698 A85-39897 Heat transfer investigation in the junction region of

circular cylinder normal to a flat plate at 90 deg location [ASME PAPER 84-WA/HT-70] p 698 A85-39898 Investigation of heat transfer to a turbine blade cascade

using a shock tube

p 671 N85-27871 [AD-A153090]

Testing of materials and coatings for jet engine components under simulated operational conditions p 672 N85-27873 [B8580073] TURBINE ENGINES

Aircraft preliminary design companison of advanced compound engines with advanced turbine engines for helicopter applications [AIAA PAPER 85-1276]

p 666 A85-39693

Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft [AIAA PAPER 85-1466] p 670 A85-39794 Development of a noninterference technique for

measuring turbine engine rotor blade stresses [AIAA PAPER 85-1472] p 697 p 697 A85-39797

SUR IFCT INDEX

Flow characteristics of a partially submerged liquid

[DE85-008744] p 699 N85-28276 Improved statistical analysis method for prediction of maximum inlet distortion

[AD-A153767] o 673 N85-28947 Ceramic Technology for Advanced Heat Engines Project

[DE85-008755] n 691 N85-29052 Ceramic coatings for heat engine materials. Status and

future needs (DE85-008759) n 691 N85-29053

Ceramic coatings for heat engine materials p 691 N85-29054 DE85-0052381 TURBINE WHEELS

A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors 1 - Axial flow stream function formulation p 622 A85-37931 Air turbine starter turbine wheel containment

p 661 A85-39156 [SAE PAPER 841546] p 661 A85-39156 Unsteady heat transfer due to time-dependent free p 699 N85-27947 stream velocity TURBINES

Ceramic turbochargers A case study of a near-term application of high-strength ceramics

p 700 N85-28379 [DE85-0064951] TURBOCOMPRESSORS

The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 A generalization of experimental data on heat transfer from the working medium to the housing components of

the compressor of a gas-turbine engine p 660 A85-39112 Determination of the blade height of the last compressor stage for a refined thermodynamic design analysis of p 661 A85-39126 turbofan engines

Correlation and prediction of rotating stall inception by vergence method p 629 A85-39245 divergence method

Effects of inlet pressure fluctuations on axial flow compressors - Some experimental and theoretical results

p 696 A85-39619 [AIAA PAPER 85-1135] Cantilevered stator vane tip leakage studies

[AIAA PAPER 85-1136] p 664 A85-39620 Stall transients of axial compression systems with inlet

distortion [AIAA PAPER 85-1348] p 632 A85-39740

Axial-flow compressor stage post-stall analysis [AIAA PAPER 85-1349] p 632 A85 p 632 A85-39741 Quantitative evaluation of transient heat transfer on axial flow compressor stability

[AIAA PAPER 85-1352] p 697 A85-39742 High speed compressor rig as a stall recovery research

tool [AIAA PAPER 85-1428] p 682 A85-39773 An investigation of lift augmentation of tandem

cascades [ASME PAPER 84-WA/FM-3] p 633 A85-39875 Unsteady flow in multistage turbines p 698 N85-27946

Precision die forging of blades or gas turbines p 672 N85-28148

Ceramic turbochargers A case study of a near-term application of high-strength ceramics p 700 N85-28379 DE85-0064951 Future of ceramic turbochargers Promises and

tfalls [DE85-0062091 p 700 N85-28380 TURBOFAN AIRCRAFT Tweety-bird replacement --- from T-37B to Fairchild

T-46A trainer aircraft p 646 A85-37945 Twin tilt nacelle V/STOL aircraft SAE PAPER 841556] p 650 A85-39208

TURBOFAN ENGINES Application of technology to achieve value - Added

in-service support --- of jet engines [SAE PAPER 841566] p 659 A85-39067 A study of the thermal inertia of a thermocouple exposed

to short temperature pulses at high Reynolds numbers p 695 A85-39117 Determination of the blade height of the last compressor

stage for a refined thermodynamic design analysis of p 661 A85-39126 turbofan engines F-20 air turbine cartridge start system

p 662 A85-39160 [SAE PAPER 841570] p 662 A85-39160 Model test results of the split-fan cross-ducted propulsion system concept for medium speed V/STOL aucraft

[SAE PAPER 841495] p 663 A85-39203 The unducted fan engine

p 665 A85-39648 (AIAA PAPER 85-1190) Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts

[AIAA PAPER 85-1281] p 631 A85-39697 Engine thrust measurement uncertainty

p 669 A85-39765 [AIAA PAPER 85-1404]

Dynamic engine behavior during post surge operation of a turbofan engine

[AIAA PAPER 85-1430] p 669 A85-39774 Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796 Spacer structure

[AD-D011641] p 670 N85-27866 Fan noise suppression in turbofan engines

(B8580076) p 671 N85-27872 DEAN A program for dynamic engine analysis p 673 N85-28945 [NASA-TM-87033]

TURBOJET ENGINES Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment p 697 A85-39796 AIAA PAPER 85-1471]

TURBOMACHINE BLADES The influence of blade wakes on the performance of

outwardly curved combustor pre-diffusers [AIAA PAPER 85-1291] p 6 p 667 A85-39704 A study of internal and distributed damping for vibrating turbomachiner blades

[NASA-CR-175901] p 671 N85-27868 Unsteady heat transfer due to time-dependent free p 699 N85-27947 stream velocity

TURBOMACHINERY Families of variational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow turbomachines p 622 A85-37930

Numerical simulation of three-dimensional transonic flow p 625 A85-38965 in a turbomachinery

Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines [AIAA PAPER 85-1332] p 631 A85-39728

Two-dimensional turbulent flow an turbomachinery by the finite element method [ASME PAPER 84-WA/FM-2] p 633 analysis

p 633 A85-39874 Vibrations of rotors connected through couplings with p 672 N85-28147 backlash TURBOPROP AIRCRAFT

Stability and control results for advanced turboprop aft-mount installations

[SAE PAPER 841479] p 675 A85-39059 Aerodynamic test results for a wing-mounted turboprop propulsion installation

SAE PAPER 841480] p 627 A85-39060 Comparison of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds

p 630 A85-39686 [AIAA PAPER 85-1264] Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing

p 631 A85-39700 AIAA PAPER 85-1286] TURBOPROP ENGINES

Advanced single-rotation propfan drive system p 663 A85-39577

TURBOSHAFTS

Turboshaft truce in Europe p 658 A85-38436 Temperature distortion generator for turboshaft engine testina

[SAE PAPER 841541] p 659 A85-39065 Engine design for maintenance and support [AIAA PAPER 85-1204] p 665 A

p 665 A85-39654 Vanable cycle turboshaft technology for rotor-craft of the 90's

[AIAA PAPER 85-1278] p 666 A85-39695 TURBULENT BOUNDARY LAYER

The separation of a turbulent boundary layer within a two-face angle before an obstruction

p 619 A85-37340 The effects of surface discontinuities on convective hear transfer in hypersonic flow

p 620 A85-37621 TAIAA PAPER 85-09711 Computations of projectile Magnus effect at transonic velocities

p 626 A85-38981 Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins

p 626 A85-38984 PNS predicted shock location and jump conditions at supersonic and hypersonic speeds --- Parabolized Navier-Stokes

[AIAA PAPER 85-1407] p 632 A85-39766 The transpired turbulent boundary layer in various pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698

p 698 A85-39899 TURBULENT FLOW Experimental research on the effect of separation flow

on ablation in supersonic turbulent flow [AIAA PAPER 85-0975] p 694 A85-37625

Modelling vortex flowfields by supercomputers with super-size memory p 628 A85-39242 A further assessment of numerical annular dump diffuser flow calculations

[AIAA PAPER 85-1440] p 633 A85-39779 Two-dimensional turbulent flow analysis in

urbomachinery by the finite element method ASME PAPER 84-WA/FM-21 p 633 A85-39874

Vertical plate fin with conjugated forced convection-conduction turbulent flow

LINSWEPT WINGS

[ASME PAPER 84-WA/HT-8] p 698 A85-39878 An introduction to vortex breakdown and vortex core burstina

p 635 N85-27829 [NAE-AN-28] TURBULENT JETS

Interaction of twin turbulent circular let

p 617 A85-37049 Experiment of turbulent round jet parallel to ground p 622 A85-38367 plane

Charactenstics of a two-dimensional turbulent jet in a bounded slipstream p 695 A85-39131

TURNING FLIGHT An experimental investigation of the aerodynamic effects

on a body of revolution in turning flight [AIAA PAPER 85-0866] p p 624 A85-38782

TWISTING Pretwist and shear flexibility in the vibrations of turbine

blades p 657 A85-37233 TWO DIMENSIONAL BODIES

The drag of simple shaped bodies in the rarefied hypersonic flow regime

[AIAA PAPER 85-09981 p 621 A85-37642 TWO DIMENSIONAL FLOW

Dynamic ground effects on a two-dimensional flat p 628 A85-39226 nlate A computational study of the unsteady shock-wave

structure in a two-dimensional transonic rotor p 629 A85-39578 Accurate and efficient solutions of transonic internal

[AIAA PAPER 85-1334] p 631 A85-39729

Two-dimensional turbulent now analysis in turbomachinery by the finite element method

p 633 A85-39874 [ASME PAPER 84-WA/FM-2] p 633 A85-39874 Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method

[NAL-TR-842-PT-3] p 684 N85-28952 TWO DIMENSIONAL JETS

Characteristics of a two-dimensional turbulent let in a bounded slipstream p 695 A85-39131 TWO PHASE FLOW

Flow characteristics of a partially submerged liquid ckup

[DF85-008744] p 699 N85-28276

U

U.S.S.R.

mechanism

compressor

combustion

results

tunnel

[AIAA PAPER 85-1134]

[AIAA PAPER 85-1135]

[AIAA PAPER 85-1248]

[NASA-TM-86383]

UNSWEPT WINGS

USSR report Transportation [JPRS-UTR-84-025] p 641 N85-27841 UDIMET ALLOYS

The substitution of nickel for cobalt in hot isostatically pressed powder metallurgy UDIMET 700 alloys

p 686 A85-37415 ULTRALIGHT AIRCRAFT

Ultralights break the rules p 615 A85-38439 ULTRASONIC WELDING

Aircraft service testing of ultrasonically welded panels p 646 A85-37408 UNSTEADY FLOW

A new unsteady prescribed wake model of the aerodynamic behavior of a rotor in forward flight

p 617 A85-37178 Aerodynamic charactenstics of the Weis-Fogh echanism p 623 A85-38370 Stability of the thin-jet model of the unsteady jet flap

A computational study of the unsteady shock-wave

Unsteady blade row interactions in a multi-stage

Effects of inlet pressure fluctuations on axial flow

Combustion instability sustained by unsteady vortex

Background noise measurements from let exit vanes

Conical similarity of shock/boundary-layer interactions

designed to reduced flow pulsations in an open-jet wind

Unsteady flow in multistage turbines

generated by swept and unswept fins

CI Beta of unswept flat wings in sideslip II

compressors - Some experimental and theoretical

p 630 A85-39618

p 696 A85-39619

p 689 A85-39676

p 683 N85-27916

p 698 N85-27946

p 623 A85-38371

p 626 A85-38984

A-31

structure in a two-dimensional transonic rotor p 629 A85-39578

UPPER SURFACE BLOWING

UPPER SURFACE BLOWING

- Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A85-39209 USER MANUALS (COMPUTER PROGRAMS)
- Users manual for coordinate generation code CRDSRA
- [NASA-CR-172584] p 634 N85-27824 User's manual for airfoil flow field computer code SRAIR
- [NASA-CR-172585] p 634 N85-27825 Airport and airway system cost allocation model Volume 7 User's manual
- [AD-A152877] p 683 N85-27917

V

V/STOL AIRCRAFT

- Research trend in advanced technology helicopter p 647 A85-38360 AV-8B-mean Manne V/STOL machine p 648 A85-38437 V/STOL: An update and overview; Proceedings of the Aerospace Congress and Exposition, Long Beach, CA, October 15-18, 1984
- [SAE SP-591] p 616 A85-39201 Computer study of a jet flap ASTVOL 'Harner'
- [SAE PAPER 841457] p 650 A85-39202 Model test results of the split-fan cross-ducted
- propulsion system concept for medium speed V/STOL aircraft [SAE PAPER 841495] p 663 A85-39203
- Senes flow tandem fan A high-speed V/STOL propulsion concept
- [SAE PAPER 841496] p 650 A85-39204 Circulation control technology applied to propulsive high lift systems
- [SAE PAPER 841497] p 627 A85-39205 Recent developments in ejector design for V/STOL
- aircraft [SAE PAPER 841498] p 663 A85-39206 Twin tilt nacelle V/STOL aircraft
- [SAE PAPER 841556] p 650 A85-39208 Study of an asymmetric flap nozzle as a thrust-vectoring device p 629 A85-39582 Future of V/STOL aircraft systems A survey of
- opinions [NASA-TM-86689] p 654 N85-28937
- VANADIUM ALLOYS The influence of microstructure on the temperature-dependent flow properties of Ti-6AI-4V

p 687 A85-38749

VANELESS DIFFUSERS

- Development of an advanced vaneless inlet particle separator for helicopter engines
- [AIAA PAPER 85-1277] p 666 A85-39694 VANES
- Influence of the blockage ratio on the efficiency of swirl generation with vane swirlers [AIAA PAPER 85-1103] p 696 A85-39605
- VARIABLE CYCLE ENGINES Vanable cycle turboshaft technology for rotor-craft of
- the 90's [AIAA PAPER 85-1278] p 666 A85-39695
- Supersonic cruise technology [NASA-SP-472] p 617 N85-28912 VARIABLE SWEEP WINGS
- Discussions on the regular behavior of the longitudinal dynamic response of aircraft during variable sweep flights p 674 A85-38974
- VARIATIONAL PRINCIPLES
- Families of vanational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow turbomachines p 622 A85-37930 VELOCITY DISTRIBUTION
- Power spectral density of subsonic jet noise p 704 A85-37898
- Computations of projectile Magnus effect at transonic velocities p 626 A85-38981 VELOCITY MEASUREMENT
- Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161
- VERTICAL AIR CURRENTS Instationary dolphin flight - The optimal energy exchange between a saliplane and vertical currents in the atmosphere p 646 A85-37488
- Numencal solution of the minimum-time flight of a glider _through a thermal by use of multiple shooting methods p 638 A85-37489
 - Aircraft performance in a JAWS microburst p 701 A85-39213
- Model of the wind field in a downburst p 701 A85-39218

VERTICAL TAKEOFF AIRCRAFT

- Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage
- [SAE PAPER 841555] p 663 A85-39207 The integration of a new concept in VTOL aircraft propulsion
- [AIAA PAPER 85-1448] p 651 A85-39785 Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness
- [AD-A152627] p 675 N85-27876 VHF OMNIRANGE NAVIGATION
- A balloon tracking system that uses the VHF omidirectional range (VOR) network p 643 A85-38313 VIBRATION DAMPING
 - A study of internal and distributed damping for vibrating turbomachiner blades
- [NASA-CR-175901] p 671 N85-27868 Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149 VIBRATION FFFECTS
- Vibrations of rotors connected through couplings with backlash p 672 N85-28147 Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149
- VIBRATION MEASUREMENT Development of a noninterference technique for
- Mevelopment of a noninterterence technique for measuring turbine engine rotor blade stresses [AIAA PAPER 85-1472] p 697 A85-39797 Noncontact engine blade vibration measurements and
- analysis [AIAA PAPER 85-1473] p 670 A85-39798 VIBRATION MODE
- Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177
- VIBRATION TESTS Efficiencies of multiple-input techniques for aircraft ground vibration testing
- [SAE PAPER 841575] p 682 A85-39274 Vibrations of rotors connected through couplings with
- backlash p 672 N85-28147 VISCOELASTICITY Hyperbolic phenomena in the flow of viscoelastic
- fluids [AD-A153533] p 700 N85-29186
- VISCOSITY Aerodynamic sound generation caused by viscous processes p 705 A85-38432 Aerodynamic performance of a wing in ground effect
- using the PANAIR program [AD-A153303] p 635 N85-27832 VISCOUS FLOW
- A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of attack p 619 A85-37333
- European transonic wind tunnel p 681 A85-37491 Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack
- [AIAA PAPER 85-0924] p 620 A85-37593 Computational methods for hypersonic viscous flow over finite ellipsoid-cones at incidence
- [AIAA PAPER 85-0925] p 620 A85-37594 Numerical solution of two- and three-dimensional rotor tip leakage models p 626 A85-38989
- tip leakage models p 626 A85-38989 Galculation of three-dimensional, viscous flow through turbomachinery blade passages by parabolic marching [AIAA PAPER 85-1408] p 632 A85-39767
- [AIAA PAPER 85-1406] p 532 A55-39767 Numerical investigation of internal high-speed viscous flows using a parabolic technique
- flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768
 - Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion [AIAA PAPER 85-1441] p 697 A85-39780
- [AIAA PAPER 85-1441]
 p 697
 A85-39780

 Proceedings of the 9th US Air Force and the Federal

 Republic of Germany Data Exchange Agreement Meeting,

 Viscous and Interacting Flow Field Effects

 [AD-A153020]
 p 699

 N85-28266
- VISUAL OBSERVATION Observation of birds in the flight path of aircraft - An important stage in the prevention of bird strikes
- P 639 A85-37544
- Wake effects on the aerodynamic performance of horizontal axis wind turbines
- [NASA-CR-174920] p 702 N85-29364 VORTEX BREAKDOWN
- An introduction to vortex breakdown and vortex core bursting [NAE-AN-28] p 635 N85-27829
- VORTEX SHEDDING Local instability charactenstics and frequency
- determination of self-excited wake flows p 623 A85-38430
- Dynamic ground effects on a two-dimensional flat plate p 628 A85-39226

VORTEX SHEETS

- Stability of the thin-jet model of the unsteady jet flap p 626 A85-38997 A study of aerodynamic control in stalled flight
- leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928 VORTICES
- A supersonic panel method based on the triplet singularity p 617 A85-37191
- The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 Aerodynamic sound generation caused by viscous
- processes p 705 A85-38432 An application of source-panel and vortex methods for aerodynamic solutions of airship configurations
- [AIAA PAPER 85-0874] p 624 A85-38789 The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge
- vortex separation p 625 A85-38966 An extension of the generalized vortex-lattice method of supersonic sideslipping wings p 626 A85-38972
- Modelling vortex flowfields by supercomputers with super-size memory p 628 A85-39242 Combustion instability sustained by unsteady vortex
- combustion [AIAA PAPER 85-1248] p 689 A85-39676
- On the modelling of a fully-relaxed propeller slipstream
- [AIAA PAPER 85-1262] p 630 A85-39685 VORTICITY EQUATIONS
- Ci Beta of unswept flat wings in sideslip II p 623 A85-38371
- Hyperbolic phenomena in the flow of viscoelastic fluids
- [AD-A153533] p 700 N85-29186

- WAKES The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 Local instability characteristics and frequency determination of self-excited wake flows p 623 A85-38430 Simulation of wake passing in a stationary turbine rotor p 629 A85-39589 cascade A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928 Wake effects on the aerodynamic performance of horizontal axis wind turbines [NASA-CR-174920] p 702 N85-29364 WALL FLOW An integral method of wall interference correction for p 682 A85-38962 low speed wind tunnel The free interaction in a supersonic flow over a porous p 626 A85-39021 wall Investigation of the effect of two endwall contours on the performance of an annular nozzle cascade p 630 A85-39661 (AIAA PAPER 85-1218) Adaptive wall wind tunnels and wall interference correction methods [DFVLR-IB-222-84-A-37] p 683 N85-27912 WALL TEMPERATURE Comparison of advanced cooling concepts using color thermography -- for high temperature-nse gas combustors [AIAA PAPER 85-1289] p 667 A85-39702 WARNING SYSTEMS North warning system airship feasibility study p 640 A85-38777 [AIAA PAPER 85-0858] WATER TUNNEL TESTS Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 WAVE DIFFRACTION Diffraction of a single plane wave by a conical wing p 623 A85-38483 WAVE FRONT RECONSTRUCTION Methods for design aerodynamics of modern transport aucraft [DFVLR-FB-85-05] p 636 N85-27838 WAVE PROPAGATION Hyperbolic phenomena in the flow of viscoelastic fluids [AD-A153533] p 700 N85-29186 WEAR Friction and wear behavior of aluminum and composite 1-beam stiffened airplane skins ~--[NASA-TM-86418] p 652 N85-27852 WEATHER
- Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847

WEDGE FLOW

The isolated nature of solutions with a strong attached shock wave at the edges of a conical wing and a wedge p 623 A85-38488

WEIBULL DENSITY FUNCTIONS

Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 WEIGHT INDICATORS

Effect of superconducting solenoid model cores on spanwise iron magnet roll control [NASA-TM-86378] o 683 N85-27915

WEIGHT REDUCTION

Structural optimization --- in aircraft design p 694 A85-38352

WELD TESTS Aircraft service testing of ultrasonically welded panels p 646 A85-37408

WELDED JOINTS Feasibility study of the welding of SiC

p 688 A85-39339

WELDED STRUCTURES

Aircraft service testing of ultrasonically welded panels p 646 A85-37408

WEST GERMANY

Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects [AD-A153020] p 699 N85-28266

Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471

WETTING

improved resins for wet layup repair of advanced composite structure p 686 A85-37381 WINCHES

Development of balloon-borne reel-down and-up winch system p 640 A85-38311 A new reeling technique for very long extension scanning in the stratosphere p 640 A85-38312

WIND DIRECTION

Aircraft performance in a JAWS microburst

- p 701 A85-39213 Model of the wind field in a downburst
- p 701 A85-39218 WIND EFFECTS

Minimum-time path through wind fields p 647 A85-38358 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind [IFD-1/84-PT-2]

p 654 N85-28940 WIND PROFILES

Aerodynamics of an aspect ratio 8 wing at low Reynolds numbers p 628 A85-39223 WIND SHEAR

- Aircraft performance in a JAWS microburst p 701 A85-39213 Contributions on the subject of longitudinal movements of aircraft in wind shears [NASA-TM-77837] p 702 N85-29432
- WIND TUNNEL APPARATUS Investigation on reducing the flow noise of the 0.6 m x 0 6 m trisonic wind tunnel p 682 A85-38968 Construction 1976-1980 Design, manufacturing, calibration of the German-Dutch wind tunnel (DNW)

p 683 N85-27913 Effect of superconducting solenoid model cores on

[NASA-TM-86378]	p 683	N85-27915	
Cryogenic test technology, 1984 [AGARD-AR-212]	p 700	N85-29116	
WIND TUNNEL MODELS	P		
European transpore wind tunnel	n 691	A95 27401	

Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds

p 628 A85-39241 The application of numerical control (NC) in manufacturing wind tunnel models

[B8580078] p 699 N85-28140 Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles

[AD-A153039] p 699 N85-28328 WIND TUNNEL STABILITY TESTS

Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part [IFD-1/84-PT-1] p 654 p 654 N85-28939

WIND TUNNEL TESTS An improved procedure for calculating the

aerothermodynamic properties of a vitiated air test medium [AIAA PAPER 85-0913] p 704 A85-37583

Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels

[AIAA PAPER 85-1003] p 681 A85-37644 Transition measurements heat-transfer instrumentation on a 0 5 bluntness 9 75-deg cone at Mach 7 with and without mass addition

p 621 A85-37645 [AIAA PAPER 85-1004] Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10

[AIAA PAPER 85-1061] p 621 A85-37675 Wind tunnel experiments of the high-performance rotor p 622 A85-38362 blades

Wind tunnel investigation of the interaction of an airship configuration with lifting rotors [AIAA PAPER 85-0875] p 625 A85-38790

Investigation on configurations in longitudinal direction wind-tunnel testing of forward swept wings p 625 A85-38969

The wind tunnel investigation for obtaining rolling coment with small asymmetry p 674 A85-38970 moment with small asymmetry Stability and control results for advanced turboprop aft-mount installations

p 675 A85-39059 [SAE PAPER 841479] Dynamic pressure fluctuations in the internozzle region of a twin-let nacelle

p 627 A85-39064 [SAE PAPER 841540] A study of the thermal inertia of a thermocouple exposed to short temperature pulses at high Reynolds numbers

p 695 A85-39117 Circulation control technology applied to propulsive high lift systems

[SAE PAPER 841497] p 627 A85-39205 Aerodynamics of an aspect ratio 8 wing at low Reynolds

p 628 A85-39223 numbers Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices

[AIAA PAPER 85-1104] p 664 A85-39606 Companson of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds

p 630 A85-39686 [AIAA PAPER 85-1264] The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators

p 651 A85-39698 [AIAA PAPER 85-1284] Wing tunnel investigation of dynamic stall of an NACA 0018 airfoil oscillating in pitch

p 635 N85-27830 [NAE-AN-27] Design of a basic profile for a low sweep airfoil Part Experimental investigation on the DFVLR-W1 airfoil

profile in the Brunswick transonic wind tunnel DFVLR-FB-85-01-PT-2] p 635 N85-27833 Rotorcraft research testing in the National Full-Scale [DEVLB-FB-85-01-PT-2]

Aerodynamics Complex at NASA Arnes Research Center

[NASA-TM-86687] p 652 N85-27854 Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel

p 679 N85-27903 Background noise measurements from jet exit vanes designed to reduced flow pulsations in an open-jet wind tunnel

p 683 N85-27916 [NASA-TM-86383] The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany DFVLR-FB-85-04] p 684 N85-27920 Heating parameter estimation using coaxial [DFVLR-FB-85-04]

thermocouple gages in wind tunnel test articles p 699 N85-28328 [AD-A153039]

Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter p 637 N85-28923 [NASA-TP-24201

Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles

p 637 N85-28924 [NASA-TP-2432] Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis

p 681 N85-28950 INAK-TR-861 Cryogenic test technology, 1984

AGARD-AR-212] p 700 N85-29116 Activities of the Department of Aerospace Engineering p 706 N85-29844

WIND TUNNEL WALLS

An integral method of wall interference correction for low speed wind tunnel p 682 A85-38962 Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds

p 628 A85-39241 Adaptive wall wind tunnels and wall interference correction methods

[DFVLR-IB-222-84-A-37] p 683 N85-27912 WIND TURBINES

Field test report of the Department of Energy's 100-kW vertical axis wind turbine [DE85-008475]

p 702 N85-28458 A 5-year research plan, 1985-1990 Wind energy technology Generating power from the wind [DE85-008427] p 702

p 702 N85-28463

WINDPOWERED GENERATORS Field test report of the Department of Energy's 100-kW vertical axis wind turbine [DE85-008475] p 702 N85-28458 WING CAMBER Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 mission adaptive wing aircraft WING FLOW METHOD TESTS Aerodynamic characteristics of the Weis-Footh p 623 A85-38370 mechanism WING NACELLE CONFIGURATIONS Aerodynamic test results for a wing-mounted turboprop propulsion installation [SAE PAPER 841480] p 627 A85-39060 WING OSCILLATIONS Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies p 618 A85-37197 A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 Stability of the thin-jet model of the unsteady jet flap p 626 A85-38997 Propulsion efficiency of vibrating bodies in subsonic gas

Wake effects on the aerodynamic performance of

Field test report of the Department of Energy's 100-kW

A 5-year research plan, 1985-1990 Wind energy

technology Generating power from the wind [DE85-008427] p 702

horizontal axis wind turbines [NASA-CR-174920]

WINDPOWER UTILIZATION

vertical axis wind turbine

[DE85-008475]

stream p 699 N85-28159 WING PANELS A program for computenzed structural resizing of aircraft

structure subject to strength and local panel buckling p 693 A85-37187 criteria under multiple loading WING PLANFORMS

Theoretical considerations in the aerodynamic effectiveness of winglets p 628 A85-39224 Supersonic aerodynamic characteristics of canard,

tailless, and aft-tail configurations for 2 wing planforms [NASA-TP-2434] p 634 N85-27822 Some effects of sweep direction and strakes for wings

with sharp leading edges p 634 N85-27826 [CA-8421]

A method to calculate the parameters of wings of arbitrary planform

AD-A1526891 p 635 N85-27831 WING PROFILES

Development in UK rotor blade technology p 615 A85-38236

Diffraction of a single plane wave by a conical wing p 623 A85-38483 The isolated nature of solutions with a strong attached

shock wave at the edges of a conical wing and a wedge p 623 A85-38488

WING SPAN

Effect of a wing-tip mounted pusher turboprop on the aerodynamic charactenstics of a semi-span wing [AIAA PAPER 85-1286] p 631 A85-39700

WING TIP VORTICES

Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing [AIAA PAPER 85-1286] p 631 A85-39700 WING TIPS

Development in UK rotor blade technology

p 615 A85-38236 WINGLETS Winglet effects on the flutter of a twin-engine ansport-type wing p 650 A85-39217 transport-type wing Theoretical considerations in the aerodynamic p 628 A85-39224 effectiveness of winglets WINGS

Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film technique

p 681 A85-37622 p 648 A85-38440 [AIAA PAPER 85-0972] Something old, something new Material evaluation of second-generation composites for

transport wing application [SAE PAPER 841520] p 688 A85-39291 Wing buffeting active control testing on a transport

aircraft configuration in a large sonic windtunnel p 679 N85-27903

Method of calculating separation flow of subsonic gas p 636 N85-28161 stream around wings

Further investigations to improve the fatigue life of the

[ARL-STRUC-TM-397] p 654 N85-28938 Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis [NAK-TR-86] p 681 p 681 N85-28950

p 702 N85-29364

p 702 N85-28458

p 702 N85-28463

WIRE

WIRE

WINC Dynamic behaviour of cold wires in heated airflows (T in the range from 300 to 600 K) p 694 A85-38069 WORKLOADS (PSYCHOPHYSIOLOGY) Aspects of application of ACT systems for pilot workload alleviation p 677 N85-27887

X

X RAY ASTRONOMY

An automatic navigation and aspect sensing system for Aray astronomy p 643 A85-38314 X-ray astronomy X RAYS

Further observations of X-rays inside thunderstorms p 701 A85-37720 X-29 AIRCRAFT

9 AIRCRAFT X-29 digital flight control system design p 677 N85-27889

Y

YAW

Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles [NASA-TP-2432] p 637 N85-28924

YIELD POINT Fatigue life evaluation program for the Kfir aircraft p 645 A85-37182

YTTRIUM High-temperature erosion of plasma-sprayed, yttna-stabilized zirconia in a simulated turbine environment [AIAA PAPER 85-1219]

p 689 A85-39662 YTTRIUM OXIDES

Progress in the utilization of an oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284

Ζ

ZIRCONIUM

High-temperature	e eros	sion	of	plasma-sprayed,	
yttna-stabilized a environment	urconia	'n	а	simulate	ed turbine
AIAA PAPER 85-	1219]			p 689	A85-39662

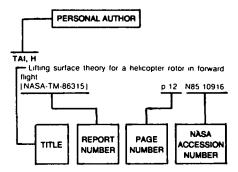
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AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

OCTOBER 1985

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report) The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

Δ

ABBINK, F. J.

- Flying in spite of the weather [NLR-MP-84021-U] p 644 N85-27847
- ABRAMSON, M. R. A comparison of several digital map-aided navigation p 642 A85-37829 techniques
- ABRAMSON, P. D. Program to support the approval of supplemental
- navigation aids in the National Airspace System p 644 A85-38541 ABTAHI. A. A.
- Aerodynamics of an aspect ratio 8 wing at low Reynolds p 628 A85-39223 numbers ADAMS, N. G.
- Cantilevered stator vane tip leakage studies
- p 664 A85-39620 [AIAA PAPER 85-1136] ADAMS, R. E.
- North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A85-38777
- AFFENS, W. A. The distribution of higher n-alkanes in partially frozen
- middle distillate fuels [AD-A153940] p 692 N85-29074
- AFJEH, A. A. Wake effects on the aerodynamic performance of
- horizontal axis wind turbines [NASA-CR-174920] p 702 N85-29364
- AFONINA, N. E. A numerical investigation of a viscous hypersonic air
- flow around elongated blunted bodies at large angles of p 619 A85-37333 attack ALEMASOV, V. E.
- The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101

ALIN, V. N.

Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket p 685 A85-38610

ALTEN, S E.

Deployable Core Automated Maintenance System (DCAMS) [AD-A1536951 p 706 N85-29839

AMAR, A.

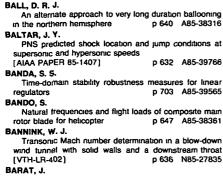
- A program for computerized structural resizing of aircraft structure subject to strength and local panel buckling p 693 A85-37187 criteria under multiple loading AMERI, A.
- Unsteady heat transfer due to time-dependent free p 699 N85-27947 stream velocity ANDERSON, D. C.
- Application of AFTI/F-16 task-tailored control modes in p 677 N85-27888 advanced multirole fighters ANDERSON, J. G.
- A new reeling technique for very long extension scanning p 640 A85-38312 in the stratosphere ANDERSON, L.
- F-20 air turbine cartridge start system [SAE PAPER 841570] p 662 A85-39160 ANDERSON, M J.
- An aerodynamic performance model for hybrid heavy lift systems
- [AIAA PAPER 85-0865] p 648 A85-38781 ANDERSON, O. L.
- Numerical investigation of internal high-speed viscous flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768
- ANDERSON, R. D. Advanced single-rotation propfan drive system
- p 663 A85-39577 ANDERSON, B. H.
- Secondary power generation system considerations for advanced aircraft
- [SAE PAPER 841604] p 650 A85-39164 ANDRE, W. L.
- Aircraft preliminary design comparison of advanced compound engines with advanced turbine engines for helicopter applications
- [AIAA PAPER 85-1276] p 666 A85-39693 ANDREEV, A. V.
- Unstable combustion in the combustion chamber of a gas-turbine aircraft engine p 660 A85-39115 ANDREEV. G. N.
- Investigation of three-dimensional separated flows p 619 A85-37338 ANDREWS, H.
- Future of V/STOL aircraft systems A survey of opinions
- p 654 N85-28937 [NASA-TM-866891 ANEX, R.
- Development and evaluation of an integrated flight and propulsion control system p 669 A85-39771 AIAA PAPER 85-14231
- ANFIMOV. N. A.
- The problems arising in testing of carbon-based materials for structural components of airframes p 686 A85-37339
- ANTOSHKINA, G. I. Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles
- p 646 A85-37323 APPLIN, Z. T.
- Stability and control results for advanced turboprop aft-mount installations
- [SAE PAPER 841479] p 675 A85-39059 ARAKI. T.
- Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade [ASME PAPER 84-WA/HT-69] p 698 A85-39897 p 698 A85-39897 ARDEMA, M.
- Slow and fast state variables for three-dimensional flight dynamics p 675 A85-39567 ARIELI, R.
- The evaluation of aerodynamic coefficients for projectiles fired from a hovering helicopter p 618 A85-37203
- ARKHIPOVA, L. I A supersonic inhomogeneous flow of an ideal gas around
- p 619 A85-37335 blunted bodies ARNDT. W. E.
- Drive system development for Propfan Test Assessment Program
- p 664 A85-39646 [AIAA PAPER 85-1188]

ARTERBURY, R. L

- Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film technique [AIAA PAPER 85-0972] p 681 A85-37622 ASAL K. Theoretical considerations in the aerodynamic
- effectiveness of winglets p 628 A85-39224 ASHRATOV. E. A. Gas flow in nozzles and jets p 619 A85-37337
- ASHTON, A. Attitude determination in a limb-scanning balloon
- radiometer p 655 A85-38319 ASTRIDGE, D. G.
- Advanced techniques for health and usage monitoring of helicopter transmissions
- p 617 A85-39621 [AIAA PAPER-85-1142] AUXIER. T.
- Military engine durability improvements through INNOVATIVE Advancements In turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 AŽUMA. A.
- Research trend in advanced technology helicopter p 647 A85-38360 В

- BAAS, J. P Model test results of the split-fan cross-ducted
- propulsion system concept for medium speed V/STOL aircraft
- [SAE PAPER 841495] p 663 A85-39203 BABA. S.
- Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method
- p 684 N85-28952 [NAL-TR-842-PT-3] BABUSHKIN, A. I.
- Methods for the assembly of aircraft structures
- p 616 A85-38641 BACH, R. E., JR
- Applications of state estimation in aircraft flight-data p 650 A85-39211 analysis BADAMSHIN, I. KH
- Accelerated testing of gas-turbine aircraft engines using he 'softening' method p 660 A85-39118 the 'softening' method
- BAHR, D. W. Technology for the design of high temperature rise
- combustors [AIAA PAPER 85-1292] p 668 A85-39705 BAILEY, D. B.
- North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A85-38777
- BAILEY, R. O.
- The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698
- BAIN, K. R.
- The effect of coatings on the thermomechanical fatigue Infe of a single crystal turbine blade material [AIAA PAPER 85-1366] p 689 p 689 A85-39744
- BAIRD, C. A.
- A comparison of several digital map-aided navigation techniques p 642 A85-37829 BAIRD, J. P.
- Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973]
- p 620 A85-37623 Density and velocity profiles in non-equilibrium laminar
- boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626
- BAKKER, P. G. Transonic Mach number determination in a blow-down
- wind tunnel with solid walls and a downstream throat (VTH-LR-402) p 636 N85-27835 BAKUMENKO, I. K.
- Stressed-strained state of tightening buckles in sectional runners of gas turbines p 672 N85-28149 BALASUBRAMANIAM, S.
- Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape

BALL, D. R. J.



First results of a stratospheric experiment using a p 639 A85-38308 Montgolfiere Infra-Rouge (MIR) BARBER, E. M.

A method to calculate the parameters of wings of arbitrary planform

[AD-A152689] p 635 N85-27831 BARNES, F. H.

- The flow past two cylinders having different diameters p 696 A85-39240 BARNES, G. R.
- integration of vectoring nozzles in a STOL transonic tectical aircraft

[AIAA PAPER 85-1285] p 667 A85-39699 BARSONY-NAGY, A.

- Lift and drag of airfoils in nonuniform supersonic p 618 A85-37200 stream BARTA, J.
- Evaluation of nozzle throat materials for ramjet p 686 A85-37201 engines BARTH, R. L.
- Temperature distortion generator for turboshaft engine testing
- [SAE PAPER 841541] p 659 A85-39065 BARTLETT, G. R. Comparison of advanced turboprop installation on swept
- and unswept supercritical wings at transonic speeds p 630 A85-39686 [AIAA PAPER 85-1264] Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wind [AIAA PAPER 85-1286] p 631 A85-39700
- BARTZ. D. Flow characteristics of a partially submerged liquid pickup
- [DE85-008744] p 699 N85-28276 BARUCH, M.
- A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling criteria under multiple loading p 693 A85-37187 BASS, R. M.
- A review of some recent U K propeller developments [AIAA PAPER 85-1261] p 666 A85-39684 BAUMSHTEIN, M. V.
- Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567 BAXENDALE, A. J.
- The flow past two cylinders having different diameters p 696 A85-39240 BEACH, R. F.
- Advanced secondary power system for transport aurcraft
- p 673 N85-28944 [NASA-TP-2463] BEAL, E. J.
- The distribution of higher n-alkanes in partially frozen middle distillate fuels [AD-A153940] p 692 N85-29074
- BEATTY, T. G. the utilization of Progress រោ an
- oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284
- BECK, W. E., JR. Model test results of the split-fan cross-ducted
- propulsion system concept for medium speed V/STOL aircraft [SAF PAPER 841495] p 663 A85-39203
- BEDRIK, B. G. Determination of the optimum lubricant change period
- for the joints of the landing gear of aircraft p 695 A85-38600 BEGUN, A. M.
- Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 BEINER I
- Critical flutter parameters of orthotropic rectangular flat panels with in-plane loads p 693 A85-37192

BELIKOV. V.

Test flight of IL-76TD long-range transport variant p 641 N85-27842

- BELOTSERKOVSKIY, S. M. Method of calculating separation flow of subsonic gas p 636 N85-28161 stream around wings BENDA, B. J.
 - Addition of flexible body option to the TOLA computer program, part 1
 - p 652 N85-27855 [NASA-CR-132732-1] Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation p 652 N85-27856 [NASA-CR-132732-2] BENNETT, W. A.
 - Development of an advanced vaneless inlet particle separator for helicopter engines
- [AIAA PAPER 85-1277] p 666 A85-39694 BENSTEIN, E. H.
- Variable cycle turboshaft technology for rotor-craft of the 90's
- p 666 A85-39695 [AIAA PAPER 85-1278] BERENS, A. P.
- USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B [AD-A153161] p 652 N85-27858
- BEREZOVSKIL A. B. A study of the thermal inertia of a thermocouple exposed
- to short temperature pulses at high Reynolds numbers p 695 A85-39117 BERNDT, D. E.
- Integration of vectoring nozzles in a STOL transonic tactical aircraft
- [AIAA PAPER 85-1285] p 667 A85-39699 BERNDT, D.E.
- Dynamic pressure fluctuations in the internozzle region of a twin-jet nacelle p 627 A85-39064 (SAE PAPER 841540)
- BERRIER, B. L. Static investigation of several yaw vectoring concepts
- on nonaxisymmetric nozzles [NASA-TP-2432] p 637 N85-28924
- BERRY, J. D. Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter
- N85-28923 p 637 [NASA-TP-2420] BERTAUX, J. L.
- First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) p 639 A85-38308 BEURRIER, D.
- The interactive generation of specifications for an onboard software series (GISELE) p 679 N85-27906 BHAGIRADHA RAO, E. S.
- Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape BHATIA, K. G.
- Winglet effects on the flutter of a twin-engin p 650 A85-39217 transport-type wing BIESIADNY, T. J.
- Temperature distortion generator for turboshaft engine testina
- [SAE PAPER 841541] p 659 A85-39065 BILIMORIA, K. D. Classical and neo-classical cruise-dash ontimization
- p 650 A85-39212 BILLIG, F. S.
- Numerical solutions of ramjet nozzle flows [AIAA PAPER 85-1270] p 631 A85-39689 BIRD. G. A.
 - Low density aerothermodynamics
- [AIAA PAPER 85-0994] p 620 A85-37640 **BISSINGER, N. C.**
- Results of AGARD assessment of prediction capabilities for nozzle afterbody flows [AIAA PAPER 85-1464] p 633 A85-39793
- BLAZEWICZ, W.
- Fatigue-crack propagation in aircraft Duralumin shell p 695 A85-38918 structures BLUMBERG, K.
- Development and evaluation of an integrated flight and propulsion control system
- [AIAA PAPER 85-1423] p 669 A85-39771 BLYTHE, A. A.
- Prospects and problems of advanced open rotors for commercial aircraft
- p 665 A85-39649 [AIAA PAPER 85-1191] BOCHAROV, B. V.
- Chemical preparations for protecting aircraft against hirds p 638 A85-37541 BOEDER, H.
- Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components ~ [BMFT-FB-T-84-302] p 672 N85-27874
- BOEHRET, H.
- OLGA. An open loop gust alleviation system p 678 N85-27897

PERSONAL AUTHOR INDEX

BOHRER, D. A.

- Integration of sensor and display subsystems p 656 A85-38955
- BONNER, G. A. Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 BOOZER, D. D.
- The AFTI/F16 terrain-aided navigation system
- [DE85-008411] p 645 N85-28935 BORETZ J.E.
- Propellant options for long duration, high altitude unmanned aircraft [AIAA PAPER 85-1326]
- p 689 A85-39727 BORISIUK, M. N.
- Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles n 646 A85-37323
- BOUCHER, R. J. Starduster A solar powered high altitude airplane [AIAA PAPER 85-1449] p 651 A85-39786 BOUDREAU, A. H.
- Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels
- [AIAA PAPER 85-1003] p 681 A85-37644 Transition measurements heat-transfer via Instrumentation on a 0 5 bluntness 9 75-deg cone at Mach with and without mass addition
- [AIAA PAPER 85-1004] p 621 A85-37645 BOZZOLA, R.
- Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines
- p 631 A85-39728 [AIAA PAPER 85-1332] BRADLEY, J.
- Global positioning system as a sole means for civil air navigation p 643 A85-37832 BRAFF, R.
- Global positioning system as a sole means for civil air p 643 A85-37832 navigation BRAHNEY, J. H.
- Fasteners for composite structures examined
- p 692 A85-37074 BRAYBROOK, R.
- Tweety-bird replacement p 646 A85-37945 BREDT. M.
- The need to return to hydrogen in airships [AIAA PAPER 85-0873] p 648 A85-38788
- BREEMAN, J. H. Parameter identification results of tests in nonsteady
- symmetric flight with the Hawker Hunter Mk 7 [NLR-TR-83042-U] p 653 N85-27860
- BRITCHER, C. P.

BROWN, E. F.

BRUCKER, D.

BRYSON, A. E., JR.

BUCKINGHAM, S. L.

fin configuration

engines for the 1990's [AtAA PAPER 85-1460]

Internal flow passages [SAE PAPER 841503]

[AIAA PAPER 85-0860]

[AD-A153646]

BULLER M. J.

BUNKER, R. S.

BURGIO, R. G.

BUFF, R. S.

[AIAA PAPER 85-1309]

Lectureship in Research)

- Effect of superconducting solenoid model cores on spanwise iron magnet roll control [NASA-TM-86378] p 683 N85-27915
- BROEK. D.
- Concepts and application of aircraft damage tolerance analysis p 645 A85-37206 BROOK, M.
- Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 BROT, A. Fatigue life evaluation program for the Kfir aircraft

Calculation of the flow in a dump combustor

projectiles fired from a hovering helicopter

simulation studies to preliminary design

The evaluation of aerodynamic coefficients for

New concepts in control theory, 1959-1984 (Dryden

The evolution of ACS for helicopters Conceptual

Subsonic and transonic aerodynamics of a wraparound

The conception and development of a family of small

Acquisition of detailed heat transfer behavior in complex

Tethered aerostat operations in the manne environment

p 645 A85-37182

p 668 A85-39716

p 618 A85-37203

p 703 A85-39551

p 677 N85-27890

p 637 N85-28927

p 670 A85-39791

p 695 A85-39061

p 640 A85-38778

PERSONAL AUTHOR INDEX

BURKETT, M. A.

Reliability assessment from small sample inspection data for gas turbine engine components [SAE PAPER 841599] p 659 A85-39069

BURLEY, J. R., II Circular-to-rectangular transition ducts for high-aspect ratio nonaxisymmetric nozzles

[AIAA PAPER 85-1346] p 632 A85-39738 BURTON, R. A.

Flight testing and development of the F/A-18A digital flight control system p 678 N85-27696 BURVIN. J.

A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling critena under multiple loading p 693 A85-37187 BURWELL, A. E.

Quantitative evaluation of transient heat transfer on axial flow compressor stability

[AIAA PAPER 85-1352] p 697 A85-39742 Dynamic engine behavior during post surge operation of a turbofan engine

[AIAA PAPER 85-1430] p 669 A85-39774 BUSURIN. V. N.

The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine stage p 660 A85-39107

С

CAGLAYAN, A. K.

Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-28941

CAHALANE, P. T. Examination of fire safety of commercial aircraft cabins p 639 A85-37693

CAHOON, N. T. Heating parameter estimation using coaxial thermocouple gages in wind tunnel test articles

[AD-A153039] p 699 N85-28328

The wind tunnel investigation for obtaining rolling moment with small asymmetry p 674 A85-38970 CAI, R. Families of vanational principles for the semi-inverse and

type-A hybrid problems on a S2-streamsheet in mixed-flow turbomachines p 622 A85-37930 CALDOW, J. R.

Airborne electronic color displays - A review of UK activity since 1981 p 656 A85-38953 CALISE. A. J.

Piloted simulation of an algorithm for onboard control of time-optimal intercept

[NASA-TP-2445] p 681 N85-28949 CAMPBELL, A. F.

External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

CAMPBELL, C. W.

Adding computationally efficient realism to Monte Carlo turbulence simulation [NASA-TP-2469] p 704 N85-28708

CAO, Y.

Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39663 CAPECE, V. R.

Unsteady blade row interactions in a multi-stage compressor

[AIAA PAPER 85-1134] p 630 A85-39618 CARLSON, J. G.

Model test results of the split-fan cross-ducted propulsion system concept for medium speed V/STOL aircraft

[SAE PAPER 841495] p 663 A85-39203 CARLSON, J. R.

Comparison of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686

CARROLL, B. F.

Transonic flow in the throat region of radial or nearly radial supersonic nozzles p 626 A85-39001 CARROLL, R. G.

Segmented zoned fuel injection system for use with a combustor

[AD-0011640] p 670 N85-27865 CARTEN, A. S., JR. The Tethered Aerostat Antenna Program (TAAP)

demonstration phase [AIAA PAPER 85-0883] p 616 A85-38797

CAUGHEY, D. A. Multignd calculation of transonic flow past

wing-tail-fuselage combinations p 628 A85-39216

CERNY, G. A.

- Ceramic coatings for heat engine materials Status and future needs [DE85-0087591 0 691 N85-29053
- [DE85-008759] p 691 N85-29053 CHAMBERS, L. J. Automated maintenance system test program increment
- VI production scheduling [AD-A153694] p 706 N85-29838
- CHAN, S. W. K. The development of a hardware-in-the-loop engine
- simulation facility [AIAA PAPER 85-1293] p 682 A85-39706
- CHANG, H.-P.
- Aircraft performance in a JAWS microburst p 701 A85-39213 CHANG, J.
- Analysis of control system from a viewpoint of desired pole placement and desired degree of robustness [AD-A152627] p 675 N85-27876
- CHEATWOOD, F. M.
- A review of some approximate methods used in aerodynamic heating analyses [AIAA PAPER 85-0906] p 620 A85-37580
- CHEN, C. L.
- Numerical study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828 CHEN. C.-K.
- Vertical plate fin with conjugated forced convection-conduction turbulent flow [ASME PAPER 84-WA/HT-8] p 698 A85-39878
- CHEN, R. An extension of the generalized vortex-lattice method
- of supersonic sideslipping wings p 626 A85-38972 CHEN, Y.-S.
- Dynamic ground effects on a two-dimensional flat plate p 628 A85-39226 CHERNIKOV, S. K.
- Charactenstics of the oscillations of a tail unit in a flow of an incompressible gas p 649 A85-39125
- CHI, R. M. Noncontact engine blade vibration measurements and analysis
- [AIAA PAPER 85-1473] p 670 A85-39798 CHIN. J.
- X-29 digital flight control system design p 677 N85-27889
- CHOI, D. H. A study of aerodynamic control in stalled flight long
- laminar separation bubble analysis [AD-A153850] p 638 N85-28930 CHOPLIN. J.
- The interactive generation of specifications for an onboard software senes (GISELE) p 679 N85-27906 CHOW, C. Y.
- Numencal study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828 CHOW. W. L.
- Study of an asymmetric flap nozzle as a thrust-vectoring device p 629 A85-39582 CHUDETSKII, IU. V.
- The problems arising in testing of carbon-based materials for structural components of airframes
- p 686 A85-37339 CIFONE, A. J.
- Combustion technology A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763
- CITURS, K. D. Controller requirements for uncoupled aircraft motion, volume 1
- [AD-A153173] p 675 N85-27878 Controller requirements for uncoupled aircraft motion,
- volume 2 [AD-A153300] p 676 N85-27879
- CLAUS, R. W. Flame radiation and liner heat transfer in a tubular-can
- combustor p 663 A85-39580 Numerical calculation of subsonic jets in crossflow with reduced numerical diffusion
- [AIAA PAPER 85-1441] p 697 A85-39780 CLEAVER, J. W.
- Vertical plate fin with conjugated forced convection-conduction turbulent flow
- [ASME PAPER 84-WA/HT-8] p 698 A85-39878 CLER, A.
- A survey of recent development in helicopter aerodynamics p 653 N85-28915 CLEVENGER, D.
- Military engine durability improvements through innovative advancements in turbine design and materials [AIAA PAPER 85-1221] p 666 A85-39664 CLIFF, E. M.
 - Classical and neo-classical cruise-dash optimization p 650 A85-39212

CLINGINGSMITH, T. W.
Senes flow tandem fan - A high-speed V/STOL propulsion concept
[SAE PAPER 841496] p 650 A85-39204 COE, P. L., JR.
Stability and control results for advanced turboprop aff-mount installations
[SAE PAPER 841479] p 675 A85-39059 COHN, J. A.
Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length arcraft
[AIAA PAPER 85-1466] p 670 A85-39794
COLE, E. O. Optical system for measuring shadowgraph data
[AD-D011642] p 705 N85-28784
A supersonic panel method based on the triplet
COLEMAN, E B.
Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices
[AIAA PAPER 85-1104] p 664 A85-39606 Boron slurry fuel atomization evaluation
[AIAA PAPER 85-1184] p 689 A85-39645
COLLINSWORTH, H. S. Computer-aided start-system design and ventication
[SAE PAPER 841508] p 661 A85-39152 COOPER, D. L.
Strutless diffuser for gas turbine engine
[AD-D011662] p 672 N85-28943 COTE. S. M.
Usage monitoring - A milestone in engine life
management [AIAA PAPER 85-1206] 0 665 A85-39656
[AIAA PAPER 85-1206] p 665 A85-39656 COUSINS, W. T.
Axial-flow compressor stage post-stall analysis
[AIAA PAPER 85-1349] p 632 A85-39741
COVELL, P. F. Supersonic aerodynamic characteristics of canard,
tailless, and aft-tail configurations for 2 wing planforms
[NASA-TP-2434] p 634 N85-27822
COVERDILL, R. E. Research test facility for evaporation and combustion
of alternative jet fuels at high air temperatures
[AD-A153830] p 691 N85-29073
COVEY, B. J. B-1B secondary power subsystem
[SAE PAPER 841607] p 662 A85-39166
CRAWFORD, R. A. Quantitative evaluation of transient heat transfer on axial
flow compressor stability
[AIAA PAPER 85-1352] p 697 A85-39742
CRIMMINS, A. G. The Cyclo-Crane - A new concept to heavy vertical lift
[AIAA PAPER 85-0871] p 648 A85-38786 CRIPPEN, D. M.
Deployable Core Automated Maintenance System (DCAMS)
[AD-A153695] p 706 N85-29839
CRISLER, L. C. Robotic drilling of acrylic windshields and canopies for
fighter aircraft p 703 A85-37396
CRONAUER, V. The Command Flight Path Display - All weather, all
missions p 656 A85-38959 CUMMINGS, W. G., III
Radiative transfer in a gas turbine combustor
[AIAA PAPER 85-1072] p 658 A85-37682
CUNNINGHAM, V. Airplane mounted accessory gearbox design
[SAE PAPER 841605] p 696 A85-39165
CURRAN, L. E. The use of flight simulators in measuring and improving
training effectiveness [AD-A153817] p 684 N85-28954
D
D DADONE, A.
D DADONE, A. Accurate and efficient solutions of transonic internal
D DADONE, A.
DADONE, A. Accurate and efficient solutions of transonic internal flows [AIAA PAPER 85-1334] p 631 A85-39729 DAINEKO, V. I.
D DADONE, A. Accurate and efficient solutions of transonic internal flows [AIAA PAPER 85-1334] p 631 A85-39729

DAITOKU, A. A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 DALAUDIER. F.

First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) p 639 A85-38308

DALAUDIER, F.

DALESSANDRO, D. D.

DALESSANDRO, D. D. Fuel injection characterization and design methodology to improve lean stability [AIAA PAPER 85-1183] p 664 A85-39644 DALEY F. An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893 DANIEL, S. R. Jet fuel instability mechanisms p 690 N85-28127 [NASA-CR-175856] DAS. D. K. Effects of inlet pressure fluctuations on axial flow compressors - Some experimental and theoretical results [AIAA PAPER 85-1135] p 696 A85-39619 DAULERIO, L. A. The development of the generalized escape system simulation program [ASME PAPER 84-WA/DSC-20] p 651 A85-39869 DÁVIDSON, J. R. The development of a hardware-in-the-loop engine simulation facility [AIAA PAPER 85-1293] p 682 A85-39706 DAVIS. D. G. M. A review of some recent U K propeller developments p 666 A85-39684 [AIAA PAPER 85-1261] DAVIS. D. K. Review of empirical and analytical specific impulse methodologies [AIAA PAPER 85-1434] p 669 A85-39776 DAVIS. F. Companison of advanced cooling concepts using color thermography p 667 A85-39702 [AIAA PAPER 85-1289] DÁVIS, W. J. Demonstration of relaxed static stability on a commercial p 679 N85-27898 transport DAVYDOV, IU. M. A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method p 624 A85-38562 DE JONG, J. L. Instationary dolphin flight - The optimal energy exchange Instationary doipnin light- the optimal currents in the between a saliplane and vertical currents in the atmosphere p 646 A85-37488 DEGUZMAN, J. The distribution of higher n-alkanes in partially frozen middle distillate fuels p 692 N85-29074 [AD-A153940] DEJARNETTE, F. R. A review of some approximate methods used in aerodynamic heating analyses p 620 A85-37580 [AIAA PAPER 85-0906] Numerical and experimental determination of secondary separation on delta wings in subsonic flow p 628 A85-39219 DELAURIER, J. An experimental investigation of the aerodynamic effects on a body of revolution in turning flight p 624 A85-38782 [AIAA PAPER 85-0866] An application of source-panel and vortex methods for aerodynamic solutions of airship configurations p 624 A85-38789 [AIAA PAPER 85-0874] Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship p 649 A85-38791 [AIAA PAPER 85-0876] DELAURIER, J. D. Wind tunnel investigation of the interaction of an airship configuration with lifting rotors p 625 A85-38790 (AIAA PAPER 85-0875) DELGUERCIO, V. Helicopter flight test of a ring laser gyro Attitude and Heading Reference System p 643 A85-38529 DEMUTS, E. Assessment of damage tolerance in composites p 688 A85-39598 DENARO, R. P. Simulation and analysis of differential GPS p 685 A85-38546 DENGLER, R. P. Advanced secondary power system for transport aurcraft [NASA-TP-2463] p 673 N85-28944 DENTRY, C. S. Description and illustration of the use of CRACKS IV [AD-A153543] p 701 N85-29325 DEO, R. B. Assessment of damage tolerance in composites p 688 A85-39598 DEQUIN, A. M. A survey of recent development in helicopter p 653 N85-28915 aerodynamics DESMARAIS, L A. Fuel freeze point investigations p 690 N85-28129 [AD-A152801]

B-4

DESTUYNDER, R.

Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel p 679 N85-27903

DETERMANN, O. Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part

[IFD-1/84-PT-1] p 654 N85-28939 Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind

[IFD-1/84-PT-2] p 654 N85-28940 DETTLEFF, G.

Pitot pressure and heat transfer measurements in hydrazine thruster plumes [AIAA PAPER 85-0934] 0 685 A85-37599

[AIAA PAPER 85-0934] p 685 A85-3759 DEVINO, V.

An argument for standardization in modern aircraft crew stations p 657 A85-38961 DEVLIN, R. E.

Advanced single-rotation propfan drive system p 663 A85-39577 DICARLO, J. A.

Fibers for structurally reliable metal and ceramic composites p 687 A85-37484 DICK, J. W.

Addition of flexible body option to the TOLA computer program, part 1

[NASA-CR-132732-1] p 652 N85-27855 Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation [NASA-CR-132732-2] p 652 N85-27856 DMITRIEV, A. S.

Nonstationary deformation of structural elements and their optimization p 696 A85-39450 DODILIK H.

Fracture toughness of adhesively bonded joints p 688 A85-39492 DOORLY, D. J.

Simulation of wake passing in a stationary turbine rotor cascade p 629 A85-39589 DOUGLASS. W. M.

Loss in turbofan thrust caused by boundary layer growth in a nacelle's inlet and exhaust ducts

[AIAA PAPER 85-1281] p 631 A85-39697 DREGALIN, A. A.

The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101

DREGALIN, A. F.

The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101 DRESCHER, K. Development and testing of the RPS-1000 parachute

Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket system p 685 A85-38608 DRONOV, IU. V.

A companson of experimental characteristics of porous and blade impellers p 660 A85-39120 DRUMMOND, J. R.

Attitude determination in a limb-scanning balloon radiometer p 655 A85-38319 DUBELL T L

Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking [AIAA PAPER 85-1288] p 667 A85-39701

DUNCAN, G. H., III

Strutiess diffuser for gas turbine engine [AD-D011662] p 672 N85-28943 DUNN M. G.

Instrumentation for gas turbine research in short-duration facilities

[SAE PAPER 841504] p 695 A85-39062 DUSA. D. J.

Axsymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length arcraft [AIAA PAPER 85-1466] p 670 A85-39794 DUTTON, J. C.

Transonic flow in the throat region of radial or nearly radial supersonic nozzles p 626 A85-39001 Flowfield and performance measurements in a vaned radial diffuser

[ASME PAPER 84-WA/FM-7]--- p 634---A85-39876 DVORAK. F. A.

A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850] p 638 N85-28930

PERSONAL AUTHOR INDEX

E

EBNER, R. E.

Integrated Inertial Sensor Assembly program status p 642 A85-37810 ELMORE, D. L. Dynamic gas temperature measurement system p 694 A85-37706 ELMORE, K. L. Aircraft performance in a JAWS microburst p 701 A85-39213 ENEVOLDSON, E. K. p 658 A85-38956 Modernizing engine displays ENGELMANN, W. H. Air turbine starter sizing for a proper bleed source match [SAE PAPER 841509] p 661 A85-39153 ENGLAR. R. J. Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497] p 627 A85-39205 EPPEL, J. C. Circulation control technology applied to propulsive high lift systems E PAPER 841497) p 627 A85-39205 EPSTEIN, A. H. Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39663 'Smart' engine components - A micro in every blade? [AIAA PAPER 85-1296] p 668 A85-39707 EREMIN, V. V. Determination of aerodynamic characteristics of bodies p 619 A85-37341 in weakly perturbed gas flows ERENBURG, V. N. The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 enaines ERICSSON, L. E. Dynamic overshoot of the static stall angle n 628 A85-39225 ESKEY. M. A. Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208 ETKIN. B. Model of the wind field in a downburst p 701 A85-39218 EVANS, D. What an airship manufacturer faces in a certification program today [AIAA PAPER 85-0870] p 641 A85-38785 EVANS. M. R. Automatic flight control modes for the AFTI/F-111 mission adaptive wing aircraft p 680 N85-27909 EVANS. W. J. Low temperature creep and fracture of near alpha titanium alloys p 687 A85-38748 EZHOV, V. N. Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567 F FAN. C. S. Acquisition of detailed heat transfer behavior in complex internal flow passages [SAE PAPER 841503] p 695 A85-39061 FANG, D. The computation of transonic nozzle flow-field by a p 625 A85-38963 time-dependent method FARNEN, L., JR. Using incentives to improve maintainability p 706 N85-29841 [AD-A153792] FARRELL P. A. Flight trials of a modified gulfstream commander carrying external stores [AD-A153376] p 653 N85-27859 FAVIN. S. Numerical solutions of ramjet nozzle flows [AIAA PAPER 85-1270] p 631 A85-39689 FEHRENBACHER, I. L. Ceramic coatings for heat engine materials: Status and future needs (DE85-0087591 p 691 N85-29053 FELLERHOFF, J. R. The AFTI/F16 terrain-aided navigation system [DE85-008411] p 645 N8 p 645 N85-28935 FENDER. D. A. The development of the generalized escape system simulation program [ASME-PAPER 84-WA/DSC-20]___p 651_ A85-39869 FERBER, H. Reaction-bonded and fiber-reinforced SiC static and

dynamic gas turbine components [BMFT-FB-T-84-302] p 672 N85-27874

PERSONAL AUTHOR INDEX

FILARSKY, S. M.

The Command Flight Path Display - All weather, all missions p 656 A85-38959 FILES. J. S.

Supportability considerations for advanced engine development [AIAA PAPER 85-1205] p 665 A85-39655

FINGER, S. N. Military engine durability improvements through innovative advancements in turbine design and materia p 666 A85-39664 [AIAA PAPER 85-1221]

FINK, D. E. Soviets tailor cargo transport for remote-site perations p 646 A85-38244 operations FIORE, A. W.

Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects [AD-A153020]

p 699 N85-28266 FISHBEIN, B. D. An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft

- p 660 A85-39121 system FIZER, L. A. Electric direct current starter motors for gas turbine
- enaines p 663 A85-39167 [SAE PAPER 841569]

FLASHNER, F. Fracture toughness of adhesively bonded joints p 688 A85-39492

FLEETER, S.

Unsteady blade row interactions in a multi-stage compressor [AIAA PAPER 85-1134] p 630 A85-39618

FOOTE, A. L. Integration of the B-52G Offensive Avionics System

- (OAS) with the Global Positioning System (GPS) p 685 A85-38545 FORD, B. J.
- A general area air traffic controller simulation using colour graphics (AD-A153634)

p 645 N85-28933 FORESTER, C. K.

External compression supersonic inlet analysis using a finite difference two-dimensional Navier-Stokes code p 629 A85-39581

FRANKE, M. E.

Performance characteristics of rectangular and circular thrust augmenting ejectors [AIAA PAPER 85-1344] p 631 A85-39736

FRANKLIN, B.

- An automatic navigation and aspect sensing system for X-ray astronomy p 643 A85-38314 FRENCH, J. V.
- Modeling post-stall operation of aircraft gas turbine enaines
- [AIAA PAPER 85-1431] p 669 A85-39775 FREYMANN, R.

The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany p 684 N85-27920 (DFVLR-FB-85-04) FROLOV. L. G.

Approximate relationships for determining pressure at the surface of a sphere or a cylinder for arbitrary free-stream Mach numbers p 624 A85-38563 FROST. W.

Aircraft performance in a JAWS microburst p 701 A85-39213

FRYE, R. J. Advanced secondary power system for transport aircraft [NASA-TP-2463] p 673 N85-28944

FUKUNISHI, H. Feasibility studies of 'Polar Patrol Balloon' p 647 A85-38321

G

- GAI, S. L. Stagnation point heat transfer in hypersonic high enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623 Density and velocity profiles in non-equilibrium laminar
- boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626 GAINES, M.

AV-8B-mean Marine V/STOL machine

- p 648 A85-38437 p 648 A85-38438 LHX - A giant leap GAJAN. P.
- Dynamic behaviour of cold wires in heated airflows (T p 694 A85-38069 in the range from 300 to 600 K) GALDOS, J. I.
- Spectral analysis of optimal and suboptimal gyro ionitoring filters p 696 A85-39459 monitoring filters

GALKOWSKI, J. T.

- Passive navigation by triangulation and tracking of undistinguished features in successive high-resolution p 642 A85-37830 imades GALKOWSKI, P. J.
- Passive navigation by thangulation and tracking of undistinguished features in successive high-resolution p 642 A85-37830 images GALLAGHER, J. P.
- USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B
- p 652 N85-27858 [AD-A1531611 GANY. A.
- Combustion studies of metallized fuels for solid fuel ramiets [AIAA PAPER 85-1177] p 689 A85-39640
- GATLIN, P.
- Usage monitoring A milestone in engine life management (AIAA PAPER 85-1206) p 665 A85-39656
- GEE. T. F. Derivative T56 engine development experience
- [AIAA PAPER 85-1459] p 670 A85-39790 GEIER, B.
- Research on structural analysis at the DFVLR, p 701 N85-29314 Brunswick GELHAUSEN, P
- Control response measurements of the Skyship-500 airship
- [AIAA PAPER 85-0881] p 649 A85-38796 GEORGIOU. D. P.
- The transpired turbulent boundary layer in various pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698 A85-39899
- GERNANDT. M.
- Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket system p 685 A85-38608 GERSHTEIN, M. I.
- Characteristics of the oscillations of a tail unit in a flow p 649 A85-39125 of an incompressible gas GIARD, J. R.
- Air turbine starter turbine wheel containment [SAE PAPER 841546] p 661 A85-39156
- GIARDINA, C. R. Redundancy management in strapdown navigation p 644 A85-38530 systems
- GIESSLER, F. J.
- USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B
- p 652 N85-27858 [AD-A1531611 GILBERTSON, F. L.
- Recent developments in ejector design for V/STOL aircraft
- [SAE PAPER 841498] p 663 A85-39206 GIRARD, M. A.
- Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191 GIRSHOVICH, T. A.
- Characteristics of a two-dimensional turbulent jet in a bounded slipstream p 695 A85-39131 GISHVAROV, A. S.
- Accelerated testing of gas-turbine aircraft engines using the 'softening' method p 660 A85-39118 p 660 A85-39118 GLADDEN, H. J.
- Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment p 697 A85-39796 [AIAA PAPER 85-1471] GLAGOLEV, A. I.
 - Investigation of three-dimensional separated flows
 - p 619 A85-37338 The separation of a turbulent boundary layer within a
- two-face angle before an obstruction p 619 A85-37340
- GLICKEN, D. H. Engine thrust measurement uncertainty
- p 669 A85-39765 [AIAA PAPER 85-1404] GLIDEWELL, R.
- Integration of vectoring nozzles in a STOL transonic tactical aircraft
- p 667 A85-39699 [AIAA PAPER 85-1285] GMELIN, B.
- Aspects of application of ACT systems for pilot workload p 677 N85-27887 alleviation GMELIN, B. L.
 - Mission requirements and handling qualities p 680 N85-28918
- GNOFFO, P. A.
- Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10
- [AIAA PAPER 85-1061] p 621 A85-37675

Investigation of heat transfer to a turbine blade cascade [AD-A153090] p 671 N85-27871 Evaluation of a fault tolerant system for an integrated p 657 N85-28941 GODSTON, J. Future prop-fans - Tractor or pusher [AIAA PAPER 85-1189] p 664 A85-39647 Aerodynamic performance of a wing in ground effect using the PANAIR program [AD-A153303] p 635 N85-27832 Description and test methods for a frequency output ccelerometer p 694 A85-38536 Flight trials of a modified gulfstream commander carrying external stores [AD-A153376] p 653 N85-27859 The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 enaines Similarity properties in the problem of flow from a p 629 A85-39445 Ultralights break the rules p 615 A85-38439 Unsteady heat transfer due to time-dependent free stream velocity p 699 N85-27947 The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) p 639 A85-38308 GRADY, W. T. A new concept of hybrid airship [AIAA PAPER 85-0868] p 649 A85-38798 GRAEBER, U. P. Realisation of relaxed static stability on a commercial p 679 N85-27899 transport GRANT. I. The flow past two cylinders having different diameters p 696 A85-39240 GRAVES, C. B. Fuel injection characterization and design methodology to improve lean stability [AIAA PAPER 85-1183] p 664 A85-39644 GRAVES. M. J. Damage tolerance of composite cylinders p 688 A85-39600 GREEN. K. A. Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage [SAE PAPER 841555] p 663 A85-39207 GREENBERG, I. Evaluation of nozzle throat materials for ramjet ngines p 686 A85-37201 enaines GREENE. E. E. Laminated thermoplastic radome p 691 N85-29045 [AD-D011664] GREENHILL, J. G. An automatic navigation and aspect sensing system for ray astronomy p 643 A85-38314 X-ray astronomy GRIAZNOV, B. A. The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 GRINKRUG, L. S. The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine stage p 660 A85-39107 GRISHIN, A. N. Characteristics of a two-dimensional turbulent jet in a p 695 A85-39131 bounded slipstream GRISHIN. A. V. The isolated nature of solutions with a strong attached shock wave at the edges of a conical wing and a wedge p 623 A85-38488

- GROMOV, V. G. A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of
 - p 619 A85-37333 attack GRUZDEVA, Z. KH.
 - The 'solution-large molecules' method for calculating the equilibrium composition of heterogeneous systems p 687 A85-39101 GU, Y.-D.
 - Balloon system and balloon-borne experiments in China p 640 A85-38310

- GOCHENAUR, J. E.
- using a shock tube
- GODIWALA P. M.
 - avionics sensor configuration with TSRV flight data [NASA-CR-172589] p 657 N85-
- GÒETZ. A. R.
- GOGIC, A. M.
- GOLDMAN, A.
- GOLLAND, A. B.
- GOLOVACHEV, IU. P.
- supersonic source past a sphencal bluntness
- GOOLD, I.
- GORLA, R. S. R.
- GORODETSKII, S. S.
- GOUTAIL F.

GUENETTE, G. R. Time resolved measurements of a turbine rotor stationary tip casing pressure and heat transfer field p 666 A85-39663 [AIAA PAPER 85-1220] GUNNESKOV. O. Pretwist and shear flexibility in the vibrations of turbine p 657 A85-37233 blades GUTMARK, E. Interaction between acoustics and subsonic ducted flow a ramjet configuration p 704 A85-37209 in a ramjet configuration н HAAS. D. G. Engine thrust measurement uncertainty p 669 A85-39765 [AIAA PAPER 85-1404] HACH, J.-P. The cockpit of the Airbus A310 p 655 A85-37896 HADLEY, J. W. A method for the evaluation of the boundary lubricating properties of aviation turbine fuels p 687 A85-37495 HAGENBERG, T. H. M. Developments in the area of air traffic control systems and the relation with meteorology [NLR-MP-84029-U] p 645 N85-27848 HALE, A. A. Calculation of the flow in a dump combustor [AIAA PAPER 85-1309] p 668 A85-39716 HALL J. L. An introduction to vortex breakdown and vortex core bursting [NAE-AN-28] p 635 N85-27829 HAMILTON, H. H. A review of some approximate methods used in aerodynamic heating analyses p 620 A85-37580 [AIAA PAPER 85-0906] HANDSCHUH, R. F. erosion of plasma-sprayed, High-temperature yttria-stabilized zirconia in a simulated turbine environment AIAA PAPER 85-1219] p 689 A85-39662 HANIN M. Lift and drag of airfoils in nonuniform supersonic stream p 618 A85-37200 HANKEY, W. L. Numerical simulation of a supercritical inlet flow [AIAA PAPER 85-1214] p 6 Use of quaternions in flight mechanics p 630 A85-39658 [AD-A152616] p 675 N85-27875 HANSEN, I. G. Advanced secondary power system for transport aırcraft [NASA-TP-2463] p 673 N85-28944 HANSEN. R. S. Flight testing and development of the F/A-18A digital p 678 N85-27896 flight control system HANSON, D. B. Noise of counter-rotation propellers p 705 A85-39220 HARF. F. H. The substitution of nickel for cobalt in hot isostatically pressed powder metallurgy UDIMET 700 alloys p 686 A85-37415 HARPER-TERVET, J. Material evaluation of second-generation composites for transport wing application SAE PAPER 8415201 p 688 A85-39291 HÀRRIS, M. J. Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497] p 627 A85-39205 Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A p 663 A85-39209 HARTZUIKER, J. P. Cryogenic test technology, 1984 [AGARD-AR-212] p 700 N85-29116 HASLIM, L. A. Electro-expulsive separation system [NASA-CASE-ARC-11613-1] p 700 N85-29150 HÀTHAWAY, W. H. Subsonic and transonic aerodynamics of a wraparound fin configuration [AD-A153646] p 637 N85-28927 HAUCHECORNE, A. First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) p 639 A85-38308 HAUSNER. H. Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066 HAZEN, N. L. A new reeling technique for very long extension scanning p 640 A85-38312 in the stratosphere Assuring payload security in flight and recovery - Design p 640 A85-38315

The distribution of higher n-alkanes in partially frozen middle distillate fuels (AD-A1539401 p 692 N85-29074

- HAZLEWOOD, K. H. External caps - An approach to stress reduction in
- p 647 A85-38306 halloons HEATH, B. R.
- Boron slurry fuel atomization evaluation [AIAA PAPER 85-1184] p 6 p 689 A85-39645 HEAVEY. K. R.
- Computations of projectile Magnus effect at transonic velocities p 626 A85-38981 HEIDER. W.
- Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components
- [BMFT-FB-T-84-302] p 672 N85-27874 HEITMAN, P. W.
- Ceramic applications in turbine engines [NASA-CR-174715] p 69 p 690 N85-28109 HELDT. P. H.
- p 655 A85-37896 The cockpit of the Airbus A310 HELLER. M.
- Reducing the effects of rivet holes on fatigue life by adhesive bonding p 693 A85-37472 HELMS. H. E.
- Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28109
- HEPWORTH, H. K. Cantilevered stator vane tip leakage studies
- [AIAA PAPER 85-1136] p 664 A85-39620 HEBRICK, P. W.
- Propulsion influences on air combat p 651 A85-39789 [AIAA PAPER 85-1457] HESS. R. A.
- Toward a unifying theory for aircraft handling qualities p 651 A85-39554 HIEMENZ, R. J.
- Instrumentation for gas turbine research in short-duration facilities
- p 695 A85-39062 [SAE PAPER 841504] HINCKEL, J. N.
- Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location ASME PAPER 84-WA/HT-70] p 698 A85-39898 HIRANO, Y.
- Structural optimization p 694 A85-38352 HIRAOKA, K.
- A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 HIRSCH. C.
- Turbulence structure in the boundary layers of an oscillating airfoil [AD-A153631] p 637 N85-28926
- HITCHCOCK. L Pictorial format program - Past, present, and future
- p 656 A85-38958 HOAD, D. R.
- Background noise measurements from let exit vanes designed to reduced flow pulsations in an open-jet wind tunnel [NASA-TM-86383] p 683 N85-27916
- HOARD, M. Selecting the correct bearing can improve avionic
- p 694 A85-38403 instrument performance HOERNER, F. C.
- evaluation of airborne color display systems p 655 A85-38952
- Advanced secondary power system for transport aircraft
- [NASA-TP-2463] p 673 N85-28944 HOFMANN, D. J.
- program HOGUE, J. R.
- HOLDEMAN, J. D. Experiments in dilution jet mixing - Effects of multiple
- [AIAA PAPER 85-1104] p 664 A85-39606
- Approach to interior noise control 1 Damped trim panels p 650 A85-39221
- Numerical study of porous airfoils in transonic flow [NASA-TM-86713] p 635 N85-27828
- The Command Flight Path Display All weather, all p 656 A85-38959 missions HOPKINS, H.
- Cockpit of the future? p 655 A85-37925

PERSONAL AUTHOR INDEX

HORNER, R. M.
ACT flight research experience p 678 N85-27894
HORNUNG, H. Adaptive wall wind tunnels and wall interference
correction methods [DFVLR-IB-222-84-A-37] p 683 N85-27912
HOUSTON, G. G.
Lubrication systems for air turbine starters [SAE PAPER 841547] p 662 A85-39157 HUANG, M.
An extension of the generalized vortex-lattice method
of supersonic sideslipping wings p 626 A85-38972 HUANG, X.
The wind tunnel investigation for obtaining rolling
moment with small asymmetry p 674 A85-38970
HUBER, F. W.
Application of 3-D flow computations to gas turbine aerodynamic design
[AIAA PAPER 85-1216] p 630 A85-39659
HUBER, H.
The role of simulation p 684 N85-28919
HUGHES, L. A.
Repairing commercial aircraft jet engine nacelle composite structures
[SAE PAPER 841567] p 616 A85-39068
HULL, G.
Material evaluation of second-generation composites for
transport wing application
[SAE PAPER 841520] p 688 A85-39291 HUMENIK, F. M.
Flame radiation and liner heat transfer in a tubular-can
combustor p 663 A85-39580
KUNT, D. L
Efficiencies of multiple-input techniques for aircraft
ground vibration testing [SAE PAPER 841575] p 682 A85-39274
HURCHALLA, J.
United States Air Force engine damage tolerance
requirements
[AIAA PAPER 85-1209] p 665 A85-39657
HURLEY, S. R.
Efficiencies of multiple-input techniques for aircraft ground vibration testing
[SAE PAPER 841575] p 682 A85-39274
HURRASS, K.
The Avionics Flight Evaluation System (AFES) of
[DFVLR-MITT-85-01] p 657 N85-27864 HYNES, R. J.
Automatic flight control modes for the AFTI/F-111
mission adaptive wing aircraft p 680 N85-27909
I
IAKOBI, V. E. Observation of birds in the flight path of aircraft - An
important stage in the prevention of bird strikes
p 639 A85-37544
IAKOVLEV, A. P.
Dissipative properties of inhomogeneous materials and
systems p 687 A85-38874

- IANSHIN, A. M. Shading and interference effects during the rotation of a plate p 624 A85-38559 ICHIKAWA, A. CI Beta of unswept flat wings in sideslip II
- p 623 A85-38371 ICHIKAWA, T.
- A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV Computer program SOLST 1 p 622 A85-38355 IGNATEV, V. N.
- The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion p 661 A85-39122 chambers IKEGAWA, M.
- Two-dimensional turbulent flow analysis เก turbomachinery by the finite element method
- ASME PAPER 84-WA/FM-2] p 633 A85-39874 ILICHEV. V. D. Protection of materials and technical equipment against
- bırds p 638 A85-37540 ILIFF, K. W.
- Extraction of aerodynamic parameters for aircraft at extreme flight conditions [NASA-TM-86730] p 704 N85-29686
- IMAHASHI, S.
- Wind tunnel experiments of the high-performance rotor blades p 622 A85-38362 IRWIN, K. S.
- Meeting the 1985 FAA noise regulations with old engines and modern acoustic technology
 - p 651 A85-39616
 - [AIAA PAPER 85-1120]

- A systematic program for the development and
- HOFFMAN, A. C.

- The University of Wyoming's small scientific balloon p 639 A85-38309
- Control response measurements of the Skyship-500
- airship (AIAA PAPER 85-0881) p 649 A85-38796
- rows and non-circular onfices
- HOLMER. C. I.
- HOLST. T. L.
- HOOVER; G. W.

PERSONAL AUTHOR INDEX

ISHIDA, Y.

A method of determining the suction velocity for laminar flow control of two-dimensional airfoil in incompressible flow

- [NAL-TR-845] p 637 N85-28925 ITO, T
- Study on the comfortability of helicopter Flight test of p 647 A85-38365 acoustic noise level IUDIN. E. IA.
- The battle against noise in industry p 705 A85-39349
- IVANOV. S. G. Shading and interference effects during the rotation of p 624 A85-38559 a plate

J

JACKSON, K. E.

- Friction and wear behavior of aluminum and composite 1-beam stiffened airplane skins [NASA-TM-86418] p 652 N85-27852
- JANKOVIC, J. The finite element formulation of airflow around a
- deformable wing by using the incremental finite element p 621 A85-37879 method JARMARK. B.
- A missile duel between two aircraft
- p 703 A85-39563 JEFFERIES, K. S.
- Advanced secondary power system for transport aurcraft [NASA-TP-2463] p 673 N85-28944
- JENKINS, P. C.
- Integration of sensor and display subsystems p 656 A85-38955 JENKINS, P. E.
- Flowfield and performance measurements in a vaned radial diffuser
- [ASME PAPER 84-WA/FM-7] p 634 A85-39876 JEX. H R. Control response measurements of the Skyship-500
- airship [AIAA PAPER 85-0881] p 649 A85-38796
- JEYACHANDRABOSE, C. Explicit formulation for a high precision triangular
- laminated anisotropic thin plate finite element p 696 A85-39170

JIANG. S.

- The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade JIANG. T.
- An investigation of high performance, short thrust augmenting ejectors [ASME PAPER 84-WA/FE-10]
- p 697 A85-39873 JANG 7
- The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade Computation of the thrust performance of axisymmetric
- nozzles p 622 A85-37932 JOACHUM, A. M.
- Three powered salplanes as meteorological instrumentation for atmospheric boundary layer studies at DEVI R
- [DFVLR-FB-84-50] p 653 N85-27862 JOHNSON, H. F
- Critical speed testing of the Grumman X-29A power take-off shaft subsystem
- [SAE PAPER 841603] p 662 A85-39163 JOHNSON, L. R.
- Ceramic turbochargers A case study of a near-term application of high-strength ceramics p 700 N85-28379
- [DE85-006495] JOHNSON, W.
- Rotorcraft research testing in the National Full-Scale Aerodynamics Complex at NASA Ames Research
- p 652 N85-27854 [NASA-TM-86687] Recent developments in the dynamics of advanced rotor p 653 N85-28917 systems JOHNSTON, D.
- A perspective on superaugmented flight control advantages and problems p 677 N85-27886 JOHNSTON R
- Advanced avionics management system prevents pilots from being swamped by information overload
- p 655 A85-38401 JOHNSTON, W. L. Examination of fire safety of commercial aircraft
- p 639 A85-37693 cabins JONES, C. S. A computational method for wings of arbitrary planform
- [AD-A1537881 p 638 N85-28929

JONES. H. T

- Development of a noninterference technique for measuring turbine engine rotor blade stresses
- p 697 A85-39797 [AIAA PAPER 85-1472] JONES R
- Reducing the effects of rivet holes on fatigue life by p 693 A85-37472 adhesive bonding JONES, S. P.
- Aerodynamics of a new aerostat design with inverted-Y
- [AIAA PAPER 85-0867] p 624 A85-38783 Dynamic charactenstics of the STARS aerostat [AIAA PAPER 85-0880] p 674 A85 p 674 A85-38795
- JOSEPH, D. D. Hyperbolic phenomena in the flow of viscoelastic
- flunds [AD-A153533] p 700 N85-29186
- JOSEPH, R.
- Evaluation of nozzle throat materials for ramjet p 686 A85-37201 engines JOSHI, D.
- Development and evaluation of an integrated flight and propulsion control system [AIAA PAPER 85-1423]
- p 669 A85-39771 JOSIFOVIC. M.
- The finite element formulation of airflow around a deformable wing by using the incremental finite element p 621 A85-37879 method

Κ

- KAKINUMA, A.
- Natural frequencies and flight loads of composite main p 647 A85-38361 rotor blade for helicopter KAMANIN, L. N.
- A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust charactenstics and fuel efficiency p 660 A85-39106
- KAMIYA, N
- On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory p 684 N85-28953 [NAL-TR-847] KÀNDA, H.
- Flow quality of National Aerospace Laboratory wo-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method
- [NAL-TR-842-PT-3] p 684 N85-28952 KAPLAN, R M. Advanced Floatwall combustor liner technology
- eliminates TF30-P-100 transition duct fatigue cracking p 667 A85-39701 [AIAA PAPER 85-1288] KÅRIMOVA, A. G.
- A generalization of experimental data on heat transfe from the working medium to the housing components of the compressor of a gas-turbine engine
- p 660 A85-39112 KAROU A
- The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 KATO K
- An evading path against 3 D obstacles p 674 A85-38357
- Minimum-time path through wind fields p 647 A85-38358
- KATSANIS. T.
- Calculation of three-dimensional, viscous flow through turbomachinery blade passages by parabolic marching [AIAA PAPER 85-1408] p 632 A85-39767 KAUL. H. J.
- The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908
- KAWAMURA, K. Interaction of twin turbulent circular jet
- p 617 A85-37049 KAY, N. J.
- Instrumentation for gas turbine research in short-duration facilities p 695 A85-39062 [SAE PAPER 841504]
- KEDROV. B. M. The ideas of K E Tsiolkovskii and present-day scientific
- p 685 A85-38775 nrohlome KEENER. E. R.
- Computational/experimental pressure distributions on a p 628 A85-39210 transonic, low-aspect-ratio wing KEKELIUK, S.
- A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot p 652 N85-27857 [NRC-24173]
- KELLER, W. F. F-20 air turbine cartridge start system [SAE PAPER 841570] p 662 A85-39160

KELLEY, H. J.

Classical and neo-classical cruise-dash optimization p 650 A85-39212 KENIG. S.

KNEELAND, B. T.

- Fracture toughness of adhesively bonded joints o 688 A85-39492
- KEY, A. N. Hovercraft skirt design and manufacture
- p 694 A85-38233 KEYS, C N.
 - Rotary-wing aerodynamics Volume 1 Basic theories of rotor aerodynamics (With application to helicopters) Volume 2 Performance prediction of helicopters (2nd p 617 A85-36996 revised and enlarged edition) KHUDENKO, B. G.
 - Selecting design parameters for an engine from the totality of flight conditions p 659 A85-39103 KIDD. C. T.
 - Measurement of wing-leading-edge heating rates on wind tunnel models using the thin-film technique [AIAA PAPER 85-0972] p 681 A8
- p 681 A85-37622 Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels
- [AIAA PAPER 85-1003] p 681 A85-37644 KILIK, E.
- Influence of the blockage ratio on the efficiency of swirl eneration with vane swirlers
- [AIAA PAPER 85-1103] p 696 A85-39605 KILKENNY, E. A.
- An assessment of the suitability of the BHGA structural test ng for aerodynamic testing of hang gliders [CA-8505] p 652 N85-27853 [CA-8505]
- **кім. к к**. Research test facility for evaporation and combustion
- of alternative jet fuels at high air temperatures p 691 N85-29073 (AD-A153830) KIM. K. W.
- Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures (AD-A153830) p 691 p 691 N85-29073
- KIMURA, H. Man-powered aircraft p 615 A85-38353
- KIMURA, T.
- Aerodynamic charactenstics of the Weis-Fogh nechanism p 623 A85-38370 mechanism KING. A.
- An experimental investigation of the aerodynamic effects on a body of revolution in turning flight [AIAA PAPER 85-0866] p 624 A85-38782
- KING. A S. Progress report on the engineering development of the

An experimental determination of the longitudinal

United States Air Force engine damage tolerance

The effect of the pitch of axisymmetric nozzles on the

Explicit formulation for a high precision triangular

Research test facility for evaporation and combustion

The University of Wyoming's small scientific balloon

Temperature distortion generator for turboshaft engine

Helicopter flight test of a nng laser gyro Attitude and

Integral profile method for production of carbon fiber

Heat resistant Carbon Fiber Reinforced Plastics (CFRP)

Flight testing and development of the F/A-18A digital

laminated anisotropic thin plate finite element

Auxiliary and emergency power system

of alternative jet fuels at high air temperatures

efficiency of the nozzle assembly and of the turbine

p 649 A85-38791

D 674 A85-38794

o 665 A85-39657

p 660 A85-39107

p 696 A85-39170

p 662 A85-39162

p 691 N85-29073

p 639 A85-38309

p 659 A85-39065

p 643 A85-38529

p 690 N85-27975

p 690 N85-27976

p 678 N85-27896

B-7

Magnus Aerospace LTA 20-1 airship

stability properties of the LTA 20-1 airship [AIAA PAPER 85-0879] p 67

[AIAA PAPER 85-0876]

[AIAA PAPER 85-1209]

KING, T. T.

requirements

KIRILLOV, I. I.

KIRKMAN, B. G.

KIRWAN, J. E.

KJOME, N. T.

program

testing

KLANN, G. A.

KLEMES, M. S.

KLENNER. J.

KNEELAND, B. T.

flight control system

sheets

[AD-A153830]

[SAE PAPER 841572]

[SAE PAPER 841541]

Heading Reference System

[MBB/LFA34/CFK/PUB/006]

hardening equipment [MBB/LFA33/CFK/PUB/007]

stage KIRKHOPE, J.

KOCH. W.

Local instability characteristics and frequency determination of self-excited wake flows p 623 A85-38430

KODAMA, M. Feasibility studies of 'Polar Patrol Balloon'

p 647 A85-38321 KOECK. C.

Computation of three-dimensional flow using the Euler equations and a multiple-grid scheme p 627 A85-39200

KOGAN, M. N.

Propulsion efficiency of vibrating bodies in subsonic ga p 699 N85-28159 stream KOIKE, A.

- On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory p 684 N85-28953 [NAL-TR-847] KOKHMANIUK, S. S.
- Nonstationary deformation of structural elements and p 696 A85-39450 their optimization KOLYKHALOV, P. I.
- Instability of plane-parallel supersonic gas flows in the p 623 A85-38551 linear approximation KONDRATEV. A. B.
- Rationalizing the choice of an actuating mechanism for p 661 A85-39124 a jet drive KOPPENWALLNER, G.
- The drag of simple shaped bodies in the rarefied hypersonic flow regime
- p 621 A85-37642 [AIAA PAPER 85-0998] KORTE U. Some flight test results with redundant digital flight
- p 678 N85-27892 control systems KORZHNEV, V. N.
- Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161 KORZIUKOV. A. I.
- The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas in order to prevent bird-aircraft collisions p 638 A85-37542
- KOVARTSEV, A. N.
- An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft system p 660 A85-39121 KOZLOV, V. V.
- Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow KRAG. B.
- OLGA An open loop gust alleviation system p 678 N85-27897
- KRAIKO, A. N. Configuration of shock waves closing a local supersonic p 623 A85-38481 zone
- KRAUSMAN, J. A. Dynamic characteristics of the STARS aerostat p 674 A85-38795 [AIAA PAPER 85-0880]
- KRAUSPE P p 684 N85-28919 The role of simulation
- Contributions on the subject of longitudinal movements of aircraft in wind shears [NASA-TM-77837] p 702 N85-29432
- KRENK, S. Pretwist and shear flexibility in the vibrations of turbine blades p 657 A85-37233
- KRIER, H. Research test facility for evaporation and combustion
- of alternative jet fuels at high air temperatures p 691 N85-29073 (AD-A153830) KRIVEC, D. K.
- Investigation of transonic inlet drag characteristics [SAE PAPER 841539] p 627 A85-39063 KRUEGER, E. L.
- Combustion technology A Navy perspective [AIAA PAPER 85-1400] p 690 A85-39763
- KULAKOVSKAYA, N. A. Stressed-strained state of tightening buckles in sectional
- p 672 N85-28149 runners of gas turbines KULIKOV. V. D.
- A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method p 624 A85-38562 KURKALOV. I. I.
- Lift and thrust of a linear synchronous engine with a Lift and unuse of a solid-conductor stator winding p 658 A85-37550 KUZMICHEV, V. S.
- An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft p 660 A85-39121 system

- LABOR, J. D. composite Repair procedures for sinewave p 686 A85-37380 substructure LACKEY, W. J.
- Ceramic coatings for heat engine materials Status and future needs
- [DE85-008759] p 691 N85-29053 Ceramic coatings for heat engine materials [DE85-005238] p 691 N85-29054
- LAGACE, P. A. Damage tolerance of composite cylinders
- p 688 A85-39600 LAMPKIN, B. A.
- Future of V/STOL aircraft systems A survey of opinions [NASA-TM-86689] p 654 N85-28937
- LAREAU. J. P.
 - Twin tilt nacelle V/STOL aircraft ρ 650 A85-39208 [SAE PAPER 841556]
 - LARINA, I. N. The effect of the bluntness shape on the drag coefficient of a body in hypersonic flow of a rarefied gas
 - p 624 A85-38564 LARSEN, R. P.
 - Ceramic turbochargers A case study of a near-term application of high-strength ceramics p 700 N85-28379 [DE85-006495]
 - Promises and Future of ceramic turbochargers pitfalls p 700 N85-28380 DF85-0062091
 - LAU. M. K. The AFTI/F16 terrain-aided navigation system
 - p 645 N85-28935 [DE85-008411] LAYTON, D. M.

p 624 A85-38780

- Basic aerostatics A ti [AIAA PAPER 85-0864] A tutonal
- LEARMOUNT, D. Who needs advanced-technology airliners?
- p 647 A85-38434 LEAVITT. L. D.
- Summary of nonaxisymmetric nozzle internal performance from the NASA Langley Static Test Facility AIAA PAPER 85-1347] p 668 A85-39739 LEBEDEV. M. G.
- A supersonic inhomogeneous flow of an ideal gas around blunted bodies p 619 Å85-37335 LECORDIER, J. C.
- Dynamic behaviour of cold wires in heated airflows (T in the range from 300 to 600 K) p 694 A85-38069 LEDWA. K.
- Heat resistant Carbon Fiber Reinforced Plastics (CFRP) hardening equipment [MBB/LFA33/CFK/PUB/007] p 690 N85-27976
- LEE, R. D. Electro-expulsive separation system
- [NASA-CASE-ARC-11613-1] p 700 N85-29150 LEFAS. C. C.
- Algorithms for improved, heading assisted, maneuver p 644 A85-39458 racking LEFEBVRE. A. H.
- Influence of downstream distance on simplex atomizer pray characteristics
- [ASME PAPER 84-WA/HT-25] p 698 A85-39888 LEGGE. H.
- Pitot pressure and heat transfer measurements in hvdrazine thruster plumes [AIAA PAPER 85-0934] p 685 AB5-37599
- LEISSA, A. W.
- A study of internal and distributed damping for vibrating turbomachiner blades
- [NASA-CR-175901] p 671 N85-27868 LEODOLTER, W.
- Pilot production of superplastically formed/diffusion bonded T-38 main landing gear doors [AIAA PAPER 84-0933]
- p 616 A85-39214 LETOURNEAU, J. J.
- Advanced Floatwall combustor liner technology eliminates TF30-P-100 transition duct fatigue cracking [AIAA PAPER 85-1288] p 667 A85-39701 LEWIS. D.
- The conception and development of a family of small engines for the 1990's p 670 A85-39791 [AIAA PAPER 85-1460]
- LEWIS, J. H. Engine thrust measurement uncertainty
- [AIAA PAPER 85-1404] p 669 A85-39765
- WIS, J. T. High speed compressor rig as a stall recovery research tool
- [AIAA PAPER 85-1428] p 682 A85-39773 LI, C. P.
- Computational methods for hypersonic viscous flow over finite ellipsoid-cones at incidence [AIAA PAPER 85-0925] p 620 A85-37594

Investigation of three-dimensional separated flows

LIAGUSHIN, B. E.

- p 619 A85-37338 LIBRESCU, L
- Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies p 618 A85-37197

LIDL, J.

- Investigation of air pollution impact in Eastern Bavana Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471 LIEN. F.-S.
- Vertical plate fin with conjugated forced convection-conduction turbulent flow p 698 A85-39878
- [ASME PAPER 84-WA/HT-8] LIGUM. T. I.
- The aerodynamics of the Tu-154B aircraft p 649 A85-38850
- LILLEY. D. G.
- Predictions and measurements of isothermal flowfields in axisymmetric combustor geometries [NASA-CR-174916] p 671 N85-27867

LIN. B.

- The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967 LINDENBAUM, B.
- A new concept of hybrid airship

in weakly perturbed gas flows

stream function formulation

laminate at low temperature

LIU. D.

LIU. G.

LIU. R.

LIZZA, G. D.

LOGAN, T. R.

LOHMAN, A. L.

[AD-A152710]

LOKAI, V. I.

LORENZ, J.

LOUIS, J. F.

LOWE, J. D.

a gas turbine engine

flights

turbomachines

- [AIAA PAPER 85-0868] p 649 A85-38798 LINDGREN. L. C.
- Ceramic applications in turbine engines p 690 N85-28109 [NASA-CR-174715]
- LINDSEY, T. H. Drive system development for Propfan Test Assessment
- Program [AIAA PAPER 85-1188] p 664 A85-39646
- LING, R. T.
- Investigation of transonic inlet drag characteristics [SAE PAPER 841539] p 627 A85-39063 LIOU. M.-S.
- Numerical simulation of a supercritical inlet flow p 630 A85-39658 [AIAA PAPER 85-1214] LIPERRA, L. D.
- Computer study of a jet flap ASTVOL 'Harner [SAE PAPER 841457] p 650 A85-39202 LIPINSKI, J. J.
- Boron slurry fuel atomization evaluation AIAA PAPER 85-1184] p 689 A85-39645
- LIPNITSKIL IU. M. Determination of aerodynamic characteristics of bodies

Discussions on the regular behavior of the longitudinal

Families of variational principles for the semi-inverse and

A general theory of hybrid problems of fully 3-D

Fracture behavior of glass-cloth/polyester composite

Integrated CADCAM - An approach for advanced

An investigation into the soot production processes in

A generalization of experimental data on heat transfer

Numerical solution of the minimum-time flight of a glider

The transpired turbulent boundary layer in various

Progress report on the engineering development of the

An investigation into the hovering behaviour of the LTA

through a thermal by use of multiple shooting methods p 638 A85-37489

from the working medium to the housing components of

the compressor of a gas-turbine engine

pressure gradients and the blow-off condition [ASME PAPER 84-WA/HT-71] p 698

Magnus Aerospace LTA 20-1 airship

20-1 airship in calm and turbulent air

[AIĂA PAPER 85-0876]

[AIAA PAPER 85-0878]

composite primary aircraft structure p 703 A85-37211

Pictorial format program - Past, present, and future

compressible potential flow in turbo-rotors 1 - Axial flow,

type-A hybrid problems on a S2-streamsheet in mixed-flow

dynamic response of aircraft during variable sweep

p 619 A85-37341

p 674 A85-38974

p 622 A85-37930

p 622 A85-37931

p 688 A85-39228

p 656 A85-38958

p 690 N85-27992

p 660 A85-39112

p 698 A85-39899

p 649 A85-38791

p 641 A85-38793

PERSONAL AUTHOR INDEX

An experimental determination of the longitudinal stability properties of the LTA 20-1 airship [AIAA PAPER 85-0879] p 67 p 674 A85-38794 LU. F. K.

Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins

- p 626 A85-38984 LUKIS. G.
- Instrumentation for gas turbine research in short-duration facilities [SAE PAPER 841504] p 695 A85-39062
- LUNEV. V. V. Stability of a stationary solution to the ablation
- p 623 A85-38555 equation LUO, S.-J. A second-order approximate method for transonic
- small-disturbance potential flow and its application to the p 625 A85-38922 analysis of flows over airfoils LUPSÓN. W. F.
- Further investigations to improve the fatigue life of the Mirage 1110 wing main span [ARL-STRUC-TM-397] p 654 N85-28938
- LUXFORD, E. G. Redundancy management in strapdown navigation
- p 644 A85-38530 systems LYÉR, V. S. V.
- Simplified implicit block-bidiagonal finite difference method for solving the Navier-Stokes equations
- p 695 A85-39003 LYONS, P. R. A. Stagnation point heat transfer in hypersonic high
- enthalpy flow [AIAA PAPER 85-0973] n 620 A85-37623
- Density and velocity profiles in non-equilibrium faminar boundary layers in air [AIAA PAPER 85-0976]
- p 620 A85-37626

Μ

MABEY, D. G.

- Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds p 628 A85-39241
- MACE, J. L.
- Numerical simulation of a supercritical inlet flow p 630 A85-39658 [AIAA PAPER 85-1214] MACHIN, A. S.
- Further investigations to improve the fatigue life of the
- Mirage 1110 wing main span [ARL-STRUC-TM-397] p 654 N85-28938 MAEDA, Y.
- Subsonic multiple-jet aerodynamic window
- p 693 A85-37216 MAIORSKIL E. V.
- A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method D 624 A85-38562
- MAKSIMOV, O. L.
- A generalization of experimental data on heat transfer from the working medium to the housing components of the compressor of a gas-turbine engine p 660 A85-39112
- MALATERE, P.
- Long-duration flights using MIR (infrared balloon p 639 A85-38307 system) MANCINI, J. M.
- Engine thrust measurement uncertainty p 669 A85-39765 [AIAA PAPER 85-1404]
- MANKBADI, R. R. An investigation of lift augmentation of tandem
- [ASME PAPER 84-WA/FM-3] p 633 A85-39875 MANN, J. Y.
- Reducing the effects of rivet holes on fatigue life by p 693 A85-37472 adhesive bonding Further investigations to improve the fatigue life of the
- Mirage 1110 wing main span [ARL-STRUC-TM-397] p 654 N85-28938 MANUYLOVICH, S. V.
- Supersonic flow around blunt wedge
- p 636 N85-28158 MANWARING, S. R. Unsteady blade row interactions in a multi-stage
- compresso [AIAA PAPER 85-1134] p 630 A85-39618
- MARCHMAN, J. F., III Aerodynamics of an aspect ratio 8 wing at low Reynolds p 628 A85-39223 numbers
- MARCHUKOV, E. IU. Unstable combustion in the combustion chamber of a
- p 660 A85-39115 gas-turbine aircraft engine MARCKS, A. Preparation of sinteractive silicon nitride powders
- p 691 N85-29066 [BMFT-FB-T-84-303]

- MARCUS. A. J. The use of flight simulators in measuring and improving
- training effectiveness p 684 N85-28954 (AD-A1538171
- MARESKO, W. A. Critical speed testing of the Grumman X-29A power
- take-off shaft subsystem [SAE PAPER 841603] p 662 A85-39163 MARTELL, D. W.
- The University of Wyoming's small scientific balloon orogram p 639 A85-38309 MARTIN. R. M.
- Background noise measurements from jet exit vanes designed to reduced flow pulsations in an open-jet wind
- [NASA-TM-86383] p 683 N85-27916 MASHIBA, C. K.
- Improved resins for wet layup repair of advanced p 686 A85-37381 composite structure MASON. M. L.
- Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles p 637 N85-28924
- [NASA-TP-2432] MASUDA, W. Subsonic multiple-jet aerodynamic window
- p 693 A85-37216 MASUE, T.
- Development of the BK 117 helicopter p 674 A85-38369
- MATS, E. B. The software pack GRAD for the analysis of gas-turbine p 660 A85-39119
- onninee MATŠUZAKA. Y. Development of balloon-borne reel-down and-up winch
- evetern n 640 A85-38311 MATTHES. M.
- Air traffic Instruments, airports, companies, post, cargo nd passengers p 641 N85-28932 and passengers MATTHEWS, M. C.
- Ceramic Technology for Advanced Heat Engines Project
- [DE85-008755] p 691 N85-29052 MATTHEWS. R. K.
- Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels p 681 A85-37644 [AIAA PAPER 85-1003]
- MAYER. A. H. Heat management system for aircraft
- p 654 N85-28936 (AD-D011658) MAYER, D. W.
- PNS predicted shock location and jump conditions at supersonic and hypersonic speeds
- [AIAA PAPER 85-1407] p 632 A85-39766 MÅYER, N. J.
- North warning system airship feasibility study [AIAA PAPER 85-0858] p 640 A p 640 A85-38777 MAYMON, G.
- Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177
- MAYOROV, G. P. Vibrations of rotors connected through couplings with
- hacklash p 672 N85-28147 MCCARTHY, J. Aircraft performance in a JAWS microburst
- p 701 A85-39213 MCCARTHY, M.
- Further observations of X-rays inside thunderstorms p 701 A85-37720
- MCCLARY, C. R. Autocalibration of a laser gyro strapdown inertial
- p 642 A85-37808 reference/navigation system MCDEVITT. J. B.
- Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility [NASA-TP-2485] p 634 N85-27823 MCGEHEE, J. R.
- Active control landing gear for ground load alleviation p 679 N85-27902
- MCGOWAN, J. Avionics data base
- [AD-A152415]
- p 657 N85-27863 Avionics Data Base users manual [AD-A153810] p 657 N85-28942
- MCKEOWN, W L. Investigation of imaging and flight guidance concepts
- for rotorcraft zero visibility approach and landing [NASA-CR-166571] p 644 N85-27843 MCKINNEY, W. D.
- Wind tunnel investigation of the interaction of an airship configuration with lifting rotors
- [AIAA PAPER 85-0875] p 625 A85-38790 Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship
- [AIAA PAPER 85-0876] p 649 A85-38791

An experimental determination of the longitudinal stability properties of the LTA 20-1 airship [AIAA PAPER 85-0879] p 674 A85-38794 MCLEAN, F. E. Supersonic cruise technology INASA-SP-472] p 617 N85-28912 MCMONAGLE, D. R. Application of AFTI/F-16 task-tailored control modes in a dhur nced multirole fighters p 677 N85-27888 MCRUFR. D A perspective on superaugmented flight control p 677 N85-27886 advantages and problems MEISNER, S. C. Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures p 691 N85-29073 [AD-A153830] MELCHER, K. J. DEAN A program for dynamic engine analysis [NASA-TM-87033] p 673 N85-28945 MENGUC, M. P. Radiative transfer in a gas turbine combustor AIAA PAPER 85-1072] p 658 A85-37682 MERRIFIELD, R. M. A systematic program for the development and evaluation of airborne color display systems p 655 A85-38952 METCALFE, M. P. On the modelling of a fully-relaxed propeller elinetroom [AIAA PAPER 85-1262] p 630 A85-39685 METZGER, D. E. Acquisition of detailed heat transfer behavior in complex internal flow passages [SAE PAPER 841503] p 695 A85-39061 MEYERS, G. D. Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices [AIAA PAPER 85-1104] p 664 A85-39606 MEYERS. L. P. Integrated flight/propulsion control - Adaptive engine control system mode [AIAA PAPER 85-1425] p 669 A85-39772 MILLAN, P. P. Progress m the utilization oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284 MILLER, C. G. Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10 [AIAA PAPER 85-1061] p 621 A85-37675 MILLER, L. E. Use of quaternions in flight mechanics [AD-A152616] p 6 p 675 N85-27875 MILLMAN, V. Development of an active laminar flow nacelle [AIAA PAPER 85-1116] p 629 A8 p 629 A85-39613 MINKOV. A. Computer aided tube routing design in aircrafts p 615 A85-37183 MINOSTSEV, V. B. Investigation of three-dimensional separated flows p 619 A85-37338 MISHCHENKO, V. D. Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323 MITCHELL, R. A. Engine system field experience simulation program [SAE PAPER 841601] p 659 A85-39071 MIWA. H. Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method p 684 N85-28952 [NAL-TR-842-PT-3] MOERDER, D. D. Piloted simulation of an algorithm for onboard control of time-optimal intercept [NASA-TP-2445] p 681 N85-28949 MOLLER. P. S. The integration of a new concept in VTOL aircraft propulsion [AIAA PAPER 85-1448] p 651 A85-39785 MONTERO MORENO, R.

- Costs and tanff levies in air transportation p 705 A85-37950 MOORE, F. K.
- Stall transients of axial compression systems with inlet distortion
- [AIAA PAPER 85-1348] p 632 A85-39740 MOORE, G. W.
- Segmented zoned fuel injection system for use with a combustor [AD-D011640] p 670 N85-27865

MOORE, T. J.

- Feasibility study of the welding of SiC p 688 A85-39339 MOORHOUSE, D. J.
- The STOL and maneuver technology program integrated control system development p 680 N85-27910 MOR. H.
- Crack propagation analysis of longitudinal skin cracks in a pressurized cabin p 645 A85-37188
- MORAN, W. A. Operational and developmental experience with the F/A-18A digital flight control system
- p 678 N85-27895 MORDOFF, K. F.
- Teledyne Ryan focuses R & D effort on new RPVs, target versions p 646 A85-38245 MORGAN, D. G.
- NATCS Navigation Aided Target Control System for multiple drone applications p 642 A85-37803 MORGAN. M.
- A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot [NRC-24173] p 652 N85-27857
- MORGAN, R. G. Shock tunnel measurements of heat transfer in a model scramjet
- [AIAA PAPER 85-0908] p 658 A85-37582 MORIN, R.
- Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 669 A85-39765 MOROZOV. M. A.
- An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft system p 660 A85-39121 MOROZOV, S. A.
- The software pack GRAD for the analysis of gas-turbine engines p 660 A85-39119 MORRIS. D. L.
- Active control landing gear for ground load alleviation p 679 N85-27902
- MOUNT, J. S. Development of an active laminar flow nacelle [AIAA PAPER 85-1116] p 629 A85-39613
- MOUSTAPHA, S. H. Investigation of the effect of two endwall contours on the performance of an annular nozzle cascade (AIAA PAPER 85-1218) p 630 A85-39661
- MOXON, J.
 Turboshaft truce in Europe
 p 658
 A85-38436
- MUELLER, W. S. North warning system airship feasibility study
- [AIAA PAPER 85-0858] p 640 A85-38777 MUKHOPADHYAY, V.
- A multiloop robust controller design study using singular value gradients p 703 A85-39564 MULARZ, E. J.
- Future fundamental combustion research for aeropropulsion systems [NASA-TM-87049] p 671 N85-27870
- MURTHY, H. S. Analysis of unsteady pressure measurements on a
- supercritical arfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds [DFVLR-FB-84-49] p 636 N85-27837 WYERS, G.
- Companson of advanced cooling concepts using color thermography [AIAA PAPER 85-1289] p 667 A85-39702
- MYERS, T. A perspective on superaugmented flight control
- A perspective on superaugmented flight control advantages and problems p 677 N85-27886

Ν

- NABATOV, O. S.
- Communication in automated air-traffic-control systems p 644 A85-38647 NAGABHUSHAN, B. L. Thrust vectored take-off, landing and ground handling
- of an airship [AIAA PAPER 85-0877] p 641 A85-38792 NAGAMATSU, H. T.
- Hypersonic gas dynamics [AIAA PAPER 85-0999]
- [AIAA PAPER 85-0999] p 621 A85-37643 Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location [ASME PAPER 84-WA/HT-70] p 698 A85-39898 NAGARAJA, K. S.
- Winglet effects on the flutter of a twn-engine transport-type wing p 650 A85-39217 NAITO, A. Man-powered aircraft p 615 A85-38353

NAKAMURA, S.

- On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory [NAL-TR-847] p 684 N85-28953
- NAKANO, S. Two-dimensional turbulent flow analysis
- turbomachinery by the finite element method [ASME PAPER 84-WA/FM-2] p 633 A85-39874
- NAKASHIMA, T.
- Minimum-time path through wind fields p 647 A85-38358 NAKATA, Y.
- Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade [ASME PAPER 84-WA/HT-69] p 698 A85-39897 NALIMOV. IU S.
- The effect of stress raisers on the load-bearing capacity of titanium-alloy compressor blades p 658 A85-37575 NASTASE, A.
- Wing optimization and fuselage integration for future generation of supersonic aircraft p 618 A85-37212 NATHMAN, J. K.
- A study of aerodynamic control in stalled flight leading-edge vortex formation analysis [AD-A153758] p 638 N85-28928
- NAYANI, S. N. Compressor and turbine models - numerical stability and
 - other aspects [AD-A153811] p 673 N85-28948
- NEELY, G. M.
- Flame radiation and liner heat transfer in a tubular-can combustor p 663 A85-39580 NEGOMETIANOV, IU. B.
- Determination of aerodynamic charactenstics of bodies in weakly perturbed gas flows p 619 A85-37341 NELEPOVITZ, D. O.
- Performance of a new nose-lip hot-air anti-icing concept
- [AIAA PAPER 85-1117] p 664 A85-39614 NELLUMS, R. O.
- Field test report of the Department of Energy's 100-kW vertical axis wind turbine [DE85-008475] p 702 N85-28458
- NESTLER. D. E.
- The effects of surface discontinuities on convective hear transfer in hypersonic flow [AIAA PAPER 85-0971] p 620 A85-37621
- NETHAWAY, D. H. United States Air Force engine damage tolerance
- requirements [AIAA PAPER 85-1209] p 665 A85-39657
- NETZER, D. W. Combustion studies of metallized fuels for solid fuel
- ramjets [AIAA PAPER 85-1177] p 689 A85-39640 NEWSOM, J. R.
- A multiloop robust controller design study using singular value gradients p 703 A85-39564 NEWTON. J.
- Ice shapes and the resulting drag increase for a NACA 0012 arrfol
- [NASA-TM-83556] p 641 N85-27839 NI, R. R.
- Application of 3-D flow computations to gas turbine aerodynamic design [AIAA PAPER 85-1216] p 630 A85-39659
- NICHOLS, J. H., JR.
- Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497] p 627 A85-39205
- [SAE PAPER 841497] p 627 A85-39205 NICHOLS, J. J., JR.
- Development of a pneumatic thrust deflector [SAE PAPER 841558] p 663 A85-39209
- NIEMELA, J.
- Helicopter flight test of a ring laser gyro Attitude and Heading Reference System p 643 A85-38529 NIETUBICZ, C. J.
- Computations of projectile Magnus effect at transonic velocities p 626 A85-38981 NISHIMURA. J.
- Development of balloon-borne reel-down and-up winch system p 640 A85-38311 Feasibility studies of 'Polar Patrol Balloon'
- p 647 A85-38321 NORGREN, C. T.
- Advanced liner-cooling techniques for gas turbine combustors
- [AIAA PAPER 85-1290]
 p 667
 A85-39703

 Small gas turbine combustor study Fuel injector performance in a transpiration-cooled liner [AIAA PAPER 85-1312]
 p 668
 A85-39717
- NORMAN, D. C. Automatic flight control modes for the AFTI/F-111
- mission adaptive wing aircraft p 680 N85-27909

- NORTH, R. J.
- Cryogenic test technology, 1984 [AGARD-AR-212] p 700 N85-29116
- NORTON, R. J. G.
- Time resolved measurements of a turbine rotor stationary up casing pressure and heat transfer field [AIAA PAPER 85-1220] p 666 A85-39663 NOVICK. A. S.
 - Advanced single-rotation propfan drive system
 - p 663 A85-39577
 - Drive system development for Propfan Test Assessment Program
- [AIAA PAPER 85-1188] p 664 A85-39646 NTONE, F.
- An investigation of high performance, short thrust augmenting ejectors
- [AŠME PAPER 84-WA/FE-10] p 697 A85-39873 NUGENT. J
- Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft
- [SAE PAPER 841543] p 649 A85-39066 NUTT. K. W.
- Developments in aerothermal test techniques at the AEDC supersonic-hypersonic wind tunnels [AIAA PAPER 85-1003] p 681 A85-37644
 - 0

OBERMEIER, F.

cascade

OLSEN. W.

0012 arfoli

OLSON, G. L.

program

ORLOV. IU. F.

ORSZULAK, R. L.

ORVILLE, R. E.

[IFD-1/84-PT-1]

[IFD-1/84-PT-2]

OSIPOV, B. M.

enaines

OTSUKI T.

OSER J

[SAE PAPER 841504]

OLLERHEAD, J. B.

Rotorcraft noise

[NASA-TM-83556]

OMELCHENKO, V. V.

- Aerodynamic sound generation caused by viscous processes p 705 A85-38432 OBRIEN. W. F.
- Axial-flow compressor stage post-stall analysis [AIAA PAPER 85-1349] p 632 A85-39741
- OHTOMO, M. Natural frequencies and flight loads of composite main rotor blade for helicopter p 647 A85-38361
- OKAMOTO, T. Interaction of twin turbulent circular jet
- p 617 A85-37049 Expenment of turbulent round jet parallel to ground plane p 622 A85-38367
- OKUNO, A. F. Static and dynamic pressure measurements on a NACA 0012 airfoil in the Ames High Reynolds Number Facility [NASA-TP-2485] p 634 N85-27823 OLDFIELD, M. L. G.

Simulation of wake passing in a stationary turbine rotor

Ice shapes and the resulting drag increase for a NACA

The University of Wyoming's small scientific balloon

The effect of stress raisers on the load-bearing capacity

Software-engineering elements in the problem of the

Instrumentation for gas turbine research in short-duration facilities

Nighttime observations of thunderstorm electrical

Experimental and theoretical determination of the

Experimental and theoretical determination of the

wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for

The software pack GRAD for the analysis of gas-turbine

Automatic flight control system (AFCS) of helicopter

wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating

Derivatives (MOD) on an experimental part

calculation of the lateral wind

using an optical control algorithm

activity from a high altitude airplane p 702 A85-39526

optimal design of lift systems for flight vehicles

of titanium-alloy compressor blades p 658 A85-37575

p 629 A85-39589

p 705 N85-28916

p 641 N85-27839

p 639 A85-38309

p 646 A85-37323

p 695 A85-39062

p 654 N85-28939

p 654 N85-28940

p 660 A85-39119

p 674 A85-38364

P

- PADFIELD, G. D. The evolution of ACS for helicopters Conceptual simulation studies to preliminary design
 - p 677 N85-27890 Flight testing for performance and flying qualities
- p 654 N85-28920 PAFFRATH, D.
- Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984 p 702 N85-28471 [DFVLR-FB-85-03] PAGE, G. S.
- Aerodynamic test results for a wing-mounted turboprop propulsion installation n 627 A85-39060
- [SAE PAPER 841480] PAGE. M. A. The free interaction in a supersonic flow over a porous
- p 626 A85-39021 wali PAISLEY, D. J.
- On the effect of wing taper and sweep direction on leading edge transition p 634 N85-27827
- [CA-84351 PANCHENKO, A. A. A comparison of experimental characteristics of porous
- and blade impellers p 660 A85-39120 PANCHENKOV, A. N.
- Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323
- PANOV. IU. A. The separation of a turbulent boundary layer within a two-face angle before an obstruction
- p 619 A85-37340 PAQUET, M.
- Usage monitoring A milestone in engine life management [AIAA PAPER 85-1206] p 665 A85-39656
- PARANTHOEN, P. Dynamic behaviour of cold wires in heated airflows (T
- in the range from 300 to 600 K) p 694 A85-38069 PARKS, G. K.
- Further observations of X-rays inside thunderstorms p 701 A85-37720
- PASKONOV, V M.
- A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic p 619 A85-37336 flow
- PATTERSON, G. T. Dynamic engine behavior during post surge operation of a turbofan engine
- [AIAA PAPER 85-1430] p 669 A85-39774 PATTERSON, J. C., JR.
- Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing p 631 A85-39700 [AIAA PAPER 85-1286]
- PAUSDER, H. J. Mission requirements and handling qualities p 680 N85-28918
- PAVLOV, V. A.
- Characteristics of the oscillations of a tail unit in a flow p 649 A85-39125 of an incompressible gas PEITZSCH. R.
- Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066
- PELEGRIN, M. J. Active Control Technology (ACT) Past, present and p 676 N85-27884 future
- PELL. R. A.
- Reducing the effects of rivet holes on fatigue life by p 693 A85-37472 adhesive bonding PENDERGRAFT, O. C., JR.
- Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft
- [SAE PAPER 841543] p 649 A85-39066 Companson of advanced turboprop installation on swept
- and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686
- PERETZ. A. Evaluation of nozzle throat materials for ramjet p 686 A85-37201 engines
- PERRY, J. C. aerostat operations in the marine Tethered environmen
- p 640 A85-38778 [AIAA PAPER 85-0860] PERSHING, B. M.
- An aerodynamic performance model for hybrid heavy lift systems
- [AIAA PAPER 85-0865] p 648 A85-38781 PETERS, J. E.
- Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures p 691 N85-29073 (AD-A153830)

- PETERS, R. B.
 - Description and test methods for a frequency output accelerometer p 694 A85-38536 PETERS, W.
 - Investigation of air pollution impact in Eastern Bavana Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471 PETERS. W. L.
 - A simulation technique for jet temperature effects on nozzle-afterbody drag at transonic Mach numbers [AIAA PAPER 85-1463] p 633 A85 p 633 A85-39792
 - PETIT. C. Dynamic behaviour of cold wires in heated airflows (T
 - in the range from 300 to 600 K) p 694 A85-38069 PETROV G L
 - A system of shock and rarefaction waves in flows past bodies with complex shapes p 618 A85-37330 PETUKHOVA, T. P.
 - A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic p 619 A85-37336 flow PHELPS, A. E., III
 - Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter INASA-TP-2420] p 637 N85-28923
 - PHILIPPE, J. J. A survey of recent development in helicopter aerodynamics p 653 N85-28915
 - p 653 N85-28915 PIEMSOMBOON, P.
 - Flowfield and performance measurements in a vaned radial diffuser ASME PAPER 84-WA/FM-7] p 634 A85-39876
 - PIENING. M. The static aeroelasticity of a composite wing
 - p 701 N85-29321 PITTS, D. R.
 - An investigation of high performance, short thrust
 - augmenting ejectors [ASME PAPER 84-WA/FE-10] p 697 A85-39873 PLENCNER, R. M.
 - Advanced secondary power system for transport aircraft [NASA-TP-2463]
- p 673 N85-28944 PLUNTZE, S. C.
- Integration of the B-52G Offensive Avionics System (OAS) with the Global Positioning System (GPS) p 685 A85-38545
- POKROVSKII, A. N. Approximate relationships for determining pressure at
- the surface of a sphere or a cylinder for arbitrary free-stream Mach numbers p 624 A85-38563 POLIAKOV, I. N.
- Stability of a stationary solution to the ablation p 623 A85-38555 equation POLL D. I. A.
- Some effects of sweep direction and strakes for wings with sharp leading edges [CA-8421] p 634 N85-27826
- On the effect of wing taper and sweep direction on leading edge transition [CA-8435]
- p 634 N85-27827 POMMEREAU, J. P.
- First results of a stratospheric experiment using a p 639 A85-38308 Montgolfiere Infra-Rouge (MIR) PORTER. B.
- Design of digital flight control systems for helicopters p 673 A85-37195 PORTER, J. H.
- What an airship manufacturer faces in a certification program today
- AIAA PAPER 85-0870] p 641 A85-38785 POTONIDES, H.
- Substantiation of the applicability of VSAERO panel method to subsonic inlet design [AIAA PAPER 85-1119] p 629 A85-39615
- POTTER, J. L. Transitional, hypervelocity aerodynamic simulation and
- scaling in light of recent flight data [AIAA PAPER 85-1028] p 621 A85-37661
- POWELL, E. S. calculating An improved procedure for tho aerothermodynamic properties of a vitiated air test medium
- [AIAA PAPER 85-0913] p 704 A85-37583 POWER, G. D
- Numerical investigation of internal high-speed viscous flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768
- POZNYAK, E. L. Vibrations of rotors connected through couplings with
- backlash p 672 N85-28147 PRICE, D. B.
- Piloted simulation of an algorithm for onboard control of time-optimal intercept [NASA-TP-2445]
- p 681 N85-28949

- PRISNIAKOV, V. F
- A companison of experimental characteristics of porous and blade impellers p 660 A85-39120 PROCTOR. M. P.

REHFIELD, L. W.

- Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796 PROKOPENKO, A. V.
- Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567 PROKOPEV. V. I.
- A generalization of experimental data on heat transfer from the working medium to the housing components of the compressor of a gas-turbine engine
- p 660 A85-39112 PRZYBYLKO S J
 - Application of system identification techniques to poststall combustor dynamics
 - [AIAA PAPER 85-1353] p 669 A85-39743 PSUL IA. M.
 - Development and testing of the RPS-1000 parachute system for the MMR-06-DART meteorological rocket system p 685 A85-38608 PHILIN DI
 - Stability of the thin-jet model of the unsteady jet flap p 626 A85-38997
- PUTNAM I F Results of AGARD assessment of prediction capabilities for nozzle afterbody flows
 - [AIAA PAPER 85-1464] p 633 A85-39793

Q

- QIU, C. H.
- Some effects of sweep direction and strakes for wings with sharp leading edges [CA-8421] p 634 N85-27826
- QUAM. D. L. A new concept of hybrid airship
- p 649 A85-38798 [AIAA PAPER 85-0868] QUICK. S.
 - An overview of structural repair adhesives p 686 A85-37407

R

RABIN, U. H.

separation

RAJAN. N.

dynamics

RAKOV. G. L.

stage

RALPH. B.

RAND, J. L.

RAND. O.

RAO, S.

stage

REDDY, K. C.

REDING, J. P.

REDKAR, R. T.

REDMAN. J. F.

REHFIELD, L. W.

from equatorial latitudes

[SAE PAPER 841601]

other aspects

[AD-A153811]

separation

RASSOKHIN, V. A.

The limits of stratofilm

Flight testing and development of the F/A-18A digital flight control system RAISINGHANI, S. C. p 678 N85-27896

Slow and fast state variables for three-dimensional flight

The effect of the pitch of axisymmetric nozzles on the

A new unsteady prescribed wake model of the

The effect of the pitch of axisymmetric nozzles on the

efficiency of the nozzle assembly and of the turbine

Compressor and turbine models - numerical stability and

Stratospheric flights with large polyethylene balloons

Engine system field experience simulation program

Experimental determination of the effect of nonlinear

Dynamic overshoot of the static stall angle

stiffness on the vibration of elastic structures

efficiency of the nozzle assembly and of the turbine

temperature-dependent flow properties of TI-6AI-4V

aerodynamic behavior of a rotor in forward flight

Perturbed motion of airplane

and safe store p 674 A85-38168

p 675 A85-39567

p 660 A85-39107

p 687 A85-38749

p 646 A85-38302

p 617 A85-37178

and safe store p 674 A85-38168

p 660 A85-39107

p 673 N85-28948

p 628 A85-39225

p 639 A85-38304

p 659 A85-39071

p 692 A85-37177

B-11

the

Perturbed motion of airplane

REICHERT, G. Helicopter aeromechanics Introduction and historical p 653 N85-28914 revie REINBERG. E. Influence of fighter aircraft load spectrum variations on fatigue crack initiation and growth p 693 A85-37181 ROSEN, A. REINHARDT, M. E. Three powered saliplanes as meteorological instrumentation for atmospheric boundary layer studies at p 653 N85-27862 [DFVLR-FB-84-50] REISING, J. M. Pictorial format program - Past, present, and future ROSENTHAL H. A. p 656 A85-38958 RENSHAW, T. Aircraft service testing of ultrasonically welded panels p 646 A85-37408 REYNOLDS. C. Future prop-fans - Tractor or pusher p 664 A85-39647 [AIAA PAPER 85-1189] RHODES, C Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 RHODES, D. L. Predictions and measurements of isothermal flowfields in axisymmetric combustor geometries [NASA-CR-174916] p 671 N85-27867 RICHARDS, W. R. ACT applied to helicopter flight control p 678 N85-27891 RIDDLEBAUGH, S. M. Advanced liner-cooling techniques for gas turbine combustors p 667 A85-39703 [AIAA PAPER 85-1290] Small gas turbine combustor study - Fuel injector performance in a transpiration-cooled liner [AIAA PAPER 65-1312] p 668 A85-39717 RIDGELY, D. R. Time-domain stability robustness measures for linear regulators p 703 A85-39565 RIEDLER, W. Scientific ballooning - IX, Proceedings of the Seventh Symposium, Graz, Austna, June 25-July 7, 1984 p 615 A85-38301 RILEY. N. The free interaction in a supersonic flow over a porous wall p 626 A85-39021 RISING, J. J. SACHS, I. B. Demonstration of relaxed static stability on a commercial transport p 679 N85-27898 RIZK. N. K. influence of downstream distance on simplex atomizer spray characteristics p 698 A85-39888 [ASME PAPER 84-WA/HT-25] RIZZI. A SAITO, K. Modelling vortex flowfields by supercomputers with super-size memory p 628 A85-39242 ROBACK, R. Fuel injection characterization and design methodology to improve lean stability [AIAA PAPER 85-1183] p 664 A85-39644 ROBERTS, J. H. Engine thrust measurement uncertainty [AIAA PAPER 85-1404] p 6 p 669 A85-39765 ROBINSON, W. W. Noncontact engine blade vibration measurements and anatysis [AIAA PAPER 85-1473] p 670 A85-39798 RODGERS, C. Secondary power unit options for advanced fighter SANTAVICCA, D. A. [AIAA PAPER 85-1280] p 666 A85-39696 RODIN, K. G. The effect of the pitch of axisymmetric nozzles on the SARVAT ALI, S. efficiency of the nozzle assembly and of the turbine p 660 A85-39107 stage ROESCH, P. SATO, T. A survey of recent development in helicopter aerodynamics p 653 N85-28915 ROGO, C. SATO, Y. Vanable cycle turboshaft technology for rotor-craft of the 90's [AIAA PAPER 85-1278] p 666 A85-39695 ROHLF, D. Identification of gust input and gust response charactenstics from Do 28 TNT flight test data [DFVLR-FB-84-48] p 676 M p 676 N85-27881 ROMANENKO. L. G. Nonstationary deformation of structural elements and their optimization p 696 A85-39450 ROMINEK, J. P. Pressunzed Air Start System (PASS) for small gas turbine engines

[SAE PAPER 841571] p 662 A85-39161 ROPELEWSKI, R. R.

Mirage 2000 fighter combines acceleration, low-speed p 646 A85-38243 etability ROSCOE, S. N.

Display technology and the role of human factors p 656 A85-38957

- A new unsteady prescribed wake model of the aerodynamic behavior of a rotor in forward flight p 617 A85-37178
- ROSEN, J. M. The University of Wyoming's small scientific balloon p 639 A85-38309 program
- Performance of a new nose-lip hot-air anti-icing concept
- AIAA PAPER 85-11171 p 664 A85-39614 ROSLIAKOV, G. S.
- Gas flow in nozzles and jets p 619 A85-37337 ROWEY, R. J.
- Application of 3-D flow computations to gas turbine aerodynamic design [AIAA PAPER 85-1216] p 630 A85-39659
- ROYCE, B. S. H. The role of surface generated radicals in catalytic
- p 671 N85-27869 combustion RUHLIN, C. L. Winglet effects on the flutter of a twin-engine
- p 650 A85-39217 transport-type wing RUMFORD, K. J.
- Control of fuel during starting of a gas turbine [SAE PAPER 841511] p 661 Af p 661 A85-39155 RÚSAKOV. S. V.
- A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic p 619 A85-37336 RUSSELL, H. H.
- Design of robust controllers for a multiple input-multiple output control system with uncertain parameters application to the lateral and longitudinal modes of the KC-135 transport aircraft [AD-A153100] p 675 N85-27877
- RUYCK, J. D.
- Turbulence structure in the boundary layers of an oscillating airfoil p 637 N85-28926 [AD-A153631]

S

- Efficiencies of multiple-input techniques for aircraft ground vibration testing p 682 A85-39274
- [SAE PAPER 841575] SADLER, G. G.
- DEAN A program for dynamic engine analysis p 673 N85-28945 [NASA-TM-87033]
- Natural frequencies and flight loads of composite main rotor blade for helicopter p 647 A85-38361 SAKAKIBARA, S.
- Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method
- [NAL-TR-842-PT-3] p 684 N85-28952 SANBORN, J.
- Comparison of advanced cooling concepts using color thermography [AIAA PAPER 85-1289] p 667 A85-39702
- SANDEMAN, R. J. Stagnation point heat transfer in hypersonic high
- enthalpy flow [AIAA PAPER 85-0973] p 620 A85-37623
- The role of surface generated radicals in catalytic p 671 N85-27869 combustion
- Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape
- Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364
- Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study [AIAA PAPER 85-1313] p 668 A85-39718
- SATO, Y. O. M.
- Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel. Part 3 Flow turbulence level and measuring method [NAL-TR-842-PT-3] p 684 N85-28952 SCALEA. J. C.
- Airport and airway system cost allocation model Volume User's manual
- [AD-A1528771 p 683 N85-27917

PERSONAL AUTHOR INDEX

SCHADOW, K. C. Interaction between acoustics and subsonic ducted flow in a ramiet configuration p 704 A85-37209 SCHAFFHAUSER, A. C. Ceramic coatings for heat engine materials Status and firturo noode p 691 N85-29053 (DE85-008759) SCHAFRANEK. D. In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft [DFVLR-FB-84-12] p 676 N85-27880 SCHERR, S. J. Use of quaternions in flight mechanics [AD-A152616] p 6 p 675 N85-27875 SCHETZ, J. A. Numerical solutions of ramjet nozzle flows [AIAA PAPER 85-1270] p 631 p 631 A85-39689 SCHIMANSKI, D. Cryogenic test technology, 1984 [AGARD-AR-212] p 700 N85-29116 SCHMERWITZ, D. Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed range [DFVLR-FB-84-52] p 676 N85-27882 SCHMIDT, W. p 681 A85-37491 European transonic wind tunnel SCHMIDT. W. E. Lubrication systems for air turbine starters [SAE PAPER 841547] p 662 A85-39157 SCHNEIDER, E. T. p 658 A85-38956 Modernizing engine displays SCHULZ, P. The Avionics Flight Evaluation System (AFES) of DEVI B [DFVLR-MITT-85-01] p 657 N85-27864 SCHWEIKHARD, W. G. Dynamic ground effects on a two-dimensional flat p 628 A85-39226 nlate SCOTT, J. R. Improved resins for wet layup repair of advanced omposite structure p 686 A85-37381 composite structure SCOTT. L. A. Application of technology to achieve value - Added in-service support [SAE PAPER 841566] p 659 A85-39067 SEDLOCK D Improved statistical analysis method for prediction of maximum inlet distortion [AD-A153767] p 673 N85-28947 SEIDEL. M. Construction 1976-1980 Design, manufacturing, calibration of the German-Dutch wind tunnel (DNW) p 683 N85-27913 SEIFERT, R. Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data acquisition and processing system [DFVLR-MITT-85-03] p 684 N85-27921 SELEGAN, D. R. The STOL and maneuver technology program integrated p 680 N85-27910 control system development SELLA. F. The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908 SERA. N. Natural frequencies and flight loads of composite main rotor blade for helicopter p 647 A85-38361 SEROVA. V. D. Characteristics of steady-state hypersonic flow about blunted bodies with discontinuities in generators p 636 N85-28155 SETTLES, G. S. Conical similarity of shock/boundary-layer interactions generated by swept and unswept fins p 626 A85-38984 SHALEV. D. Crack growth analysis in multiple load path structure p 693 A85-37186 SHAMROTH, S. J. Users manual for coordinate generation code CRDSRA [NASA-CR-172584] p 634 N85-27824 User's manual for airfoil flow field computer code SRAIR [NASA-CR-172585] p 634 N85-27825 SHANI, S. Evaluation of nozzle throat materials for ramiet p 686 A85-37201 engines SHASTIN, E. G. Precision die forging of blades or gas turbines p 672 N85-28148

PERSONAL AUTHOR INDEX

SHAW, J. K.

Deployable Core Automated Maintenance System (DCAMS) [AD-A153695] p 706 N85-29839 SHAW, P. D. Development and evaluation of an integrated flight and

propulsion control system [AIAA PAPER 85-1423] p 669 A85-39771 SHAW, R. Ice shapes and the resulting drag increase for a NACA 0012 artfol

[NASA-TM-83556] p 641 N85-27839 SHEER, R. E., JR. Hypersonic gas dynamics

[AIAA PAPER 85-0999] p 621 A85-37643 SHELLEY, S. H. The Command Flight Path Display - All weather, all missions p 656 A85-38959

SHELTON, C. G. The influence of microstructure on th

...... unuuence of microstructure on the temperature-dependent flow properties of Ti-6AI-4V p 687 A85-38749

SHELUDKO, G. A.

Nonstationary deformation of structural elements and their optimization p 696 A85-39450 SHEN, K.-Y.

A second-order approximate method for transonic small-disturbance potential flow and its application to the analysis of flows over airfoils p 625 A85-38922 SHEN, M.

Numencal simulation of three-dimensional transonic flow in a turbomachinery p 625 A85-38965 The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967

SHEN, W. Fracture behavior of glass-cloth/polyester composite laminate at low temperature p 688 A85-39228 SHEVIAKOV. V. S.

The effectiveness of acoustic repellants in frightening birds away from airports p 639 A85-37543 SHIKANO, Y.

Two-dimensional turbulent flow analysis in turbomachinery by the finite element method [ASME PAPER 84-WA/FM-2] p 633 A85-39874

SHINAR, J. First-order feedback strategies for variable speed planar pursuit-evasion games p 703 A85-37198

SHIPILOV, S. D. Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161

SHIRAFUJI, Y. Subsonic multiple-jet aerodynamic window

- p 693 A85-37216
- On power effectient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory [NAL-TR-847] p 684 N85-28953

SHISHMAREV, A. V. The aerodynamics of the Tu-154B aircraft

p 649 A85-38850 SHLAUSTAS, R. IU.

Software-engineering elements in the problem of the optimal design of lift systems for flight vehicles p 646 A85-37323

SHMILOVICH, A. Multignd calculation of transonic flow past wing-tail-fuselage combinations p 628 A85-39216

SHOQUIST, R. R. The ARINC 704 nng laser gyro inertial Reference System p 643 A85-38528

System SHOVLIN. M. D.

Circulation control technology applied to propulsive high lift systems

[SAÉ PAPER 841497] p 627 A85-39205 SHUPIKOV. A. N.

Nonstationary deformation of structural elements and their optimization p 696 A85-39450 SHYY, W.

A further assessment of numerical annular dump diffuser flow calculations

[AIAA PAPER 85-1440] p 633 A85-39779 SIGAL, A.

The evaluation of aerodynamic coefficients for projectiles fired from a hovering helicopter p 618 A85-37203

SILVERSTEIN, L. D.

A systematic program for the development and evaluation of airborne color display systems p 655 A85-38952

SIMMONS, J. M.

Stability of the thin-jet model of the unsteady jet flap p 626 A85-38997

SKIRA, C. Development and evaluation of an integrated flight and propulsion control system [AIAA PAPER 85-1423] p 669 A85-39771 SKRIPNICHENKO, S. IU. The aerodynamics of the Tu-154B aircraft

p 649 A85-38850 SKUDRIDAKIS. J.

OLGA An open loop gust alleviation system p 678 N85-27897

- SMALL, C. J. High speed compressor ng as a stall recovery research
- tool [AIAA PAPER 85-1428] p 682 A85-39773
- SMITH, C. A. Rotorcraft research testing in the National Full-Scale Aerodynamics Complex at NASA Ames Research
- Center [NASA-TM-86687] p 652 N85-27854 SMITH. C. E.
- Fuel injection characterization and design methodology to improve lean stability
- [AIAA PAPER 85-1183] p 664 A85-39644 SMITH, D. A.
- Combustion instability sustained by unsteady vortex combustion
- [AIAA PAPER 85-1248] p 689 A85-39676 SMITH, I. S.

Recent matenals problems relating to catastrophic balloon failures p 647 A85-38303 SMITH. P.

Prospects and problems of advanced open rotors for commercial aircraft

(AIAA PAPER 85-1191) p 665 A85-39649 SMITH, R. C.

Aerodynamic test results for a wing-mounted turboprop propulsion installation

[SAE PAPER 841480] p 627 A85-39060 SMITH, R. E., JR.

From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 SMITH, W. D.

A systematic program for the development and evaluation of airborne color display systems p 655 A85-38952

SOBIECZKY, H.

Methods for design aerodynamics of modern transport aircraft

[DFVLR-FB-85-05] p 636 N85-27838 SOGA, H.

An evading path against 3 D obstacles p 674 A85-38357

SPARIS, P. D.

A computational study of the unsteady shock-wave structure in a two-dimensional transonic rotor p 629 A85-39578

SPRENT, A.

An automatic navigation and aspect sensing system for X-ray astronomy p 643 A85-38314 SRINIVASAN. R.

Experiments in dilution jet mixing - Effects of multiple rows and non-circular orifices

[AIAA PAPER 85-1104] p 664 A85-39606 STACEY, J. M.

- Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191 STALKER, R. J.
- Shock tunnel measurements of heat transfer in a model scramjet

[AIAA PAPER 85-0908] p 658 A85-37582 STANEWSKY, E.

Adaptive wall wind tunnels and wall interference correction methods

[DFVLR-IB-222-84-A-37] p 683 N85-27912 STEIN, Y.

The role of surface generated radicals in catalytic combustion p 671 N85-27869 STEINLE, F. W.

Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds

p 628 A85-39241 STELZER, I. M.

Air transport deregulation - The US experience and its applicability to Europe p 705 A85-39369 STENKIN. E. D.

Determination of the blade height of the last compressor stage for a refined thermodynamic design analysis of turbofan engines p 661 A85-39126 STEPNIEWSKI, W. Z.

Rotary-wing aerodynamics Volume 1 - Basic theories of rotor aerodynamics (With application to helicopters) Volume 2 Performance prediction of helicopters (2nd revised and enlarged edition) p 617 A85-36996

Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed range [DFVLR-FB-84-52] p 676 N85-27882 STINTON, D. P. Ceramic coatings for heat engine materials. Status and future needs [DE85-008759] p 691 N85-29053 Ceramic coatings for heat engine materials [DE85-005238] p 691 N85-29054 STOMPS, T. F. The Tethered Aerostat Antenna Program (TAAP) demonstration phase [AIAA PAPER 85-0883] p 616 A85-38797 STREBY, G. D. Multi-ducted inlet combustor research and development [AD-A153753] p 673 N85-28946 STUART, A. R. The unducted fan engine AIAA PAPER 85-1190] p 665 A85-39648 STUREK, W. B. Computations of projectile Magnus effect at transonic p 626 A85-38981 elocities STURZA, M. A. Commercial aviation GPS Navigation Set architecture

The influence of blade wakes on the performance of

outwardly curved combustor pre-diffusers

STEVENS S. J.

STICH. G.

[AIAA PAPER 85-1291]

TANNER, D. D.

D 667 A85-39704

p 644 A85-38538 SUBRAMANIAN, S. V.

Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines [AIAA PAPER 85-1332] p 631 A85-39728 SUBRENAT, E. H.

The bonding of materials for propulsion systems

- p 687 A85-39175 SUEMATSU, S. A study on the method for solving the equation of
- A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 SUNKARA, B. D.
- Dynamic charactenstics of the STARS aerostat [AIAA PAPER 85-0880] p 674 A85-38795 SUNYOTO 1
- Toward a unifying theory for aircraft handling qualities p 651 A85-39554
- SURAMPUDI, S. P. Unsteady flow in multistage turbines

p 698 N85-27946

- On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory [NAL-TR-847] p 684 N85-28953
- SUZUKI, M. On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory [NAL-TR-847] p 684 N85-28953

SYBERG, J. External compression supersonic inlet analysis using a

finite difference two-dimensional Navier-Stokes code p 629 A85-39581

Т

TAGASHIRA, T.

- Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study
- [AIAA PAPER 85-1313] p 668 A85-39718 TAKAHAMA. M.
- Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364 TAKANASHI, I.

Wind tunnel experiments of the high-performance rotor blades 0 622 A85-38362

TAKENAWA, T.

tunnel

TANNER, D. D.

[SAF PAPER 841478]

Wind turnel experiments of the high-performance rotor blades p 622 A85-38362

Terrain/wire and wirelike obstacles warning system for helicopters p 655 A85-38363 TAKISHIMA. T.

Automatic flight control system (AFCS) of helicopter using an optical control algorithm p 674 A85-38364 TANG, G. Experimental investigation of heat transfer distribution

inside the gap of a flat plate-flap combination in a shock

Engine inlet interaction with a prop-fan propulsion

p 695 A85-38973

p 627 A85-39058

B-13

TATARENKO, V. I.

TATARENKO, V. I. Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket p 685 A85-38610 TATRO, J. S.

- Display technology and the role of human factors p 656 A85-38957 TAYLOR, G. R.
- Starter-engine interface concepts [SAE PAPER 841548] p 662 A85-39158 TAYLOR, J. R.
- Fuel droplet size measurements with a laser Doppler interferometer
- p 697 A85-39643 [AIAA PAPER 85-1182] TERRELL, L. A. Integrated flight/propulsion control - Adaptive engine
- control system mode p 669 A85-39772 [AIAA PAPER 85-1425]
- THEILE, J. R. The design and development of the Grace Aircraft GAC-20 airship
- p 648 A85-38784 [AIAA PAPER 85-0869] THOMAS J B
- GPS-based certification for the microwave landing system p 642 A85-37825 THOMASSON, R. E.
- Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 mission adaptive wing aircraft
- THOMPSON, J. Design of a small airship [AIAA PAPER 85-0872] p 648 A85-38787
- THOMPSON, T. L.
- A balloon tracking system that uses the VHF omidirectional range (VOR) network p 643 A85-38313 THORNTON, C. L.
- GPS-based certification for the microwave landing p 642 A85-37825 system THRASHER, S. R.
- Ceramic applications in turbine engines [NASA-CR-174715] p 69 p 690 N85-28109
- TICATCH. L. A. Measurement of wing-leading-edge heating rates on
- wind tunnel models using the thin-film technique [AIAA PAPER 85-0972] p 681 A p 681 A85-37622 TIKHONOV, A. V.
- The effectiveness of acoustic repellants in frightening birds away from airports p 639 A85-37543
- TILL, R. D. Evaluation of radionavigation systems p 643 A85-37831
- TIMOSHENKO, O. I.
- The software pack GRAD for the analysis of gas-turbine ngines p 660 A85-39119 engines TINDELL, R.
- Substantiation of the applicability of VSAERO panel method to subsonic inlet design p 629 A85-39615 [AIAA PAPER 85-1119]
- TIPTON, D. L. Development of an advanced vaneless inlet particle
- separator for helicopter engines p 666 A85-39694 [AIAA PAPER 85-1277] TOH. H.
- Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study
- [AIAA PAPER 85-1313] p 668 A85-39718 TÒLES. R. D.
- Application of AFTI/F-16 task-tailored control modes in advanced multirole fighters p 677 N85-27888 TOLLE, F. F.
- Fuel freeze point investigations [AD-A152801] p 690 N85-28129
- TÔLMACHEV, Ý. I. Rationalizing the choice of an actuating mechanism for p 661 A85-39124 a let drive
- TOMLINSON, N. P. Thrust vectored take-off, landing and ground handling
- of an airship [AIAA PAPER 85-0877] p 641 A85-38792
- TÖRKAR, K. Scientific ballooning - IX, Proceedings of the Seventh
- Symposium, Graz, Austria, June 25-July 7, 1984 p 615 A85-38301 TOULOUSE, P.
- Certifying complex digital systems on civil aviation aircraft p 680 N85-27907 TRETIAKOV. P. V.
- Diffraction of a single plane wave by a conical wing p 623 A85-38483 TRIPPI, A
- Effects of inlet pressure fluctuations on axial flow compressors Some experimental and theoretical roculte [AIAA PAPER 85-1135] p 696 A85-39619

B-14

- TRUJILLO, E. J.
- Display technology and the role of human factors p 656 A85-38957 TSURUDA, K.
- Feasibility studies of 'Polar Patrol Balloon' p 647 A85-38321
- TSUTAHARA, M. Aerodynamic characteristics of the Weis-Footh p 623 A85-38370 mechanism
- TUNAKOV, A. P. The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 enaines
- TURŇER, D. Attitude determination in a limb-scanning balloon
- p 655 A85-38319 radiometer TURNER, J p 656 A85-38954
- Color CRT in the F-15 U

UFFEN. D. R.

- Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship
- p 649 A85-38791 [AIAA PAPER 85-0876] An experimental determination of the longitudinal stability properties of the LTA 20-1 airship
- p 674 A85-38794 AIAA PAPER 85-0879] UGRIUMOV. V. S.
- Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600
- UNNEVER. G.
- Performance characteristics of rectangular and circular thrust augmenting ejectors [AIAA PAPER 85-1344] p 631 A85-39736
- URSO. M.
- Instrumentation for gas turbine research short-duration facilities [SAE PAPER 841504] p 695 A85-39062
- USTINOV, M. V.
- Propulsion efficiency of vibrating bodies in subsonic gas p 699 N85-28159 stream

- VADYAK, J.
- Investigation of transonic inlet drag characteristics p 627 A85-39063 [SAE PAPER 841539]
- VALCKENAERE. W. Twin tilt nacelle V/STOL aircraft p 650 A85-39208 [SAE PAPER 841556]
- VAMETTEN, D. Avionics data base p 657 N85-27863
- [AD-A152415] VAN DER GEEST, J.
- Comparison of advanced cooling concepts using color thermography
- [AIAA PAPER 85-1289] p 667 A85-39702 VANDALSEM, W. R.
- Numerical study of porous airfoils in transonic flow p 635 N85-27828 [NASA-TM-86713] VANETTEN, D.
- Avionics Data Base users manual p 657 N85-28942 [AD-A153810]
- VANGOOL, M. F. G.
- How to handle failures in advanced flight control systems p 679 N85-27905 of future transport aircraft VANLEER, B.
- Upwind-difference methods for aerodynamic problems governed by the Euler equations p 635 N85-27834 [REPT-84-23]
- VANWINKLE, T. L.
- The distribution of higher n-alkanes in partially frozen middle distillate fuels [AD-A153940] p 692 N85-29074
- VASILEV, IU. K. Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket
- p 685 A85-38610 VAUGHAN, O. H., JR. Nighttime observations of thunderstorm electrical
- activity from a high altitude airplane p 702 A85-39526 VDOVICHENKO, N. S.
- Communication in automated air-traffic-control p 644 A85-38647 systems VINCENT. J. H.
- Development and evaluation of an integrated flight and propulsion control system
- [AIAA PAPER 85-1423] p 669 A85-39771 VISKANTA, R.
- Radiative transfer in a gas turbine combustor p 658 A85-37682 [AIAA PAPER 85-1072]

- VISSER, H. G.
- First-order feedback strategies for variable speed planar pursuit-evasion games p 703 A85-37198 VITTAL B. V. R.
- Development of an advanced vaneless inlet particle separator for helicopter engines [AIAA PAPER 85-1277] p 666 A85-39694
- VLASOV, A. IU. A numerical investigation of a viscous hypersonic air
- flow around elongated blunted bodies at large angles of attack p 619 A85-37333 VLASOV, I. I.
- A study of the thermal inertia of a thermocouple exposed to short temperature pulses at high Reynolds numbers
 - p 695 A85-39117
- VOGLSINGER, M. Development of a fuselage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction
- [MBB/LFA34/CFK/PUB/008] p 651 N85-27851 VOLKONSKAIA, T. G. p 619 A85-37337 Gas flow in nozzles and jets
- VOLODKO, A. M. Fundamentals of the flight operations of helicopters
- p 649 A85-38875 Aerodynamics VON LAVANTE. E.
- Simplified implicit block-bidiagonal finite difference method for solving the Navier-Stokes equations p 695 A85-39003
- VONNEGUT, B.
- Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 VORONOV, S. K.
- Characteristics of a two-dimensional turbulent jet in a p 695 A85-39131 bounded slipstream VORTHMAN, R.
- the marine Tethered aerostat operations n environment
- [AIAA PAPER 85-0860] p 640 A85-38778

W

WADIA, A. R.

WAGNER, D. A.

WALKER, D. J.

WALKER, M. J.

WANG. B.

WANG. O.

WANG. Y

WANHILL, R. J. H.

[NLR-MP-84001-U]

WANNENWETSCH. G. D.

[AIAA PAPER 85-0972]

[AIAA PAPER 85-1003]

WARMBRODT, W.

[NASA-TM-86687]

Color CRT in the F-15

Something old, something new

Interaction of twin turbulent circular jet

WARUSZEWSKI, H.

WARWICK. G.

WATANABE, A.

WATANABE, T.

temperature study

[AIAA PAPER 85-1313]

Center

[AIAA PAPER 85-1466]

ACT flight research experience

Programme (EAP) demonstration aircraft

Quasi-three-dimensional blade design code

Quasi-three-dimensional blade design code

double-tube short duration jet simulation facility

wind tunnel models using the thin-film technique

AEDC supersonic-hypersonic wind tunnels

Numerical solution of two- and three-dimensional rotor tip leakage models p 626 A85-38989 WAGENKNECHT, C. D.

Axisymmetric thrust reversing thrust vectoring exhaust

The flight control system for the Experimental Aircraft

A new technique to break diaphragms electrically in a

Engineering significance of fatigue thresholds and short fatigue cracks for structural design

Measurement of wing-leading-edge heating rates on

AIAA PAPER 85-0972] p 681 A85-37622 Developments in aerothermal test techniques at the

Rotorcraft research testing in the National Full-Scale

Application of 3-D aerothermal model and flow

visualization technique to the combustor exit gas

Aerodynamics Complex at NASA Ames Research

p 670 A85-39794

p 663 A85-39577

p 678 N85-27894

p 680 N85-27908

p 622 A85-37928

p 622 A85-37928

p 682 A85-38975

p 700 N85-28430

p 681 A85-37644

p 652 N85-27854

p 656 A85-38954

p 648 A85-38440

p 617 A85-37049

p 668 A85-39718

system for maneuver and balanced field length aircraft

Advanced single-rotation propfan drive system

PERSONAL AUTHOR INDEX

WATKINS. W. B. Dynamic gas temperature measurement system p 694 A85-37706 Noncontact engine blade vibration measurements and [AIAA PAPER 85-1473] p 670 A85-39798 WATSON, J. H. Application of AFTI/F-16 task-tailored control modes in dvanced multirole fighters p 677 N85-27888 advanced multirole fighters WEBB, G. Spacer structure p 670 N85-27866 [AD-D011641] WEBSTER, J. L. High Endurance Lighter Than Air (HELTA) Program AIAA PAPER 85-0861] p 640 A85-38779 WEFALD, K. M. Autocalibration of a laser gyro strapdown inertial reference/navigation system p 642 A85-37808 WEHOFER, S. From measurement uncertainty to measurement communications, credibility, and cost control in propulsion ground test facilities p 682 A85-39243 WÈIHS, D. The stability of symmetrical vortices in the wake of elliptical cylinders in confined flow p 618 A85-37194 WEILMUENSTER, K. J A review of some approximate methods used in aerodynamic heating analyses [AIAA PAPER 85-0906] p 620 A85-37580 WELGE, H. R. Aerodynamic test results for a wing-mounted turboprop propulsion installation p 627 A85-39060 [SAE PAPER 841480] WELKER. J. Helicopter flight test of a ring laser gyro Attitude and Heading Reference System p 643 A85-38529 WELLBORN, J. M Engine design for maintenance and support p 665 A85-39654 [AIAA PAPER 85-1204] WHEELER, R. L. Hovercraft skirt design and manufacture p 694 A85-38233 WHITAKER, A. X-29 digital flight control system design p 677 N85-27889 WHITE, C. D. Experiments in dilution jet mixing - Effects of multiple rows and non-circular onfices [AIAA PAPER 85-1104] p 664 A85-39606 WHITE, K. C. Future of V/STOL aircraft systems A survey of opinions [NASA-TM-86689] p 654 N85-28937 WHITE, R. H. Subsonic and transonic aerodynamics of a wraparound fin configuration [AD-A153646] p 637 N85-28927 WHITE, R. W. Development in UK rotor blade technology p 615 A85-38236 WHITEHEAD, R. S. Assessment of damage tolerance in composites p 688 A85-39598 WHITTLEY. D. C. Recent developments in ejector design for V/STOL aircraft [SAE PAPER 841498] p 663 A85-39206 WICHMANN, G. Design of a basic profile for a low sweep airfoil Part Experimental investigation on the DFVLR-W1 airfoil 2 profile in the Brunswick transonic wind tunnel p 635 N85-27833 [DFVLR-FB-85-01-PT-2] WICKENS. R. H. Wing tunnel investigation of dynamic stall of an NACA 0018 airfoil oscillating in pitch [NAE-AN-27] p 635 N85-27830 WIGGENRAAD, J. F. M. Frangibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431 WILDER. S. E. Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10 [AIAA PAPER 85-1061] p 621 A85-37675 WILHELM. K.

In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft XIA, J.

XIANG. Y.

XIAO, R.

XU. D.

laminate at low temperature

laminate at low temperature

vortex separation

[DFVLR-FB-84-12] p 676 N85-27880 Aspects of application of ACT systems for pilot workload p 677 N85-27887 alleviation WILLEKE, H.

Three powered sailplanes as meteorological instrumentation for atmospheric boundary layer studies at DFVLR [DFVLR-FB-84-50] p 653 N85-27862

WILLEY, C. S. Demonstration of relaxed static stability on a commercial p 679 N85-27898 transport WILLIAMS, L. J. Stability and control results for advanced turboprop aft-mount installations [SAE PAPER 841479] p 675 A85-39059 WILLIAMSON, R. G. Investigation of the effect of two endwall contours on the performance of an annular nozzle cascade [AIAA PAPER 85-1218] p 630 A p 630 A85-39661 WILSON, S. B., III Computer study of a jet flap ASTVOL 'Harrier' [SAE PAPER 841457] p 650 A85-39202 Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208 WINCHENBACH, G. L. Subsonic and transonic aerodynamics of a wraparound fin configuration [AD-A153646] p 637 N85-28927 WINGROVE, R. C. Applications of state estimation in aircraft flight-data analysis p 650 A85-39211 WINTER, J. S. The evolution of ACS for helicopters Conceptual simulation studies to preliminary design 0 677 N85-27890 WOETTING, G Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] N85-29066 p 691 WOLF. J. P. Axisymmetric thrust reversing thrust vectoring exhaust system for maneuver and balanced field length aircraft p 670 A85-39794 [AIAA PAPER 85-1466] WON. D. J. Avionics data base p 657 N85-27863 [AD-A152415] Avionics Data Base users manual [AD-A153810] p 657 N85-28942 WONG, K. Y. An application of source-panel and vortex methods for aerodynamic solutions of airship configurations p 624 A85-38789 [AIAA PAPER 85-0874] WONG. T. S. Wind tunnel investigation of the interaction of an airship configuration with lifting rotors TAIAA PAPER 85-0875] p 625 A85-38790 WOODSON, S. H. Numerical and experimental determination of secondary separation on delta wings in subsonic flow p 628 A85-39219 WRAY, A. P. The influence of blade wakes on the performance of utwardly curved combustor pre-diffusers p 667 A85-39704 [AIAA PAPER 85-1291] WRIGHT S.A. Measured and predicted vortex-induced leeward heating on a biconic at Mach 6 and 10 [AIAA PAPER 85-1061] p 621 A85-37675 WU. C. C. Study of an asymmetric flap nozzle as a thrust-vectoring device p 629 A85-39582 WU. S. C. GPS-based certification for the microwave landing p 642 A85-37825 system WÚ. W. Flow-field matrix solution for flow along arbitrarily twisted S1 surface employing non-orthogonal curvilinea p 622 A85-37927 coordinates WYATT, G. C. F. The evolution of active control technology systems for the 1990's helicopter p 680 N85-27911 WYNOSKY, T. A. Engine inlet interaction with a prop-fan propulsion system [SAE PAPER 841478] p 627 A85-39058 X

Fracture behavior of glass-cloth/polyester composite

The numerical calculation of the pressure distribution

Investigation on configurations in longitudinal direction

Fracture behavior of glass-cloth/polyester composite

wind-tunnel testing of forward swept wings

of sharp edge slender wings with leading or side edge

p 688 A85-39228

p 625 A85-38966

p 625 A85-38969

p 688 A85-39228

YAGITA. M. Interaction of twin turbulent circular jet

p 617 A85-37049 Experiment of turbulent round jet parallel to ground p 622 A85-38367 YAMAGAMI, T.

γ

- Development of balloon-borne reel-down and-up winch p 640 A85-38311 svstem YAMAMOTO, Y.
- Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack
- [AIAA PAPER 85-0924] p 620 A85-37593 YĂMANAKA, M. D.
- Development of balloon-borne reel-down and-up winch vstem p 640 A85-38311 YANG. T.
- An investigation of high performance, short thrust augmenting ejectors [ASME PAPER 84-WA/FE-10] p 697 A85-39873
- YĖ. W. Investigation on configurations in longitudinal direction
- wind-tunnel testing of forward swept wings p 625 A85-38969
- YEDAVALLI, R. K. Time-domain stability robustness measures for linear regulators p 703 A85-39565 YETERIAN. V. H.
 - Optical system for measuring shadowgraph data
- AD-D011642] p 705 N85-28784 YINDA. H.
- Experimental research on the effect of separation flow on ablation in supersonic turbulent flow p 694 A85-37625 [AIAA PAPER 85-0975]
- YÔNKE, W. A. Integrated flight/propulsion control - Adaptive engine
- control system mode [AIAA PÁPER 85-1425] p 669 A85-39772 YOSHITAKE, Y.
- Wind tunnel experiments of the high-performance rotor p 622 A85-38362 blades
- YOUNG, A. D. The aerodynamics of control p 679 N85-27901 YOUNG, L. E.
- GPS-based certification for the microwave landing system p 642 A85-37825
- YU, H. Flow-field matrix solution for flow along arbitrarily twisted
- S1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927 YU, J. C.
- Power spectral density of subsonic jet noise p 704 A85-37898 YUN. Q.
- Investigation on reducing the flow noise of the 0.6 m x 0 6 m trisonic wind tunnel p 682 A85-38968

Ζ

ZAMAN, K. B. M. Q.

- Power spectral density of subsonic jet noise p 704 A85-37898
- ZANINE, J. J. Estimation of hot gas reingestion for a VTOL aircraft at the conceptual design stage
- [SAE PAPER 841555] p 663 A85-39207 ZAPHIR. Z.
- A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling cntena under multiple loading p 693 A85-3718
- ZEWI. I. G. Fracture toughness of adhesively bonded joints p 688 A85-39492
- ZHANG. Y Quasi-three-dimensional blade design code
- p 622 A85-37928 Numerical simulation of three-dimensional transonic flow
- p 625 A85-38965 in a turbomachinery ZHAO, J.
- Fracture behavior of glass-cloth/polyester composite p 688 A85-39228 laminate at low temperature ZHIYUNG, L.
- An application of source-panel and vortex methods for erodynamic solutions of airship configurations p 624 A85-38789 [AIAA PAPER 85-0874]
- ZHOU. C. An integral method of wall interference correction for
- p 682 A85-38962 low speed wind tunnel ZHOU, S.
- The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967

ZHU, G.

ZHU, G.

Quasi-three-dimensional blade design code p 622 A85-37928 ZHU, S.

Model of the wind field in a downburst p 701 A85-39218

ZHUKOV, O. M. An evaluation of the exhaust system configuration from the cruise efficiency criteria of an engine in an aircraft system p 660 A85-39121

ZIKA, V. J. Correlation and prediction of rotating stall inception by divergence method p 629 A85-39245

ZILZ, D. E. The investigation of inlet/nozzle flowfield coupling using compact propulsion simulators

compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698 ZINN, B. T.

State of the art and research needs of pulsating combustion [ASME PAPER 84-WA/NCA-19] p 690 A85-39913

ZUBKOV, A. I. Investigation of three-dimensional separated flows p 619 A85-37338

The separation of a turbulent boundary layer within a two-face angle before an obstruction

p 619 A85-37340 ZUKOSKI, E. E.

Combustion instability sustained by unsteady vortex combustion [AIAA PAPER 85-1248] p 689 A85-39676

. ...

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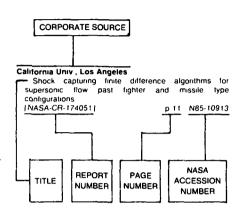
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CORPORATE SOURCE INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

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Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document

Δ

Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)

Active Control Systems	
Projections [AGARD-CP-384]	p 676 N85-27883
Helicopter Aeromechanics [AGARD-LS-139]	p 617 N85-28913
Aeronautical Research Labs. Flight trials of a modified gulfs external stores [AD-A153376]	
Further investigations to imp Mirage 1110 wing main span [ARL-STRUC-TM-397]	rove the fatigue life of the p 654 N85-28938
Description and illustration c [AD-A153543]	p 701 N85-29325
Air Force Armament Lab., Eglin Subsonic and transonic aero fin configuration [AD-A153646]	
Air Force Inst. of Tech., Wrig Aerodynamic performance of using the PANAIR program	f a wing in ground effect
[AD-A153303] Investigation of heat transfer using a shock tube	p 635 N85-27832 to a turbine blade cascade

[AD-A153090] p 671 N85-27871

Design of robust controllers for a multiple input-multiple output control system with uncertain parameters application to the lateral and longitudinal modes of the KC-135 transport aircraft [AD-A153100] p 675 N85-27877

estimation using Heating parameter coaxial

thermocouple gages in wind tunnel test articles [AD-A153039] p 699 N85-28328 Air Force Logistics Management Center, Gunter AFS,

- Automated maintenance system test program increment VI production scheduling
- [AD-A153694] p 706 N85-29838 Deployable Core Automated Maintenance System (DCAMS)
- AD-A153695] n 706 N85-29839 Air Force Wright Aeronautical Labs., Wright-Patterson AFB. Ohio.
- Use of quaternions in flight mechanics [AD-A152616] p 6 p 675 N85-27875 The STOL and maneuver technology program integrated control system development p 680 N85-27910 Proceedings of the 9th US Air Force and the Federal Republic of Germany Data Exchange Agreement Meeting, Viscous and Interacting Flow Field Effects
- p 699 N85-28266 [AD-A153020] Improved statistical analysis method for prediction of maximum inlet distortion
- p 673 N85-28947 [AD-A153767] Analytical Methods, Inc., Redmond, Wash.
- A study of aerodynamic control in stalled flight leading-edge vortex formation analysis p 638 N85-28928 [AD-A153758]
- A study of aerodynamic control in stalled flight long laminar separation bubble analysis [AD-A153850] p 638 N85-28930
- Applied Systems Inst., Inc., Washington, D.C. Avionics data base
 - p 657 N85-27863 [AD-A152415] Avionics Data Base users manual
- p 657 N85-28942 [AD-A153810] Argonne National Lab., III.
- Ceramic turbochargers A case study of a near-term application of high-strength ceramics
- p 700 N85-28379 [DE85-006495] Future of ceramic turbochargers Promises and outfalls
- [DE85-006209] p 700 N85-28380 Army Aviation Systems Command, St. Louis, Mo. Wind-tunnel evaluation of a 21-percent-scale powered
- model of a prototype advanced scout helicopter [NASA-TP-2420] p 637 N85-28923 Army Propulsion Lab., Cleveland, Ohlo.
- Temperature distortion generator for turboshaft engine
- testing [SAE PAPER 841541] p 659 A85-39065 High-temperature erosion of plasma-sprayed, yttria-stabilized zirconia in a simulated turbine environment
- [AIAA PAPER 85-1219] p 689 A85-39662 Army Research and Technology Labs., Cleveland,
- Ohio. DEAN A program for dynamic engine analysis
- p 673 N85-28945 INASA-TM-870331 Army Structures Lab., Hampton, Va.
- Friction and wear behavior of aluminum and composite I-beam stiffened airplane skins
- p 652 N85-27852 [NASA-TM-86418] Avco Lycoming Div., Stratford, Conn.
- Application of Runge Kutta time marching scheme for the computation of transonic flows in turbomachines
- p 631 A85-39728 [AIAA PAPER 85-1332] Avions Marcel Dassault-Brequet Aviation, Saint-Cloud (France).
- The interactive generation of specifications for an onboard software series (GISELE) p 679 N85-27906

в

- Boeing Commercial Airplane Co., Seattle, Wash.
- Winglet effects on the flutter of a twin-engine ansport-type wing p 650 A85-39217 transport-type wing Boeing Military Airplane Development, Seattle, Wash. Automatic flight control modes for the AFTI/F-111 p 680 N85-27909 mission adaptive wing aircraft
- Fuel freeze point investigations p 690 N85-28129 IAD-A1528011 British Aerospace Aircraft Group, Brough (England).
- ACT flight research experience p 678 N85-27894

- British Aerospace Public Ltd. Co., Lancashire (England).
- An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893

С

Center for Naval Analyses, Alexandria, Va. The use of flight simulators in measuring and improving

- training effectiveness [AD-A153817] p 684 N85-28954
- Centre d'Etudes et de Recherches, Toulouse (France). Active Control Technology (ACT) Past, present and future p 676 N85-27884
- Charles River Analytics, Inc., Cambridge, Mass. Evaluation of a fault tolerant system for an integrated avionics sensor configuration with TSRV flight data
- [NASA-CR-172589] p 657 N85-28941
- Cleveland State Univ., Ohio. Unsteady flow in multistage turbines
- p 698 N85-27946 Colorado School of Mines, Golden,
- Jet fuel instability mechanisms
- [NASA-CR-175856] p 690 N85-28127 Cranfield Inst. of Tech., Bedford (England). Some effects of sweep direction and strakes for wings
- with sharp leading edges [CA-8421] p 634 N85-27826
- On the effect of wing taper and sweep direction on leading edge transition
- [CA-8435] p 634 N85-27827 An assessment of the suitability of the BHGA structural test rig for aerodynamic testing of hang gliders p 652 N85-27853 [CA-85051

D

- Dayton Univ., Ohio.
- USAF damage tolerant design handbook Guidelines for the analysis and design of damage tolerant aircraft structures, revision B [AD-A153161]
- p 652 N85-27858 Defence Research Establishment, Ottawa. (Ontario). A general area air traffic controller simulation using colour graphics
- [AD-A153634] p 645 N85-28933 Department of Energy, Washington, D. C. A 5-year research plan, 1985-1990
- Wind energy technology Generating power from the wind [DE85-008427] p 702 N85-28463
- Department of the Air Force, Washington, D.C. Segmented zoned fuel injection system for use with a
- combustor [AD-D011640] p 670 N85-27865
- Spacer structure [AD-D011641] p 670 N85-27866
- Optical system for measuring shadowgraph data D-D011642] p 705 N85-28784 Heat management system for aircraft [AD-D011642]
- [AD-D011658] p 654 N85-28936
- Strutless diffuser for gas turbine engine [AD-D011662] p 672 N85-28943 Laminated thermoplastic radome
- [AD-D011664] p 691 N85-29045 Deutsche Forschungs- und Versuchsanstalt fuer Luft-
- und Raumfahrt, Brunswick (West Germany). Design of a basic profile for a low sweep airfoil Part Experimental investigation on the DFVLR-W1 airfoil
- profile in the Brunswick transonic wind tunnel [DFVLR-FB-85-01-PT-2] p 635 p 635 N85-27833
- The Avionics Flight Evaluation System (AFES) of DEVLR (DFVLR-MITT-85-01) p 657 N85-27864
- In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft p 676 N85-27880 [DFVLR-FB-84-12]
- Identification of gust input and gust response characteristics from Do 28 TNT flight test data [DFVLR-FB-84-48] p 676 N85-27881

SOURCE

Deutsche Forschungs- und Versuchsanstalt

Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed rance [OFVLR-FB-84-52] p 676 N85-27882

Aspects of application of ACT systems for pilot workload n 677 N85-27887 offeviation Mission requirements and handling qualities p 680 N85-28918

Structural Analysis

p 701 N85-29313 [DEVI B-MITT-84-21] Research on structural analysis at the DFVLR,

p 701 N85-29314 Brunswick The static aeroelasticity of a composite wing p 701 N85-29321

Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt, Goettingen (West Germany).

Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds p 636 N85-27837 (DFVLR-FB-84-49) Methods for design aerodynamics of modern transport

urcraft [DFVLR-FB-85-05] p 636 N85-27838

Adaptive wall wind tunnels and wall interference correction methods [DFVLR-IB-222-84-A-37] p 683 N85-27912

The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany [DFVLR-FB-85-04] p 684 N85-27920 Deutsche Forschungs- und Versuchsanstalt fuer Luft-

und Raumfahrt, Öberpfaffenhofen (West Germany). Three powered salplanes as meteorologica instrumentation for atmospheric boundary layer studies at DEVI B

p 653 N85-27862 [DFVLR-FB-84-50] Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data acquisition and processing system p 684 N85-27921 [DFVLR-MITT-85-03]

Investigation of air pollution impact in Eastern Bavaria Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471 Deutsches Museum, Munich (West Germany).

Air traffic Instruments, airports, companies, post, cargo nd passengers p 641 N85-28932 and passengers Dornier-Werke G.m.b.H., Friedrichshafen (West

Germany). OLGA An open loop gust alleviation system

p 678 N85-27897

Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamic test results for a wing-mounted turboprop propulsion installation

[SAE PAPER 841480] p 627 A85-39060 Duits-Nederlandse Windtunnel, Noordoostpolder (Netherlands).

Construction 1976-1980 Design, manufacturing, calibration of the German-Dutch wind tunnel (DNW) p 683 N85-27913

F

Federal Aviation Administration, Washington, D.C. National airspace review, change 1 [AD-A152369] p 644 N85-27844

G

- Garrett Turbine Engine Co., Phoenix, Ariz. Progress the utilization ın
- oxide-dispersion-strengthened alloy for small engine turbine blades [SAE PAPER 841512] p 688 A85-39284
- Experiments in dilution jet mixing Effects of multiple rows and non-circular onfices
- [AIAA PAPER 85-1104] p 664 A85-39606 General Dynamics Corp., Fort Worth, Tex. Application of AFTI/F-16 task-tailored control modes in

advanced multirole fighters p 677 N85-27888 General Electric Co., Binghamton, N.Y.

The state-of-the-art and future of flight control systems p 677 N85-27885 General Motors Corp., Indianapolis, Ind.

Ceramic applications in turbine engines [NASA-CR-174715] p 690 N85-28109

Grumman Aerospace Corp., Bethpage, N.Y. Twin tilt nacelle V/STOL aircraft [SAE PAPER 841556] p 650 A85-39208

Grumman Aircraft Engineering Corp., Bethpage, N. Y. X-29 digital flight control system design

p 677 N85-27889

C-2

н

Harvard Univ., Cambridge, Mass.

A new reeling technique for very long extension scanning in the stratosphere p 640 A85-38312

1

Illinois Univ., Urbana.

Research test facility for evaporation and combustion of alternative jet fuels at high air temperatures [AD-A1538301 p 691 N85-29073

J

Jet Propulsion Lab., California Inst. of Tech.,

Pasadena.

GPS-based certification for the microwave landing system p 642 A85-37825 Microwave responses of the western North Atlantic [NASA-CR-175888] p 699 N85-28191

Joint Inst. for Advancement of Flight Sciences, Hampton, Va.

A multiloop robust controller design study using singular value gradients p 703 A85-39 Joint Publications Research Service, Arlington, Va. p 703 A85-39564

USSR report. Transportation [JPRS-UTR-84-025] p 641 N85-27841

- Test flight of IL-76TD long-range transport variant p 641 N85-27842
- Vibrations of rotors connected through couplings with p 672 N85-28147 backlash Precision die forging of blades or gas turbines
- p 672 N85-28148 Stressed-strained state of tightening buckles in sectional p 672 N85-28149

runners of gas turbines Characteristics of steady-state hypersonic flow about blunted bodies with discontinuities in generators p 636 N85-28155

Supersonic flow around blunt wedge p 636 N85-28158

Propulsion efficiency of vibrating bodies in subsonic ga stream p 699 N85-28159

- Method of calculating separation flow of subsonic gas stream around winds p 636 N85-28161 MBB expands CADAM system for a 320 program p 704 N85-29099
- Lightning-safe carbon fiber composite for Airbus tail
- p 692 N85-29100 unit DFVLR research in aluminum-lithium alloys
- p 692 N85-29105

Lockheed-California Co., Burbank. Demonstration of relaxed static stability on a commerci transport 0 679 N85-27898 London Univ. (England).

The aerodynamics of control p 679 N85-27901 Loughborough Univ. of Technology (England). Rotorcraft noise p 705 N85-28916

Μ

McDonnell Aircraft Co., St. Louis, No. The investigation of inlet/nozzle flowfield coupling using

compact propulsion simulators [AIAA PAPER 85-1284] p 651 A85-39698

- Integrated flight/propulsion control Adaptive engine control system mode [AIAA PAPER 85-1425] p 669 A85-39772
- Controller requirements for uncoupled aircraft motion, volume 1
- [AD-A153173] p 675 N85-27878 Controller requirements for uncoupled aircraft motion, volume 2

[AD-A1533001 p 676 N85-27879 Operational and developmental experience with the F/A-18A digital flight control system

p 678 N85-27895 McLean (F. Edward), Yorktown, Va.

Supersonic cruise technology [NASA-SP-472]

an

p 617 N85-28912 sserschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany).

Realisation of relaxed static stability on a commercial transport p 679 N85-27899 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

Results of AGARD assessment of prediction capabilities for nozzle afterbody flows

[AIAA PAPER 85-1464] p 633 A85-39793

Some flight test results with redundant digital flight p 678 N85-27892 control systems The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft

CORPORATE SOURCE

p 680 N85-27908 p 684 N85-28919 The role of simulation Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn

(West Germany). Development of a fuselage forward section in Carbon

Fiber Reinforced Plastic (CFRP) type of construction [MBB/LFA34/CFK/PUB/008] p 651 N85-27851 Integral profile method for production of carbon fiber

[MBB/LFA34/CFK/PUB/0061 p 690 N85-27975 Heat resistant Carbon Fiber Reinforced Plastics (CFRP)

hardening equipment [MBB/LFA33/CFK/PUB/007] p 690 N85-27976 Mitre Corp., McLean, Va.

- Airport and airway system cost allocation model Volume User's manual
 - [AD-A152877] p 683 N85-27917

N

National Aeronautical Establishment, Ottawa (Ontario). An introduction to vortex breakdown and vortex core bursting p 635 N85-27829

[NAE-AN-28]

Wing tunnel investigation of dynamic stall of an NACA 0018 airfoil oscillating in pitch [NAE-AN-27] n 635 N85-27830

National Aeronautics and Space Administration, Washington, D. C.

Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914 Adding computationally efficient realism to Monte Carlo

turbulence simulation [NASA-TP-2469] p 704 N85-28708

Contributions on the subject of longitudinal movements of aircraft in wind shears

[NASA-TM-77837] p 702 N85-29432 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

Control response measurements of the Skyship-500 airship

- [AIAA PAPER 85-0881] p 649 A85-38796 Aerodynamic test results for a wing-mounted turboprop
- ropulsion installation [SAE PAPER 841480] p 627 A85-39060
- Computer study of a jet flap ASTVOL 'Harner' [SAE PAPER 841457] p 650 A85-39202
- Circulation control technology applied to propulsive high lift systems [SAE PAPER 841497]
- p 627 A85-39205 Two tilt pacelle V/STOL aircraft

p 650 A85-39208 [SAE PAPER 841556] Computational/experimental pressure distributions on a

- transonic, low-aspect-ratio wing p 628 A85-39210 Applications of state estimation aircraft flight-data
- p 650 A85-39211 analysis Computer studies of hybrid slotted working sections with

minimum steady interference at subsonic speeds p 628 A85-39241 Slow and fast state variables for three-dimensional flight

The investigation of inlet/nozzle flowfield coupling using

Static and dynamic pressure measurements on a NACA 0012 autoil in the Ames High Reynolds Number Facility

Numerical study of porous airfoils in transonic flow

Rotorcraft research testing in the National Full-Scale

Recent developments in the dynamics of advanced rotor

Future of V/STOL aircraft systems A survey of

Extraction of aerodynamic parameters for aircraft at

Dryden (Hugh L.) Flight Research Center, Edwards,

Integrated flight/propulsion control - Adaptive engine

Electro-expuisive separation system

National Aeronautics and Space Administration.

[NASA-CASE-ARC-11613-1]

extreme flight conditions

Aerodynamics Complex at NASA Ames Research

dynamics

Center

systems

opinions

Calif.

compact propulsion simulators

[AIAA PAPER 85-1284]

[NASA-TP-2485]

[NASA-TM-86713]

[NASA-TM-86687]

[NASA-TM-86689]

[NASA-TM-86730]

control system mode

[AIAA PAPER 85-1425]

p 675 A85-39567

p 651 A85-39698

p 634 N85-27823

p 635 N85-27828

p 652 N85-27854

p 653 N85-28917

p 654 N85-28937

p 700 N85-29150

p 704 N85-29686

p 669 A85-39772

CORPORATE SOURCE

National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif. Modernizing engine displays p 658 A85-38956 Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 aircraft [SAE PAPER 841543] p 649 A85-39066 National Aeronautics and Space Administration. Johnson (Lyndon B.) Space Center, Computational methods for hypersonic viscous flow over

Computational methods for hypersonic viscous flow over finite ellipsoid-cones at incidence [AIAA PAPER 85-0925] p 620 A85-37594

National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A review of some approximate methods used in aerodynamic heating analyses

[AIAA PAPER 85-0906] p 620 A85-37580 Measured and predicted vortex-induced leeward heating on a bicomic at Mach 6 and 10

[AIAA PAPER 85-1061] p 621 A85-37675 Power spectral density of subsonic jet noise p 704 A85-37898

Stability and control results for advanced turboprop aft-mount installations (SAE PAPER 841479) p 675 A85-39059

Results of a wind tunnel/flight test program to compare afterbody/nozzle pressures on a 1/12 scale model and an F-15 arcraft

[SAE PAPER 841543] p 649 A85-39066 Winglet effects on the flutter of a twin-engine transport-type wing p 650 A85-39217 A multiloop robust controller design study using singular

value gradients p 703 A85-39564 Companson of advanced turboprop installation on swept

and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264] p 630 A85-39686 Effect of a wing-tip mounted pusher turboprop on the

aerodynamic characteristics of a semi-span wing [AIAA PAPER 85-1286] p 631 A85-39700 Circular-to-rectangular transition ducts for high-aspect

ratio nonaxisymmetric nozzles [AIAA PAPER 85-1346] p 632 A85-39738 Summary of nonaxisymmetric nozzle internal performance from the NSA Langley Static Test Facility [AIAA PAPER 85-1347] p 668 A85-39739

Results of AGARD assessment of prediction capabilities for nozzle afterbody flows [AIAA PAPER 85-1464] p 633 A85-39793

Supersonic aerodynamic characteristics of canard, tailless, and aft-tail configurations for 2 wing planforms [NASA-TP-2434] p 634 N85-27822 Friction and wear behavior of aluminum and composite

I-beam stiffened airplane skins [NASA-TM-86418] p 652 N85-27852

Addition of flexible body option to the TOLA computer program, part 1 [NASA-CR-132732-1] p 652 N85-27855

Addition of flexible body option to the TOLA computer program Part 2 User and programmer documentation [NA\$A-CR-132732-2] p 652 N85-27856

Active control landing gear for ground load alleviation p 679 N85-27902 Effect of superconducting solenoid model cores on

[NASA-TM-86378] p 683 N85-27915

Background noise measurements from jet exit vanes designed to reduced flow pulsations in an open-jet wind tunnel [NASA-TM-86383] p 683 N85-27916

Wind-tunnel evaluation of a 21-percent-scale powered model of a prototype advanced scout helicopter

[NASA-TP-2420] p 637 N85-28923 Static investigation of several yaw vectoring concepts on nonaxisymmetric nozzles

[NASA-TP-2432] p 637 N85-28924 Piloted simulation of an algorithm for onboard control

of time-optimal intercept [NASA-TP-2445] p 681 N85-28949 National Aeronautics and Space Administration. Lewis

Research Center, Cleveland, Ohlo. The substitution of nickel for cobalt in hot isostatically pressed powder metallurgy UDIMET 700 alloys

p 686 A85-37415 Fibers for structurally reliable metal and ceramic p 687 A85-37484 Temperature distortion generator for turboshaft engine

[SAE PAPER 841541] p 659 A85-39065

Feasibility study of the welding of SiC p 688 A85-39339

Flame radiation and liner heat transfer in a tubular-can combustor p 663 A85-39580 Experiments in dilution jet mixing - Effects of multiple rows and non-circular orifices

[AIAA PAPER 85-1104] p 664 A85-39606

High-temperature erosion of plasma-sprayed, yttna-stabilized zirconia in a simulated turbine environment

[AIAA PAPER 85-1219] p 689 A85-39662 Advanced liner-cooling techniques for gas turbine combustors

[AIAA PAPER 85-1290] p 667 A85-39703 Small gas turbine combustor study - Fuel injector

performance in a transpiration-cooled liner [AIAA PAPER 85-1312] p 668 A85-39717 Application of Runge Kutta time marching scheme for

the computation of transonic flows in turbornachines [AIAA PAPER 85-1332] p 631 A85-39728 Calculation of three-dimensional, viscous flow through turbornachinery blade passages by parabolic marching [AIAA PAPER 85-1408] p 632 A85-39767 Numerical calculation of subsonic jets in crossflow with

reduced numerical diffusion [AIAA PAPER 85-1441] p 697 A85-39780 Transient technique for measuring beat transfer

Transient technique for measuring heat transfer coefficients on stator airfoils in a jet engine environment [AIAA PAPER 85-1471] p 697 A85-39796 Ice shapes and the resulting drag increase for a NACA 0012 airfoil

[NASA-TM-83556] p 641 N85-27839 Future fundamental combustion research for aeropropulsion systems

[NASA-TM-87049] p 671 N85-27870 Unsteady heat transfer due to time-dependent free

stream velocity p 699 N85-27947 Advanced secondary power system for transport aircraft

[NASA-TP-2463] p 673 N85-28944 DEAN A program for dynamic engine analysis

[NASA-TM-87033] p 673 N85-28945 National Aeronautics and Space Administration.

Marshall Space Flight Center, Huntsville, Ala.

Dynamic ground effects on a two-dimensional flat plate p 628 A85-39226 Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526 National Aeronautics and Sacce Administration

lational Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.

Recent materials problems relating to catastrophic balloon failures p 647 A85-38303 National Aerospace Lab., Amsterdam (Netherlands). Aerodynamic research in preparation for a new Dutch transport aircraft with supercritical wings

[B8580077] p 636 N85-27836 Flying in spite of the weather

[NLR-MP-84021-U] p 644 N85-27847 Developments in the area of air traffic control systems and the relation with meteorology [NLR-MP-84029-U] p 645 N85-27848

[NLR-MP-84029-U] p 645 N85-27848 A system for take-off and landing measurements (STALINS)

[B8580072] p 645 N85-27849 Parameter identification results of tests in nonsteady

symmetric flight with the Hawker Hunter Mk 7 [NLR-TR-83042-U] p 653 N85-27860 New materials and techniques for aircraft structures

[B8580074] p 653 N85-27861 Fan noise suppression in turbofan engines

[B8580076] p 671 N85-27872 Testing of materials and coatings for jet engine components under simulated operational conditions

[B8580073] p 672 N85-27873 How to handle failures in advanced flight control systems

of future transport aircraft p 679 N85-27905 The application of numerical control (NC) in

manufacturing wind tunnel models [B8580078] p 699 N85-28140

Engineering significance of fatigue thresholds and short fatigue cracks for structural design [NLR-MP-84001-U] p 700 N85-28430

Frangibility of obstacles at airports [NLR-MP-84002-U] p 700 N85-28431

Research on structures and materials [B8580080] p 700 N85-28432

 Operations research
 p

 [B8561897]
 p
 704
 N85-28712

 Technical services at NLR
 [B8561898]
 p
 705
 N85-28871

Cryogenic test technology, 1984 [AGARD-AR-212] p 700 N85-29116

National Aerospace Lab., Tokyo (Japan). A method of determining the suction velocity for laminar

flow control of two-dimensional airfoil in incompressible flow

 [NAL-TR-845]
 p 637
 N85-28925

 Gust load alleviation of a cantilevered rectangular elastic wing
 Wind tunnel experiment and analysis

 [NAK-TR-86]
 p 681
 N85-28950

Politecnico di Torino (Italy).

Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method [NAL-TR-842-PT-3] p 684 N85-28952

On power effectent operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory

[NAL-TR-847] p 684 N85-28953 National Research Council of Canada, Ottawa

(Ontario). A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot [NRC-24173] p 652 N85-27857

[NRC-24173] p 652 N85-27857 Naval Air Systems Command, Washington, D. C. Twin tilt nacelle V/STOL aircraft

[SAE PAPER 841556] p 650 A85-39208 Naval Air Test Center, Patuxent River, Md

Flight testing and development of the F/A-18A digital flight control system p 678 N85-27896

Naval Postgraduate School, Monterey, Calif. A method to calculate the parameters of wings of arbitrary planform

[AD-A152689] p 635 N85-27831 Analysis of control system from a viewpoint of desired

pole placement and desired degree of robustness [AD-A152627] p 675 N85-27876

An investigation into the soot production processes in a gas turbine engine

[AD-A152710] p 690 N85-27992 A computational method for wings of arbitrary

planform [AD-A153788] p 638 N85-28929

Using incentives to improve maintainability [AD-A153792] p 706 N85-29841

Naval Research Lab., Washington, D. C. The distribution of higher n-alkanes in partially frozen

middle distillate fuels [AD-A153940] p 692 N85-29074 Naval Ship Research and Development Center,

Bethesda, Md.

Circulation control technology applied to propulsive high lift systems

[SAÉ PAPER 841497] p 627 A85-39205 Navai Weapons Center, China Lake, Calif. Navy geothermal plan

[AD-A152478] p 702 N85-28450 New Mexico Inst. of Mining and Technology, Socorro. Nightime observations of thunderstorm electrical

activity from a high altitude airplane p 702 A85-39526 North Carolina State Univ., Raleigh.

A review of some approximate methods used in aerodynamic heating analyses

[AIAA PAPER 85-0906] p 620 A85-37580 Numerical and experimental determination of secondary separation on delta wings in subsoric flow

p 628 A85-39219

p 671 N85-27868

p 671 N85-27867

p 626 A85-38984

p 706 N85-29844

C-3

0

Oak Ridge National Lab., Tenn.

Ceramic Technology for Advanced Heat Engines Project

[DE85-008755] p 691 N85-29052 Ceramic coatings for heat engine materials Status and future needs

[DE85-008759] p 691 N85-29053 Ceramic coatings for heat engine materials

[DE85-005238] p 691 N85-29054 Office National d'Etudes et de Recherches

Aerospatiales, Paris (France).

Ohio State Univ., Columbus.

rbomachiner blades

Oklahoma State Univ., Stillwater.

in axisymmetric combustor geometries

generated by swept and unswept fins

[NASA-CR-175901]

[NASA-CR 174916]

Politecnico di Torino (Italy).

Wing buffeting active control testing on a transport aircraft configuration in a large sonic windtunnel

p 679 N85-27903 A survey of recent development in helicopter aerodynamics p 653 N85-28915

A study of internal and distributed damping for vibrating

Predictions and measurements of isothermal flowfields

Ρ

Pennsylvania State Univ., University Park. Conical similarity of shock/boundary-layer interactions

Activities of the Department of Aerospace Engineering

Pratt and Whitney Aircraft, West Palm Beach, Fla.

Pratt and Whitney Aircraft, West Palm Beach, Fla. Integrated flight/propulsion control - Adaptive engine

[AIAA PAPER 85-1425]	p 669	A85-39772
Princeton Univ., N. J.		
The role of surface generated	radicals	in catalytic

combustion p 671 N85-27869

Q

Queensland Univ., Brisbane (Australia). Shock tunnel measurements of heat transfer in a model

[AIAA PAPER 85-0908]

p 658 A85-37582

R

- Rensselaer Polytechnic Inst., Troy, N. Y. Heat transfer investigation in the junction region of circular cylinder normal to a flat plate at 90 deg location [ASME PAPER 84-WA/HT-70] p 698 A85-39898
- Rijksluchtvaartdienst, The Hague (Netherlands). OWEMA report. A project study concerning the possibilities and the desirability of a east-west runway for Maastricht Airport (Netherlands) as a Euro-regional air freight center
- [B8476490] p 685 N85-28955 Rotterdam Aviation Association (Netherlands).
- Rotterdam Airport and the Common Market p 641 N85-27840
- Royal Aircraft Establishment, Bedford (England). Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds
- p 628 A85-39241 The evolution of ACS for helicopters Conceptual simulation studies to preliminary design
- p 677 N85-27890 Flight testing for performance and flying qualities
 - p 654 N85-28920

S

- Sandia Labs., Albuquerque, N. Mex.
- Field test report of the Department of Energy's 100-kW vertical axis wind turbine
- (DE85-0084751 p 702 N85-28458 The AFTI/F16 terrain-aided navigation system p 645 N85-28935 [DE85-008411]
- Scientific Research Associates, inc., Glastonbury, Conn.
- Users manual for coordinate generation code CRDSRA
- [NASA-CR-172584] p 634 N85-27824 User's manual for airfoil flow field computer code SRAIR
- [NASA-CR-172585] p 634 N85-27825
- SIGRI Electrogradhit G.m.b.H., Meitingen (West Germany).
- Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components p 672 N85-27874 [BMFT-FB-T-84-302]
- Smiths Industries Ltd., Bishops Cleeve (England). ACT applied to helicopter flight control
- p 678 N85-27891 Societe Nationale Industrielle Aerospatiale, Marignane (France).
- survey of recent development in helicopter p 653 N85-28915 aerodynamics Societe Nationale Industrielle Aerospatiale, Toulouse
- (France). Certifying complex digital systems on civil aviation
- p 680 N85-27907 aircraft Stanford Univ., Calif.
- Slow and fast state vanables for three-dimensional flight dynamics p 675 A85-39567 State Univ. of New York, Albany.
- Nighttime observations of thunderstorm electrical activity from a high altitude airplane p 702 A85-39526
- System Development Corp., Hampton, Va. Measured and predicted vortex-induced leeward heating
- on a biconic at Mach 6 and 10 [AIAA PAPER 85-1061] p 621 A85-37675
- Systems Technology, Inc., Hawthorne, Calif. Control response measurements of the Skyship-500 airship
- [AIAA PAPER 85-0881] p 649 A85-38796
- A perspective on superaugmented flight control dvantages and problems p 677 N85-27886 advantages and problems

- Т
- Technische Hochschule, Darmstadt (West Germany). Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part
- p 654 N85-28939 (IFD-1/84-PT-1) Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion Part 2 Theoretical investigations for calculation of the lateral wind
- p 654 N85-28940 [IFD-1/84-PT-2] Technische Hogeschool, Delft (Netherlands).
- Upwind-difference methods for aerodynamic problems overned by the Euler equations
- [REPT-84-23] p 635 N85-27834 Transonic Mach number determination in a blow-down wind tunnel with solid walls and a downstream throat [VTH-LR-402] p 636 N85-27835 Technische Univ., Berlin (West Germany).
- Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066
- Technische Univ., Brunswick (West Germany). Helicopter aeromechanics Introduction and historical review p 653 N85-28914
- Tennessee Univ., Tullahoma. Compressor and turbine models - numerical stability and
- other aspects [AD-A1538111 p 673 N85-28948
- Textron Bell Helicopter, Fort Worth, Tex. Investigation of imaging and flight guidance concepts for rotorcraft zero visibility approach and landing
- [NASA-CR-166571] p 644 N85-27843 Toledo Univ., Ohio.
- Wake effects on the aerodynamic performance of horizontal axis wind turbines [NASA-CR-174920]
- p 702 N85-29364 Transamerica Delaval, Inc., Santa Monica, Calif. Flow characteristics of a partially submerged liquid
- nickup [DE85-008744] p 699 N85-28276

U

- United Technologies Research Center, East Hartford, Conn.
- Numerical investigation of internal high-speed viscous flows using a parabolic technique [AIAA PAPER 85-1409] p 632 A85-39768
- Universal Energy Systems, Inc., Dayton, Ohio Multi-ducted Inlet combustor research and
- development [AD-A153753] p 673 N85-28946

- Vanderbilt Univ., Nashville, Tenn.
- Transitional, hypervelocity aerodynamic simulation and scaling in light of recent flight data
- p 621 A85-37661 [AIAA PAPER 85-1028] Vigyan Research Associates, Inc., Hampton, Va.
- Comparison of advanced turboprop installation on swept and unswept supercritical wings at transonic speeds [AIAA PAPER 85-1264]
- [AIAA PAPER 85-1264] p 630 A85-39686 Effect of a wing-tip mounted pusher turboprop on the aerodynamic characteristics of a semi-span wing
- [AIAA PAPER 85-1286] p 631 A85-39700 Virginia Polytechnic Inst. and State Univ., Blacksburg. Classical and neo-classical cruise-dash optimization
- p 650 A85-39212 Vrije Universiteit, Brussels (Belgium).
- Turbulence structure in the boundary tayers of an oscillating airfoil [AD-A153631] p 637 N85-28926

W

- Westland Aircraft Ltd., Yeovil (England).
- The evolution of active control technology systems for the 1990's helicopter p 680 N85-27911 Wisconsin Univ., Madison.
- Hyperbolic phenomena in the flow of viscoelastic fluids
- [AD-A153533] p 700 N85-29186 Wyoming Univ., Laramie. The University of Wyoming's small scientific balloon

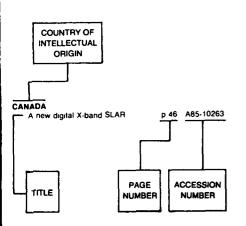
program p 639 A85-38309

FOREIGN TECHNOLOGY INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

OCTOBER 1985





Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section.

A

AUSTRALIA

- Reducing the effects of nvet holes on fatigue life by adhesive bonding p 693 A85-37472 Shock tunnel measurements of heat transfer in a model scramet
- [AIAA PAPER 85-0908] p 658 A85-37582 Stagnation point heat transfer in hypersonic high enthaloy flow
- [AIAA PAPER 85-0973] p 620 A85-37623 Density and velocity profiles in non-equilibrium laminar
- boundary layers in air [AIAA PAPER 85-0976] p 620 A85-37626 Low density aerothermodynamics
- [AIAA PAPER 85-0994] p 620 A85-37640 An automatic navigation and aspect sensing system for
- X-ray astronomy p 643 A85-38314 Stability of the thin-jet model of the unsteady jet flap
- p 626 A85-38997 The free interaction in a supersonic flow over a porous wall p 626 A85-39021 Flight trails of a modified guilfstream commander carrying external stores [AD-A153376] p 653 N85-27859
- Further investigations to improve the fatigue life of the Mirage 1110 wing main span
- [ARL-STRUC-TM-397] p 654 N85-28938 Description and illustration of the use of CRACKS IV [AD-A153543] p 701 N85-29325

С

CANADA

Attitude determination in a limb-scanning balloon radiometer p 655 A85-38319 An expenmental investigation of the aerodynamic effects on a body of revolution in turning flight

[AIAA PAPER 85-0866] p 624 A85-38782

An application of source-panel and vortex methods for aerodynamic solutions of airship configurations [AIAA PAPER 85-0874] p 624 A85-38789

Wind tunnel investigation of the interaction of an airship configuration with lifting rotors

[AIAĂ PAPER 85-0875] p 625 A85-38790 Progress report on the engineering development of the Magnus Aerospace LTA 20-1 airship

[AIAA PAPER 85-0876] p 649 A85-38791 An investigation into the hovering behaviour of the LTA 20-1 airship in calm and turbulent air

[AIAA PAPER 85-0878] p 641 A85-38793 An experimental determination of the longitudinal

stability properties of the LTA 20-1 airship [AIAA PAPER 85-0879] p 674 A85-38794 Explicit formulation for a high precision triangular laminated anisotropic thin plate finite element

p 696 A85-39170 Recent developments in ejector design for V/STOL

aircraft [SAE PAPER 841498] p 663 A85-39206 Investigation of the effect of two endwall contours on

the performance of an annular nozzle cascade [AIAA PAPER 85-1218] p 630 A85-39661 An introduction to vortex breakdown and vortex core bursting

[NAE-AN-28] p 635 N85-27829 Wing tunnel investigation of dynamic stall of an NACA

0018 airfoil oscillating in pitch [NAE-AN-27] p 635 N85-27830 A grejuminary investigation of bandling qualities

A preliminary investigation of handling qualities requirements for helicopter instrument flight during decelerating approach maneuvers and overshoot [NRC-24173] p 652 N85-27857 A general area air traffic controller simulation using

A general area air traffic controller simulation using colour graphics [AD-A153634] p 645 N85-28933

CHINA, PEOPLE'S REPUBLIC OF Experimental research on the effect of separation flow

on ablation in supersonic turbulent flow [AIAA PAPER 85-0975] p 694 A85-37625

Flow-field matrix solution for flow along arbitranly twisted S1 surface employing non-orthogonal curvilinear coordinates p 622 A85-37927 Quasi-three-dimensional blade design code p 622 A85-37928

The solution of transonic flow through three-dimensional p 622 A85-37929 turbine blade Families of variational principles for the semi-inverse and type-A hybrid problems on a S2-streamsheet in mixed-flow p 622 A85-37930 turbomachines A general theory of hybrid problems of fully 3-D compressible potential flow in turbo-rotors 1 - Axial flow, stream function formulation p 622 A85-37931 Computation of the thrust performance of axisymmetric p 622 A85-37932 nozzles Balloon system and balloon-borne experiments in China p 640 A85-38310 A second-order approximate method for transonic small-disturbance potential flow and its application to the p 625 A85-38922 analysis of flows over airfoils An integral method of wall interference correction for low speed wind tunnel p 682 A85-38962 The computation of transonic nozzle flow-field by a p 625 A85-38963 time-dependent method Numerical simulation of three-dimensional transonic flow in a turbomachinery p 625 A85-38965 The numerical calculation of the pressure distribution of sharp edge slender wings with leading or side edge vortex separation p 625 A85-38966 The characteristics compatibility conditions on the boundary points are applied to time-marching methods for transonic flow past plane cascades p 625 A85-38967 Investigation on reducing the flow noise of the 0.6 m x 0.6 m trisonic wind tunnel p 682 A85-38968 Investigation on configurations in longitudinal direction wind-tunnel testing of forward swept wings p 625 A85-38969

The wind tunnel investigation for obtaining rolling moment with small asymmetry p 674 A85-38970 An extension of the generalized vorte-lattice method of supersonic sideslipping wings p 626 A85-38972 Experimental investigation of heat transfer distribution inside the gap of a flat plate-flap combination in a shock tunnel p 695 A85-38973

Discussions on the regular behavior of the longitudinal dynamic response of aircraft during variable sweep flights p 674 A85-38974

A new technique to break diaphragms electrically in a double-tube short duration jet simulation facility p 682 A85-38975

p 682 A85-38975 Model of the wind field in a downburst

p 701 A85-39218 Fracture behavior of glass-cloth/polyester composite laminate at low temperature p 688 A85-39228

DENMARK Pretwist and shear flexibility

Pretwist and shear flexibility in the vibrations of turbine blades p 657 A85-37233

F

FRANCE

Dynamic behaviour of cold wires in heated airflows (T in the range from 300 to 600 K) p 694 A85-38069 Long-duration flights using MIR (infrared balloon

system) p 639 A85-38307 First results of a stratospheric experiment using a Montgolfiere Infra-Rouge (MIR) p 639 A85-38308

The bonding of materials for propulsion systems p 687 A85-39175

Computation of three-dimensional flow using the Euler equations and a multiple-grid scheme

	p 62/ A65-39200
Active Control Systems	Review, Evaluation and
Projections	

[AGARD-CP-384] p 676 N85-27883 Active Control Technology (ACT) Past, present and future p 676 N85-27884

Wing buffeting active control testing on a transport aircraft configuration in a large sonic windfunnel

p 679 N85-27903 The interactive generation of specifications for an onboard software senes (GISELE) p 679 N85-27906

Certifying complex digital systems on civil aviation aircraft p 680 N85-27907

Helicopter Aeromechanics [AGARD-LS-139] p 617 N85-28913 A survey of recent development in helicopter aerodynamics p 653 N85-28915

G

GERMANY, FEDERAL REPUBLIC OF

GERMANY,FEDERAL REPUBLIC OF
Wing optimization and fuselage integration for future
generation of supersonic aircraft p 618 A85-37212
Numerical solution of the minimum-time flight of a glider
through a thermal by use of multiple shooting methods
p 638 A85-37489
European transonic wind tunnel p 681 A85-37491
Pitot pressure and heat transfer measurements in
hydrazine thruster plumes
[AIAA PAPER 85-0934] p 685 A85-37599
The drag of simple shaped bodies in the rarefied
hypersonic flow regime
[AIAA PAPER 85-0998] p 621 A85-37642
The cockpit of the Airbus A310 p 655 A85-37896
Korea's air transport - Planned expansion
p 681 A85-37949
Local instability characteristics and frequency
determination of self-excited wake flows
p 623 A85-38430
Aerodynamic sound generation caused by viscous
processes p 705 A85-38432
Design of a basic profile for a low sweep airfoil Part

Design of a basic profile for a low sweep airfoil Part 2 Experimental investigation on the DFVLR-W1 airfoil profile in the Brunswick transonic wind tunnel [DFVLR-F8-85-01-PT-2] p 635 N85-27833

GERMANY, PEOPLES DEMOCRATIC REPUBLIC OF

Analysis of unsteady pressure measurements on a supercritical airfoil with a harmonically oscillating trailing edge flap at subsonic and transonic speeds p 636 N85-27837 VLR-FB-84-49] ID

Methods for design aerodynamics of modern transport aurcraft

[DFVLR-FB-85-05] p 636 N85-27838 Development of a fuselage forward section in Carbon Fiber Reinforced Plastic (CFRP) type of construction

[MBB/LFA34/CFK/PUB/008] p 651 N85-27851 meteorological Three powered saliplanes as instrumentation for atmospheric boundary layer studies at DEVI 8

[DFVLR-FB-84-50] p 653 N85-27862 The Avionics Flight Evaluation System (AFES) of DEVI R

[DEVLR-MITT-85-01] p 657 N85-27864 Reaction-bonded and fiber-reinforced SiC static and dynamic gas turbine components

(BMFT-FB-T-84-302) p 672 N85-27874 In-flight investigation of the influence of pitch damping and pitch control effectiveness on landing approach flying qualities of statically unstable transport aircraft

p 676 N85-27880 [DFVLR-FB-84-12] Identification of gust input and gust response characteristics from Do 28 TNT flight test data

p 676 N85-27881 [DFVLR-FB-84-48] Proposals for the determination of necessary elevator handling characteristics of sailplanes in high speed range [DFVLR-FB-84-52]

p 676 N85-27882 Aspects of application of ACT systems for pilot workload alleviation p 677 N85-27887

Some flight test results with redundant digital flight control systems p 678 N85-27892 OLGA An open loop gust alleviation system

p 678 N85-27897 Realisation of relaxed static stability on a commercial p 679 N85-27899 transport

The flight control system for the Experimental Aircraft Programme (EAP) demonstration aircraft p 680 N85-27908

Adaptive wall wind tunnels and wall interference correction methods

[DFVLR-IB-222-84-A-37] p 683 N85-27912 Test devices for aeronautical research and technology [NASA-TM-77651] p 683 N85-27914

The gust simulation apparatus of the 3m x 3m low speed wind tunnel of the DFVLR in Goettingen, West Germany [DFVLR-FB-85-04] p 684 N85-27920 Data processing on the rotor test stand at DFVLR in Brunswick Microprogrammable interfaces and array processor as key components in a PDP 11 real time data

acquisition and processing system [DFVLR-MITT-85-03] p 684 N85-27921 Integral profile method for production of carbon fiber

choote [MBB/LFA34/CFK/PUB/006] p 690 N85-27975 Heat resistant Carbon Fiber Reinforced Plastics (CFRP)

hardening equipment [MBB/LFA33/CFK/PUB/007] p 690 N85-27976 Investigation of air pollution impact in Eastern Bavana

Measurement results from August and September, 1984 [DFVLR-FB-85-03] p 702 N85-28471 Helicopter aeromechanics Introduction and historical p 653 N85-28914 review

Mission requirements and handling qualities p 680 N85-28918

The role of simulation p 684 N85-28919 Air traffic Instruments, airports, companies, post, cargo and passengers nd passengers p 641 N85-28932 Experimental and theoretical determination of the

induced lateral wind on the tail surfaces in oscillating rolling motion Part 1 Application of the Mobile Oscillating Derivatives (MOD) on an experimental part [IFD-1/84-PT-1] p 654 N85-28939

Experimental and theoretical determination of the wing-induced lateral wind on the tail surfaces in oscillating rolling motion. Part 2 Theoretical investigations for calculation of the lateral wind [IFD-1/84-PT-2]

p 654 N85-28940 Preparation of sinteractive silicon nitride powders [BMFT-FB-T-84-303] p 691 N85-29066

MBB expands CADAM system for a 320 program p 704 N85-29099 Lightning-safe carbon fiber composite for Airbus tail

unit p 692 N85-29100 DFVLR research in aluminum-lithium allovs p 692 N85-29105 -Structural Analysis

[DFVLR-MITT-84-21] p 701 N85-29313 Research on structural analysis at the DFVLR, Brunswick p 701 N85-29314 The static aeroelasticity of a composite wing

N85-29321 p 701

Contributions on the subject of longitudinal movements of aircraft in wind shears [NASA-TM-77837] p 702 N85-29432

GERMANY, PEOPLES DEMOCRATIC REPUBLIC OF Development and testing of the RPS-1000 parachute

system for the MMR-06-DART meteorological rocket p 685 A85-38608 system GREECE

Algorithms for improved, heading assisted, maneuver tracking p 644 A85-39458 A computational study of the unsteady shock-wave

structure in a two-dimensional transonic rotor p 629 A85-39578

INDIA

Perturbed motion of airplane and safe store p 674 A85-38168 separation Explosive forming of low carboon steel sheet into a p 694 A85-38169 stepped disc shape

Stratospheric flights with large polyethylene balloons p 639 A85-38304 from equatorial latitudes ISRAEL

Israel Annual Conference on Aviation and Astronautics, 26th, Haifa, Israel, February 8, 9, 1984, Collection of p 615 A85-37176 Papers

Experimental determination of the effect of nonlinear stiffness on the vibration of elastic structures p 692 A85-37177

A new unsteady prescribed wake model of the aerodynamic behavior of a rotor in forward flight p 617 A85-37178

Influence of fighter aircraft load spectrum variations on fatigue crack initiation and growth p 693 A85-37181

Fatigue life evaluation program for the Kfir aircraft p 645 A85-37182 Computer aided tube routing design in aircrafts

p 615 A85-37183 Crack growth analysis in multiple load path structure

p 693 A85-37186

A program for computenzed structural resizing of aircraft structure subject to strength and local panel buckling p 693 A85-37187 criteria under multiple loading Crack propagation analysis of longitudinal skin cracks in a pressurized cabin p 645 A85-37188 supersonic panel method based on the triplet Α

p 617 A85-37191 singularity Critical flutter parameters of orthotropic rectangular flat

p 693 A85-37192 panels with in-plane loads The stability of symmetrical vortices in the wake of

elliptical cylinders in confined flow p 618 A85-37194 Nonequilibrium supersonic flows past oscillating 2-D lifting surfaces and thin elastic bodies

p 618 A85-37197 First-order feedback strategies for variable speed planar p 703 A85-37198 pursuit-evasion games Lift and drag of airfoils in nonuniform supersonic

stream p 618 A85-37200 Evaluation of nozzle throat materials for ramiet p 686 A85-37201 engines

evaluation of aerodynamic coefficients for The projectiles fired from a hovering helicopter p 618 A85-37203

Fracture toughness of adhesively bonded joints p 688

A85-39492 Combustion studies of metallized fuels for solid fuel ramiets

[AIAA PAPER 85-1177] p 689 A85-39640

Accurate and efficient solutions of transonic internal p 631 A85-39729

[AIAA PAPER 85-1334] Activities of the Department of Aerospace Engineering p 706 N85-29844

J

JAPAN

Interaction of twin turbulent circular jet

p 617 A85-37049 Subsonic multiple-jet aerodynamic window p 693 A85-37216

Numerical simulation of hypersonic viscous fore- and afterbody flows over capsule-type vehicles at angles of attack

[AIAA PAPER 85-0924]	p 620	A85-37593
Development of balloon-borne	reel-down a	nd-up winch
system	p 640	A85-38311
Feasibility studies of 'Polar Pat	trol Balloon'	
	p 647	A85-38321
Structural ontimization	n 694	485.38352

Man-powered aircraft p 615 A85-38353

FOREIGN TECHNOLOGY INDEX

A study on the method for solving the equation of subsonic oscillatory lifting-surface theory IV - Computer program SOLST 1 p 622 A85-38355 program SOLST 1 An evading path against 3 D obstacles p 674 A85-38357 Minimum-time path through wind fields p 647 A85-38358 Research trend in advanced technology helicopter p 647 A85-38360 Natural frequencies and flight loads of composite main rotor blade for helicopter p 647 A85-38361 Wind tunnel experiments of the high-performance rotor p 622 A85-38362 hlades Terrain/wire and wirelike obstacles warning system for p 655 A85-38363 helicopters Automatic flight control system (AFCS) of helicopter p 674 A85-38364 using an optical control algorithm Study on the comfortability of helicopter - Flight test of p 647 A85-38365 acoustic noise level Experiment of turbulent round jet parallel to ground p 622 plane A85-38367 Development of the BK 117 helicopter p 674 A85-38369 Aerodynamic characteristics of Weis-Fogh the mechanism p 623 A85-38370 CI Beta of unswept flat wings in sideslip II p 623 A85-38371 Theoretical considerations m the aerodynamic p 628 effectiveness of winglets A85-39224 Application of 3-D aerothermal model and flow visualization technique to the combustor exit gas temperature study [AIAA PAPER 85-1313] p 668 A85-39718 Two-dimensional turbulent flow analysis in turbomachinery by the finite element method [ASME PAPER 84-WA/FM-2] p 633 p 633 A85-39874 Application of boundary element method to heat transfer coefficient measurements around a gas turbine blade [ASME PAPER 84-WA/HT-69] p 698 A85-39897 A method of determining the suction velocity for laminar flow control of two-dimensional airfoil in incompressible flow [NAL-TR-845] p 637 N85-28925

Gust load alleviation of a cantilevered rectangular elastic wing Wind tunnel experiment and analysis [NAK-TR-86]

p 681 N85-28950 Flow quality of National Aerospace Laboratory two-dimensional transonic wind tunnel Part 3 Flow turbulence level and measuring method [NAL-TR-842-PT-3]

p 684 N85-28952 On power effecient operation of the 2m x 2m transonic wind tunnel at the National Aerospace Laboratory p 684 N85-28953 [NAL-TR-847]

L

LATVIA

Lift and thrust of a linear synchronous engine with a olid-conductor stator winding p 658 A85-37550 solid-conductor stator winding

N

NETHERLANDS

Instationary dolphin flight - The optimal energy exchange sailplane and vertical currents in the between a atmosphere p 646 A85-37488 Upwind-difference methods for aerodynamic problems

governed by the Euler equations [REPT-84-23] p 635 N85-27834 Transonic Mach number determination in a blow-down

wind tunnel with solid walls and a downstream throat p 636 N85-27835 [VTH-LR-402] Aerodynamic research in preparation for a new Dutch

transport aircraft with supercritical wings [B85800771 D 636 N85-27836

Rotterdam Airport and the Common Market p 641 N85-27840

Flying in spite of the weather

[NLR-MP-84021-U] p 644 N85-27847 Developments in the area of air traffic control systems and the relation with meteorology

[NLR-MP-84029-U] p 645 N85-27848 A system for take-off and landing measurements

(STALINS) [B85800721 p 645 N85-27849

Parameter identification results of tests in nonsteady symmetric flight with the Hawker Hunter Mk 7

[NLR-TR-83042-U] p 653 N85-27860 New materials and techniques for aircraft structures [B8580074] p 653 N85-27861

Fan noise suppression in turbofan engines p 671 N85-27872 [88580076]

UNITED KINGDOM

The battle against noise in industry p 705 A85-39349 Similarity properties in the problem of flow from a supersonic source past a spherical bluntness p 629 A85-39445 Nonstationary deformation of structural elements and p 696 A85-39450 their ontimization USSR report: Transportation p 641 N85-27841 [JPRS-UTR-84-025] Test flight of IL-76TD long-range transport variant 0.641 N85-27842 Vibrations of rotors connected through couplings with p 672 N85-28147 hacklash Precision die forging of blades or gas turbines p 672 N85-28148 Stressed-strained state of tightening buckles in sectional p 672 N85-28149 runners of gas turbines Characteristics of steady-state hypersonic flow about blunted bodies with discontinuities in generators p 636 N85-28155 Supersonic flow around blunt wedge p 636 N85-28158 Propulsion efficiency of vibrating bodies in subsonic gas p 699 N85-28159 stream Method of calculating separation flow of subsonic gas stream around wings p 636 N85-28161 UNITED KINGDOM Design of digital flight control systems for helicopters p 673 A85-37195 A method for the evaluation of the boundary lubricating properties of aviation turbine fuels p 687 A85-37495 p 655 A85-37925 Cockpit of the future? p 646 A85-37945 Tweety-bird replacement p 646 A85-37946 A 320 - Third generation Airbus Hovercraft skirt design and manufacture p 694 A85-38233 Development in UK rotor blade technology p 615 A85-38236 Scientific ballooning - IX, Proceedings of the Seventh Symposium, Graz, Austria, June 25-July 7, 1984 p 615 A85-38301 Who needs advanced-technology airliners? p 647 A85-38434 Turboshaft truce in Europe D 658 A85-38436 AV-8B-mean Marine V/STOL machine p 648 A85-38437 p 648 LHX - A giant leap A85-38438 A85-38430 p 615 Ultralights break the rules Something old, something new p 648 A85-38440 Low temperature creep and fracture of near alpha p 687 A85-38748 titanium alloys of microstructure influence The on the temperature-dependent flow properties of Ti-6AI-4V p 687 A85-38749 Auxiliary and emergency power system [SAE PAPER 841572] p 662 A85-39162 The flow past two cylinders having different diameters p 696 A85-39240 Computer studies of hybrid slotted working sections with minimum steady interference at subsonic speeds p 628 A85-39241 Air transport deregulation - The US experience and its applicability to Europe p 705 A85-39369 Simulation of wake passing in a stationary turbine rotor p 629 A85-39589 cascade Advanced techniques for health and usage monitoring of helicopter transmissions [AIAA PAPER-85-1142] p 617 A85-39621 Prospects and problems of advanced open rotors for commercial aircraft p 665 A85-39649 [AIAA PAPER 85-1191] A review of some recent U K propeller developments [AIAA PAPER 85-1261] p 666 A85-39684 On the modelling of a fully-relaxed propeller slipstream [AIAA PAPER 85-1262] p 630 A85-39685 The influence of blade wakes on the performance of outwardly curved combustor pre-diffusers p 667 A85-39704 [AIAA PAPER 85-1291] The conception and development of a family of small engines for the 1990's [AIAA PAPER 85-1460] p 670 A85-39791 Some effects of sweep direction and strakes for wings with sharp leading edges [CA-8421] p 634 N85-27826 On the effect of wing taper and sweep direction on eading edge transition p 634 N85-27827 [CA-8435] An assessment of the suitability of the BHGA structural test rig for aerodynamic testing of hang gliders [CA-8505] p 652 N85-27853 The evolution of ACS for helicopters Conceptual simulation studies to preliminary design

p 677 N85-27890 ACT applied to helicopter flight control p 678 N85-27891

D-3

Observation of birds in the flight path of aircraft - An important stage in the prevention of bird strikes p 639 A85-37544

Probabilistic prediction of the fatigue life of the compressor blades of gas-turbine engines under two-level programmed loading p 658 A85-37567 The effect of stress raisers on the load-bearing capacity

of titanium-alloy compressor blades p 658 A85-37575 Configuration of shock waves closing a local supersonic p 623 A85-38481 zone

Diffraction of a single plane wave by a conical wing p 623 A85-38483 The isolated nature of solutions with a strong attached

shock wave at the edges of a conical wing and a wedge p 623 A85-38488

Flow separation from the leading edge of an airfoil and the effect of acoustic perturbations on the separated p 694 A85-38510 flow

Instability of plane-parallel supersonic gas flows in the D 623 A85-38551 linear approximation

Stability of a stationary solution to the ablation equation p 623 A85-38555

Shading and interference effects during the rotation of p 624 A85-38559 a plate

A study of the critical flow rate through cascades of thin slightly bent airfoils using the large-particle method p 624 A85-38562

Approximate relationships for determining pressure at the surface of a sphere or a cylinder for arbitrary p 624 A85-38563 free-stream Mach numbers The effect of the bluntness shape on the drag coefficient

of a body in hypersonic flow of a rarefied gas p 624 A85-38564

Determination of the optimum lubricant change period for the joints of the landing gear of aircraft p 695 A85-38600

Solution of certain technical problems connected with the development of the MMR-06M meteorological rocket p 685 A85-38610

p 644 A85-38647

p 685 A85-38775

Dissipative properties of inhomogeneous materials and

A85-38874 systems

Aerodynamics p 649 A85-38875

the equilibrium composition of heterogeneous systems p 687 A85-39101

Selecting design parameters for an engine from the p 659 A85-39103 An investigation of the autorotation of gas-turbine

engines under startup conditions p 659 A85-39104 A comparative evaluation of certain promising gas-turbine engines of foreign manufacturers in terms of their thrust characteristics and fuel efficiency

The effect of the pitch of axisymmetric nozzles on the efficiency of the nozzle assembly and of the turbine tage p 660 A85-39107 A generalization of experimental data on heat transfer stage

p 660 A85-39112

p 660 A85-39115 A study of the thermal inertia of a thermocouple exposed to short temperature pulses at high Reynolds numbers

Accelerated testing of gas-turbine aircraft engines usi

The software pack GRAD for the analysis of gas-turbine p 660 A85-39119 enaines

An evaluation of the exhaust system configuration from

chambers p 661 A85-39122 Rationalizing the choice of an actuating mechanism for

Characteristics of the oscillations of a tail unit in a flow

of an incompressible gas p 649 A85-39125 Determination of the blade height of the last compressor stage for a refined thermodynamic design analysis of p 661 A85-39126 turbofan engines

Characteristics of a two-dimensional turbulent jet in a p 695 A85-39131 bounded slipstream

Testing of materials and coatings for jet engine components under simulated operational conditions p 672 N85-27873 B85800731

How to handle failures in advanced flight control systems of future transport aircraft p 679 N85-27905 Design, manufacturing, Construction 1976-1980

calibration of the German-Dutch wind tunnel (DNW) p 683 N85-27913 The application of numerical control (NC) in

manufacturing wind tunnel models 1885800781 n 699 N85-28140 Engineering significance of fatigue thresholds and short

fatigue cracks for structural design p 700 N85-28430 [NI B-MP-84001-U] Frangibility of obstacles at airports

[NLR-MP-84002-U] p 700 N85-28431 Research on structures and materials [B8580080] p 700 N85-28432 Operations research [B8561897] p 704 N85-28712 Technical services at NLR

o 705 N85-28871 [B8561898] OWEMA report A project study concerning the possibilities and the desirability of a east-west runway for Maastricht Airport (Netherlands) as a Euro-regional air freight center p 685 N85-28955 [B8476490]

Cryogenic test technology, 1984 [AGARD-AR-212] p 700 N85-29116

D

POLAND

Fatigue-crack propagation in aircraft Duralumin shell structures p 695 A85-38918

S

SPAIN

Costs and tariff levies in air transportation p 705 A85-37950 SWEDEN

Modelling vortex flowfields by supercomputers with super-size memory p 628 A85-39242 A missile duel between two aircraft p 703 A85-39563

Т

TAIWAN

Numerical simulation of a supercritical inlet flow [AIAA PAPER 85-1214] p 630 A85-39658 Vertical plate fin with conjugated forced convection-conduction turbulent flow [ASME PAPER 84-WA/HT-8] p 698 A85-39878

U

Software-engineering elements in the problem of the

U.S.S.R

optimal design of lift systems for flight vehicles p 646 A85-37323 A system of shock and rarefaction waves in flows past p 618 A85-37330 bodies with complex shapes A numerical investigation of a viscous hypersonic air flow around elongated blunted bodies at large angles of attack p 619 A85-37333 A supersonic inhomogeneous flow of an ideal gas around p 619 A85-37335 blunted bodies A nonstationary transition process caused by injection of a gas into the near wake of a body in a supersonic flow p 619 A85-37336 Gas flow in nozzles and jets p 619 A85-37337

Investigation of three-dimensional separated flows p 619 A85-37338

The problems arising in testing of carbon-based materials for structural components of airframes p 686 A85-37339

The separation of a turbulent boundary layer within a two-face andle before an obstruction

p 619 A85-37340 Determination of aerodynamic characteristics of bodies p 619 A85-37341 in weakly perturbed gas flows

Protection of materials and technical equipment against p 638 A85-37540 birds

Chemical preparations for protecting aircraft against p 638 A85-37541

The study of bird migration over a water area in the northwestern portion of the Black Sea and adjacent areas

in order to prevent bird-aircraft collisions p 638 A85-37542

The effectiveness of acoustic repellants in frightening p 639 A85-37543 birds away from airports

Methods for the assembly of aircraft structures p 616 A85-38641 Communication in automated air-traffic-content istems systems The ideas of K E Tsiolkovskii and present-day scientific problems

The aerodynamics of the Tu-154B aircraft p 649 A85-38850

p 687 Fundamentals of the flight operations of helicopters

The 'solution-large molecules' method for calculating

totality of flight conditions

p 660 A85-39106

from the working medium to the housing components of the compressor of a das-turbine engine

Unstable combustion in the combustion chamber of a gas-turbine aircraft engine

p 695 A85-39117

p 660 A85-39118 the 'softening' method

A companison of experimental characteristics of porous p 660 A85-39120 and blade impellers

the cruise efficiency criteria of an engine in an aircraft p 660 A85-39121 system

The structure of the application software pack RAFIPKS for the analysis of physical processes in combustion

p 661 A85-39124 a let drive

FOREIGN TECHNOLOGY INDEX

YUGOSLAVIA

An update of experience on the fly by wire Jaguar equipped with a full-time digital flight control system p 678 N85-27893

ACT flight research expenence	p 678	N85-27894
The aerodynamics of control	p 679	N85-27901
The evolution of active control	technology	systems for
the 1990's helicopter	p 680	N85-27911
Rotorcraft noise	p 705	N85-28916
Flight testing for performance a	nd flying qu	alities
•	p 654	N85-28920

.

YUGOSLAVIA The finite element formulation of airflow around a deformable wing by using the incremental finite element method p 621 A85-37879

Y

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- ---

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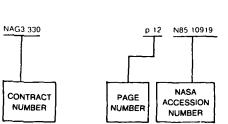
· __

CONTRACT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

OCTOBER 1985

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found

A85-38984

p 630 A85-39658

p 626

AF PROJ 2307	p 675	N85-27875
AF-AFOSR-80-0286	p 689	A85-39676
AF-AFOSR-83-0139	p 703	A85-39565
AF-AFOSR-84-0327	p 630	A85-39658
BMFT-HA-514/61	p 654	N85-28939
	p 654	N85-28940
DA PROJ 1L1-62209-AH76	p 637	N85-28923
DA PROJ 1L1-63309-AH-76	p 683	N85-27916
DA PROJ 1T1-61102-BH-57	p 637	N85-28926
DAAG29-79-C-0184	p 629	A85-39582
DAAG29-80-C-0041	p 700	N85-29186
DAAG29-82-K-0051	p 700	N85-29186
DAAG29-83-K-0043	p 629	A85-39582
DAJA45-83-C-0021	p 637	N85-28926
DE-AC03-80ER-10687	p 699	N85-28276
DE-AC04-76DP-00789	p 702	N85-28458
	0 645	N85-28935
DE-AC05-84CR-21400	p 691	N85-29052
DE-AC05-84OR-21400	p 691	N85-29053
	p 691	N85-29054
DE-AI01-76ET-20320	p 702	N85-29364
DE-AI01-77CS-51040	p 690	N85-28109
DEN3-17	p 690	N85-28109
DOT-FA01-82-Y-10513	p 701	A85-39213
DOT-FA69NS-162	p 683	N85-27917
DREO-890	p 645	N85-28933
DTFA01-83-Y-30629	p 657	N85-28942
E(49-18)-2295	p 698	A85-39899
ESTEC-5194/82/NL/PB	p 685	A85-37599
F19628-78-C-0007	p 702	A85-39526
F19628-83-C-0152	p 624	A85-38783
F33615-76-C-2092	p 695	A85-39062
F33615-77-C-5155	p 688	A85-39600
F33615-79-C-2087	p 682	A85-39773
	p 669	A85-39775
F33615-79-2075	p 695	A85-39062
F33615-80-C-3229	p 652	N85-27858
F33615-80-C-5045	p 616	A85-39214
F33615-81-C-2017	0 695	A85-39062
F33615-81-C-2074	p 673	N85-28946
F33615-B1-C-3605	p 675	N85-27878
	p 676	N85-27879
F33615-81-C-3626	p 638	N85-28928
00010-01-0-0020	p 638	N85-28930
F33615-82-C-0123	p 689	A85-39645
F33615-82-C-2262	p 690	N85-28129
F33615-84-C-2432	p 669	A85-39743
F33615-84-K-3606	p 703	
F40600-82-C-0003	p 673	N85-28948

F49620-81-K-0018

F49620-82-C-0035

F49620-83-K-0027 MOD-AT/2170/065/XR NAGW-499 NAG1-203 NAG1-549 NAG2-109 NAG3-197 NAG3-292 NAG3-353 NAG3-424 NAG3-74 NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-17561 NAS1-17561 NAS1-17561 NAS1-17719 NAS2-11388 NAS3-20073 NAS7-918 NAS8-3380 NAS8-33817 NAS8-33817 NAS8-33817 NAS8-33817 NAS8-33818 NAS8-33817 NAS8-33817 NAS8-33818 NAS8-33817 NAS8-3	p 691 p 667 p 658 p 650 p 621 p 690 p 690 p 690 p 698 p 671 p 671 p 671 p 671 p 672 p 683 p 652 p 634 p 634 p 652 p 652 p 652 p 652 p 654 p 677 p 644	N85-29073 A85-39704 A85-37582 A85-39212 A85-32661 A85-38984 N85-28127 A85-39898 N85-27868 N85-27868 N85-27868 N85-27814 N85-27814 N85-27825 N85-27825 N85-27825 N85-27825 N85-27826 A85-39768 A85-39768 A85-32841 N85-27843 N85-27893
NAGW-499 NAG1-203 NAG1-549 NAG2-109 NAG3-197 NAG3-292 NAG3-353 NAG3-424 NASW-3531 NASW-4004 NASW-4004 NASW-4006 NAS1-15214 NASW-4006 NAS1-15214 NAS1-1526 NAS1-1526 NAS1-1526 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11364 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NCC1-22	 p 658 p 650 p 626 p 690 p 698 p 671 p 671 p 671 p 671 p 672 p 683 p 652 p 634 p 632 p 652 p 652 p 632 p 654 p 677 p 688 p 699 p 702 	A85-37582 A85-39212 A85-37661 A85-38984 N85-28127 A85-39898 N85-27869 N85-27869 N85-27869 N85-27856 N85-27814 N85-27815 N85-27824 N85-27826 N85-27828 A85-39768 N85-27843 N85-27843 N85-27866
NAG1-203 NAG1-549 NAG2-109 NAG3-197 NAG3-292 NAG3-353 NAG3-424 NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-15261 NAS1-15261 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS1-17761 NAS2-11388 NAS3-20073 NAS7-918 NAS8-33817 NAS8-33817 NAS8-35918 NCC1-22	<pre>p 650 p 621 p 626 p 630 p 638 p 671 p 671 p 671 p 671 p 672 p 663 p 652 p 652 p 652 p 652 p 654 p 677 p 644 p 677 p 688 p 639 p 702</pre>	A85-39212 A85-37661 A85-38984 N85-28127 A85-38988 N85-27868 N85-27868 N85-27868 N85-27867 N85-28912 N85-29432 N85-27814 N85-27826 N85-27826 N85-27898 A85-39768 N85-27898 N85-27898
NAG1-549 NAG2-109 NAG3-197 NAG3-292 NAG3-292 NAG3-424 NAG3-74 NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-1526 NAS1-15761 NAS1-15761 NAS1-17719 NAS2-11388 NAS3-20073 NAS7-918 NAS8-33817 NAS8-33817 NAS8-33918 NCC1-22	p 621 p 626 p 690 p 698 p 671 p 671 p 671 p 671 p 677 p 683 p 652 p 634 p 634 p 634 p 632 p 657 p 644 p 677 p 688 p 699 p 670	A85-37661 A85-38984 N85-28127 A85-39898 N85-27868 N85-27868 N85-27868 N85-27914 N85-29322 N85-27914 N85-27826 N85-27826 N85-27826 N85-27898 A85-39768 N85-27843 N85-27843
NAG2-109 NAG3-197 NAG3-292 NAG3-353 NAG3-353 NAG3-74 NASW-3531 NASW-4004 NASU-15214 NAS1-15214 NAS1-15261 NAS1-15761 NAS1-17561 NAS1-17769 NAS2-11364 NAS2-11364 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NCC1-22	p 626 p 690 p 698 p 671 p 671 p 671 p 677 p 702 p 663 p 652 p 652 p 652 p 634 p 634 p 639 p 632 p 657 p 644 p 677 p 688 p 677 p 688 p 677	A85-38984 N85-28127 A85-39898 N85-27869 N85-27868 N85-27867 N85-28912 N85-29432 N85-27814 N85-27826 N85-27826 N85-27826 N85-27828 A85-39768 N85-27843 N85-27843 N85-27843
NAG3-292 NAG3-353 NAG3-424 NAG3-74 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-15214 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-33800 NAS8-33817 NAS8-35918 NAS8-35918	p 698 p 671 p 671 p 671 p 677 p 672 p 683 p 652 p 634 p 634 p 634 p 632 p 657 p 644 p 677 p 648 p 639 p 677 p 6489 p 679	A85-39898 N85-27669 N85-27667 N85-28912 N85-29432 N85-29314 N85-27855 N85-27855 N85-27856 N85-27825 N85-27828 A85-39768 N85-27843 N85-27843 N85-27843
NAG3-353 NAG3-424 NAG3-74 NAG3-74 NASW-3531 NASW-4004 NASV-4006 NAS1-13259 NAS1-15214 NAS1-15216 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918	p 671 p 671 p 671 p 677 p 702 p 683 p 652 p 652 p 654 p 634 p 639 p 632 p 657 p 644 p 677 p 688 p 659 p 652	N85-27869 N85-27868 N85-27867 N85-28912 N85-29412 N85-27855 N85-27855 N85-27856 N85-27824 N85-27824 N85-27828 A85-39768 N85-27843 N85-27843
NAG3-424 NAG3-74 NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS3-20073 NAS7-918 NAS8-3380 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918	p 671 p 671 p 702 p 683 p 652 p 634 p 634 p 634 p 639 p 632 p 637 p 644 p 677 p 648 p 679 p 639 p 677	N85-27868 N85-27867 N85-28912 N85-29432 N85-27914 N85-27855 N85-27826 N85-27826 N85-27825 N85-27898 A85-39768 N85-27843 N85-27843
NAG3-74 NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS3-20073 NAS3-2093 NAS8-32893 NAS8-3380 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918	p 671 p 617 p 702 p 683 p 652 p 652 p 634 p 634 p 679 p 632 p 657 p 644 p 677 p 688 p 689 p 689 p 702	N85-27867 N85-28912 N85-29432 N85-27914 N85-27855 N85-27856 N85-27826 N85-27826 N85-27826 N85-27898 N85-28941 N85-27843 N85-27843
NASW-3531 NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918	p 617 p 702 p 683 p 652 p 652 p 634 p 679 p 632 p 657 p 644 p 677 p 648 p 677 p 688 p 699 p 702	N85-28912 N85-29432 N85-27914 N85-27856 N85-27856 N85-27856 N85-27829 N85-27836 N85-27898 N85-28941 N85-27843 N85-27846
NASW-4004 NASW-4006 NAS1-13259 NAS1-15214 NAS1-1526 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11386 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33380 NAS8-33380 NAS8-33317 NAS8-35918 NAS8-35918	p 702 p 683 p 652 p 634 p 634 p 634 p 632 p 632 p 657 p 644 p 677 p 688 p 689 p 702	N85-29432 N85-27914 N85-27855 N85-27856 N85-27824 N85-27898 N85-27898 N85-28941 N85-28841 N85-27843 N85-27886
NASW-4006 NAS1-13259 NAS1-15214 NAS1-17561 NAS1-17769 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918 NAS8-35918	p 683 p 652 p 652 p 634 p 634 p 639 p 632 p 657 p 644 p 677 p 644 p 679 p 688 p 689 p 702	N85-27914 N85-27855 N85-27856 N85-27824 N85-27825 N85-27898 A85-39768 N85-27843 N85-27843 N85-27886
NAS1-15214 NAS1-15326 NAS1-17561 NAS1-17719 NAS2-11364 NAS2-11368 NAS3-20073 NAS7-918 NAS8-32893 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918 NAS8-35918	p 652 p 634 p 634 p 639 p 632 p 657 p 644 p 677 p 648 p 677 p 688 p 699 p 702	N85-27856 N85-27824 N85-27825 N85-27898 A85-39768 N85-28941 N85-27843 N85-27886
NAS1-15326 NAS1-17561 NAS2-11364 NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918 NAS8-35918	p 634 p 634 p 679 p 632 p 657 p 644 p 677 p 688 p 699 p 702	N85-27824 N85-27825 N85-27898 A85-39768 N85-28941 N85-27843 N85-27886
NAS1-15326 NAS1-17561 NAS1-17719 NAS2-11364 NAS3-20073 NAS3-20073 NAS3-2093 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NAS8-35918 NAS8-35918	p 634 p 679 p 632 p 657 p 644 p 677 p 688 p 699 p 702	N85-27825 N85-27898 A85-39768 N85-28941 N85-27843 N85-27886
NAS1-17561 NAS1-17719 NAS2-11364 NAS3-21388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-33893 NAS8-33380 NAS8-33380 NAS8-33917 NAS8-35918 NAS8-35918	p 679 p 632 p 657 p 644 p 677 p 688 p 699 p 702	N85-27898 A85-39768 N85-28941 N85-27843 N85-27886
NAS1-17561 NAS1-17719 NAS2-11364 NAS3-21388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-33893 NAS8-33380 NAS8-33380 NAS8-33917 NAS8-35918 NAS8-35918	p 632 p 657 p 644 p 677 p 688 p 699 p 702	A85-39768 N85-28941 N85-27843 N85-27886
NAS1-17719 NAS2-11364 NAS2-11388 NAS3-20073 NAS8-32893 NAS8-33893 NAS8-33380 NAS8-33817 NAS8-35918 NAS8-35918	p 657 p 644 p 677 p 688 p 699 p 702	N85-28941 N85-27843 N85-27886
NAS2-11364 NAS3-20073 NAS3-20073 NAS7-918 NAS8-32893 NAS8-3380 NAS8-33817 NAS8-35918 NCC1-22	p 644 p 677 p 688 p 699 p 702	N85-27843 N85-27886
NAS2-11388 NAS3-20073 NAS7-918 NAS8-32893 NAS8-33380 NAS8-33817 NAS8-33518 NCC1-22	p 677 p 688 p 699 p 702	
NAS7-918 NAS8-32893 NAS8-33380 NAS8-33817 NAS8-35918 NCC1-22	р 699 р 702	A85-39284
NAS8-32893 NAS8-33380 NAS8-33817 NAS8-35918 NCC1-22	p 702	
NAS8-33380 NAS8-33817 NAS8-35918 NCC1-22		N85-28191
NAS8-33817 NAS8-35918 NCC1-22		A85-39526
NAS8-35918 NCC1-22	p 702 p 702	A85-39526 A85-39526
NCC1-22	p 628	A85-39526 A85-39226
	p 628	A85-39219
NCC1-46	p 628	A85-39219
NCC3-5	p 702	N85-29364
NIVR-1697	p 653	N85-27860
NSF ATM-79-21080	p 702	A85-39526
NSF ATM-80-26533	p 702	A85-39526
NSF ATM-83-00164	p 701	A85-37720 A85-37720
NSF ATM-84-07143 NSF MEA-80-06806	р 701 р 698	A85-37720 A85-39898
NSG-7523	p 683	N85-27915
N00014-77-C-0033	p 628	A85-39216
N00014-80-C-0312	p 702	A85-39526
N00014-83-C-0725	p 684	N85-28954
N00014-84-K-0069	p 702	A85-39526
N00014-84-K-0093 N00140-83-C-8899	p 628	A85-39223 A85-39644
N00167-81-C-0087	р 664 р 697	A85-39873
N60530-85-WR-30011	p 689	A85-39640
SB5448-81-C-0518	p 673	N85-28946
USDA-53-04H-1-1-8488N	p 648	A85-38781
W-31-109-ENG-38	p 700	N85-28379
	p 700	N85-28380
505-31-01	p 634	N85-27823
505 04 04	p 635	N85-27828
505-31-04 505-31-42	р 671 р 671	N85-27870 N85-27869
505-31-53-10	p 683	N85-27915
505-33-43-09	p 634	N85-27824
	p 634	N85-27825
505-33-53-09	p 652	N85-27852
505-34-03-02	p 681	N85-28949
505-40-14	p 673	N85-28945
505-40-90	p 637	N85-28924
505-42-23-09	р 683 р 704	N85-27916 N85-29686
505-43-11 505-43-23-03	p 634	N85-29660
505-45-12	p 641	N85-27839
505-45-43-02	p 637	N85-28923
505-45-72	p 673	N85-28944
532-01-11	p 644	N85-27843
532-06-11	p 654	N85-28937
533-04-1A	p 671	N85-27867

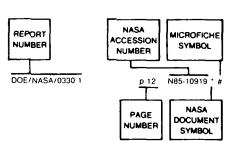
p 658	A85-37582
p 650 p 621	A85-39212
p 626	A85-37661 A85-38984
p 690	N85-28127
р 698 р 671	A85-39898 N85-27869
p 671	N85-27868
p 671	N85-27867
p 617	N85-28912
р 702 р 683	N85-29432 N85-27914
p 652	N85-27914 N85-27855
p 652	N85-27856
р 634 р 634	N85-27824 N85-27825
p 679	N85-27898
p 632	A85-39768
р 657 р 644	N85-28941 N85-27843
p 677	N85-27886
p 688	A85-39284
p 699	N85-28191 A85-39526
р 702 р 702	
p 702	A85-39526 A85-39226 A85-39210
p 628	A85-39226
р 628 р 628	A85-39219 A85-39219
p 702	N85-29364
p 653	N85-27860
р 702 р 702	A85-39526
p 701	A85-39526 A85-37720
p 701	A03-3//20
p 698	A85-39898
р 683 р 628	N85-27915 A85-39216
p 702	AR5.20526
p 684	N85-28954
р 702 р 628	N85-28954 A85-39526 A85-39223
p 664	A00-39044
p 697	A85-39873
р 689 р 673	A85-39640 N85-28946
p 648	A85-38781
p 700	N85-28379
р 700 р 634	N85-28380
p 635	N85-27823 N85-27828
p 671	N85-27870
p 671	N85-27860
р 683 р 634	N85-27803 N85-27915 N85-27824 N85-27825 N85-27852
p 634	N85-27825
p 652	1103-27032
р 681 р 673	N85-28949 N85-28945
p 637	N85-28924
p 683	N85-27916 N85-29686
р 704 р 634	N85-29686
p 634 p 641	N85-27822 N85-27839
p 637	N85-28923
p 673	N85-28944
р 644 р 654	N85-27843 N85-28937
p 671	N85-27867

REPORT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

OCTOBER 1985

Typical Report Number Index Listing



Listings in this index are arranged alphanumencally by report number. The page number indicates the page on which the citation is located The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche

A-85100	p 634	N85-27823	• #
AD-A152369	p 644	N85-27844	#
AD-A152415	•	N85-27863	
AD-A152478	p 657		#
	p 702	N85-28450	#
AD-A152616	p 675	N85-27875	#
AD-A152627	p 675	N85-27876	#
AD-A152689 AD-A152710	p 635	N85-27831	#
AD-A152710 AD-A152801	p 690	N85-27992	#
AD-A152801 AD-A152877	p 690		#
AD-A152877 AD-A153020	p 683	N85-27917 N85-28266	#
AD-A153039	p 699	N85-28200 N85-28328	#
AD-A153039	p 699 p 671	N85-26326	# #
AD-A153100	p 675	N85-27877	#
AD-A153161	p 652	N85-27858	#
AD-A153173	p 675	N85-27878	#
AD-A153300	p 676	N85-27879	#
AD-A153303	p 635	N85-27832	#
AD-A153376	p 653		#
AD-A153533	p 700	N85-29186	#
AD-A153543	p 701	N85-29325	#
AD-A153631	p 637	N85-28926	#
AD-A153634	p 645	N85-28933	#
AD-A153646	p 637	N85-28927	#
AD-A153694	p 706	N85-29838	#
AD-A153695	p 706	N85-29839	#
AD-A153753	p 673	N85-28946	#
AD-A153758	p 638	N85-28928	#
AD-A153767	p 673	N85-28947	#
AD-A153788	p 638	N85-28929	#
AD-A153792	p 706	N85-29841	#
AD-A153810	p 657	N85-28942	#
AD-A153811	p 673	N85-28948	#
AD-A153817	p 684	N85-28954	#
AD-A153830	p 691	N85-29073	#
AD-A153850	p 638	N85-28930	#
AD-A153940	p 692	N85-29074	#
AD-A154717	p 635		#
AD-A155324	p 635	N85-27829	#
AD-B085878L	p 676	N85-27880	#
AD-B089090L	p 653	N85-27860	#
AD-B089436L	p 645	N85-27848	#
AD-B090357L	p 700	N85-28431	#
AD-B090358L	p 700	N85-28430	#
AD-D011640	p 670	N85-27865	#
AD-D011641	p 670	N85-27866	#
AD-D011642	p 705	N85-28784	#
AD-D011658	p 654	N85-28936	#
AD-D011662	p 672		#
AD-D011664	p 691	N85-29045	#
AD-E801121	p 692	N85-29074	#

AD-E900434 .	p 644	N85-27844	#	AIAA PAPER 85-1116	p 629	A85-39613 #
AD-E900438		N85-28450	#	AIAA PAPER 85-1117	p 664	AB5-39614 #
	- 706	NOF 00000	"	AIAA PAPER 85-1119	p 629	A85-39615 #
AD-F630669 . AD-F630671	ρ706 ο706	N85-29838 N85-29839	# #	AIAA PAPER 85-1120	p 651	A85-39616 #
	P			AIAA PAPER 85-1134 AIAA PAPER 85-1135	p 630	A85-39618 #
AEDC-TR-85-5	p 673	N85-28948	#	AIAA PAPER 85-1135 AIAA PAPER 85-1136	p 696 p 664	A85-39619 # A85-39620 #
AFATL-TR-85-22	p 637	N85-28927	#	AIAA PAPER 85-1177	p 689	A85-39640 #
	p 00.	THE LOOL	"	AIAA PAPER 85-1182	p 697	A85-39643 #
AFIT/GAE/AA/84D-3	p 699	N85-28328	#	AIAA PAPER 85-1183 AIAA PAPER 85-1184	р 664 р 689	A85-39644 # A85-39645 #
AFIT/GAE/AA/84D-6 AFIT/GAE/AA/84D-7	p 671 p 635	N85-27871 N85-27832	# #	AIAA PAPER 85-1188	p 664	A85-39646 #
	p 000		"	AIAA PAPER 85-1189	p 664	A85-39647 #
AFIT/GE/ENG/84D-72	p 675	N85-27877	#	AIAA PAPER 85-1190 AIAA PAPER 85-1191	p 665 p 665	A85-39648 # A85-39649 #
AFLMC-LM760720	p 706	N85-29838	#	AIAA PAPER 85-1204	p 665	A85-39654 #
AFLMC-LM831215	p 706	N85-29839	#	AIAA PAPER 85-1205	p 665	A85-39655 #
15000				AIAA PAPER 85-1206 AIAA PAPER 85-1209	p 665 p 665	A85-39656 # A85-39657 #
AFOSR-85-0383TR	p 691	N85-29073	#	AIAA PAPER 85-1214	p 630	A85-39658 #
AFWAL-TR-82-3073-REV-B	p 652	N85-27858	#	AIAA PAPER 85-1216	p 630	A85-39659 #
AFWAL-TR-84-2049		N85-28129	#	AIAA PAPER 85-1218 AIAA PAPER 85-1219	р 630 р 689	A85-39661 # A85-39662 * #
AFWAL-TR-84-3045 AFWAL-TR-84-3060-VOL-1		N85-27875 N85-27878	# #	AIAA PAPER 85-1220	p 666	A85-39663 #
AFWAL-TR-84-3060-VOL-2		N85-27879	#	AIAA PAPER 85-1221	p 666	A85-39664 #
AFWAL-TR-84-3085 .	p 673		#	AIAA PAPER 85-1248 AIAA PAPER 85-1261	p 689	A85-39676 A85-39684 #
AFWAL-TR-84-3090 AFWAL-TR-84-3091	p 638	N85-28928 N85-28930	#	AIAA PAPER 85-1262	р 666 . р 630	A85-39684 # A85-39685 #
AFWAL-TR-85-2004	р 638 р 673	N85-28946	# #	AIAA PAPER 85-1264	p 630	A85-39686 * #
	•			AIAA PAPER 85-1270 AIAA PAPER 85-1276	p 631	A85-39689 #
AGARD-AR-212 .	p 700	N85-29116	#	AIAA PAPER 85-1277	p 666 p 666	A85-39693 # A85-39694 #
AGARD-CP-384	p 676	N85-27883	#	AIAA PAPER 85-1278	p 666	A85-39695 #
				AIAA PAPER 85-1280 AIAA PAPER 85-1281	p 666	
AGARD-LS-139	p 617	N85-28913	#	AIAA PAPER 85-1284	р631 . р651	A85-39697 # A85-39698 * #
AGARD-PAPER-24	D 704	N85-29686	• #	AIAA PAPER 85-1285	p 667	A85-39699 #
				AIAA PAPER 85-1286 AIAA PAPER 85-1288	p 631	A85-39700 * #
AIAA PAPER 84-0933	p 616		#	AIAA PAPER 85-1288	р 667 р 667	A85-39701 # A85-39702 #
AIAA PAPER 85-0858 AIAA PAPER 85-0860	p 640 p 640	A85-38777 A85-38778	# #	AIAA PAPER 85-1290	p 667	A85-39703 * #
AIAA PAPER 85-0861	p 640		#	AIAA PAPER 85-1291	p 667	A85-39704 #
AIAA PAPER 85-0864	p 624		#	AIAA PAPER 85-1292 AIAA PAPER 85-1293	p 682	A85-39705 # A85-39706 #
AIAA PAPER 85-0865 AIAA PAPER 85-0866	р 648 р 624		# #	AIAA PAPER 85-1296	p 668	A85-39707 #
AIAA PAPER 85-0867	p 624	A85-38783	#	AIAA PAPER 85-1309		A85-39716 #
AIAA PAPER 85-0868		A85-38798	#	AIAA PAPER 85-1312 AIAA PAPER 85-1313	p 668 p 668	A85-39717 * # A85-39718 #
AIAA PAPER 85-0869 AIAA PAPER 85-0870	р 648 р 641		# #	AIAA PAPER 85-1326	. p 689	A85-39727 #
AIAA PAPER 85-0871	p 648		#	AIAA PAPER 85-1332	p 631	A85-39728 * #
AIAA PAPER 85-0872	p 648	A85-38787	#	AIAA PAPER 85-1334 AIAA PAPER 85-1344	p 631 p 631	A85-39729 # A85-39736 #
AIAA PAPER 85-0873 AIAA PAPER 85-0874	p 648	A85-38788 A85-38789	# #	AIAA PAPER 85-1346	p 632	
AIAA PAPER 85-0875	p 625		#	AIAA PAPER 85-1347	p 668	A85-39739 * #
AIAA PAPER 85-0876		A85-38791	#	AIAA PAPER 85-1348 AIAA PAPER 85-1349		A85-39740 # A85-39741 #
AIAA PAPER 85-0877 AIAA PAPER 85-0878	р 641 р 641	A85-38792 A85-38793	# #	AIAA PAPER 85-1352	p 697	A85-39742 #
AIAA PAPER 85-0879	p 674		#	AIAA PAPER 85-1353		A85-39743 #
AIAA PAPER 85-0880		A85-38795	#	AIAA PAPER 85-1366 AIAA PAPER 85-1400	p 689 p 690	A85-39744 # A85-39763 #
AIAA PAPER 85-0881 AIAA PAPER 85-0883		A85-38796 A85-38797	*# #	AIAA PAPER 85-1404		A85-39765 #
AIAA PAPER 85-0906		A85-37580		AIAA PAPER 85-1407		A85-39766 #
AIAA PAPER 85-0908		A85-37582		AIAA PAPER 85-1408 AIAA PAPER 85-1409		A85-39767 * # A85-39768 * #
AIAA PAPER 85-0913 AIAA PAPER 85-0924	р 704 р 620	A85-37583 A85-37593	# #	AIAA PAPER 85-1423	p 669	A85-39771 #
AIAA PAPER 85-0925	p 620	A85-37594		AIAA PAPER 85-1425	p 669	
AIAA PAPER 85-0934	p 685	A85-37599	#	AIAA PAPER 85-1428 AIAA PAPER 85-1430	p 682 p 669	A85-39773 # A85-39774 #
AIAA PAPER 85-0971	p 620	A85-37621	#	AIAA PAPER 85-1431	. p 669	
AIAA PAPER 85-0972 AIAA PAPER 85-0973	р 681 р 620	A85-37622 A85-37623	# #	AIAA PAPER 85-1434	p 669	A85-39776 #
AIAA PAPER 85-0975	p 694	A85-37625	#	AIAA PAPER 85-1440 AIAA PAPER 85-1441	. p633 . p697	A85-39779 # A85-39780 * #
AIAA PAPER 85-0976 AIAA PAPER 85-0994	p 620	A85-37626 A85-37640	# #	AIAA PAPER 85-1448	. pos/ p651	A85-39785 #
AIAA PAPER 85-0994 AIAA PAPER 85-0998	р 620 р 621	A85-37640 A85-37642	# #	AIAA PAPER 85-1449	p 651	A85-39786 #
AIAA PAPER 85-0999	p 621	A85-37643	#	AIAA PAPER 85-1457 AIAA PAPER 85-1459	p 651	A85-39789 # A85-39790 #
AIAA PAPER 85-1003 AIAA PAPER 85-1004	p 681	A85-37644	#	AIAA PAPER 85-1460	p 670	A85-39790 # A85-39791 #
AIAA PAPER 85-1004	p 621 p 621	A85-37645 A85-37661	*#	AIAA PAPÉR 85-1463	p 633	A85-39792 #
AIAA PAPER 85-1061	p 621	A85-37675		AIAA PAPER 85-1464 AIAA PAPER 85-1466	p 633 p 670	
AIAA PAPER 85-1072	p 658	A85-37682	#	AIAA PAPER 85-1400 AIAA PAPER 85-1471		A85-39794 # A85-39796 * #
AIAA PAPER 85-1103	-	A85-39605	#	AIAA PAPER 85-1472	p 697	A85-39797 #
AIAA PAPER 85-1104	p 664	A85-39606	°#	AIAA PAPER 85-1473	p 670	A85-39798 #

AIAA PAPER-85-1142

REPORT NUMBER INDEX

AIAA PAPER-85-1142	p 617	A85-39621 #	EDR-11442	p 690	N85-28109 * #	NAS 1 60 2463	p 673	N85-28944 * #
	•					NAS 1 60.2469	p 704	N85-28708 * #
A!AA-85-1398	. p 671	N85-27870 * #	FAA-APO-85-4	p 657	N85-27863 #	NAS 1 60 2485	p 634	N85-27823 #
			FAA-APO-85-5	p 657	N85-28942 #	NAS 1 71 ARC-11613-1	p 700	N85-29150 * #
ANL/CNSV-47	p 700	N85-28379 #	11 4 999	- 704	NOE 00000 * #	NASA-CASE-ARC-11613-1 .	p 700	N85-29150 * #
AR-003-984	n 654	N85-28938 #	H-1290	p 704	N85-29686 * #	1101-010E-110-110-11-1	p 100	1100-20100 #
	p 004	100 20000 //	IFD-1/84-PT-1	p 654	N85-28939 #	NASA-CR-132732-1	p 652	N85-27855 * #
ARL-STRUC-TM-397	. р 654	N85-28938 #	IFD-1/84-PT-2	p 654	N85-28940 #	NASA-CR-132732-2 .	p 652	N85-27856 * #
						NASA-CR-166571	p 644	N85-27843 * #
ARL/STRUC-TM-389	p 701	N85-29325 #	ISBN-0-947767-088 .	p 634	N85-27826 #	NASA-CR-172584 .	p 634	N85-27824 * #
ARL/STRUC-TM-392	. p 653	N85-27859 #	ISBN-0-947767-096	p 634	N85-27827 #	NASA-CR-172585	p 634 p 657	N85-27825 * # N85-28941 * #
ASME PAPER 84-WA/DSC-20	. p 651	A85-39869 #	ISBN-0-947767-185 ISBN-90-346-02478	p 652 p 685	N85-27853 # N85-28955 #	NASA-CR-174715	p 690	N85-28109 * #
ASME PAPER 84-WA/FE-10	p 697	A85-39873 #	ISBN-92-835-0375-9	р 665 . р 676	N85-27883 #	NASA-CR-174916	p 671	N85-27867 * #
ASME PAPER 84-WA/FM-2	p 633	A85-39874 #	ISBN-92-835-1499-8	p 617	N85-28913 #	NASA-CR-174920 .	p 702	N85-29364 * #
ASME PAPER 84-WA/FM-3	p 633	A85-39875 #		•		NASA-CR-175856	p 690	N85-28127 * #
ASME PAPER 84-WA/FM-7	p 634	A85-39876 #	ISSN-0089-4010	p 681	N85-28950 #	NASA-CR-175888 .	p 699	N85-28191 * #
ASME PAPER 84-WA/HT-25	p 698	A85-39888 #	ISSN-0171-1342	p 635	N85-27833 #	NASA-CR-175901 .	p 671	N85-27868 * #
ASME PAPER 84-WA/HT-69 . ASME PAPER 84-WA/HT-70	. p 698 p 698	A85-39897 # A85-39898 * #	ISSN-0171-1342	p 636	N85-27837 # N85-27838 #	NASA-SP-472	n 617	N85-28912 * #
ASME PAPER 84-WA/HT-71	p 698		ISSN-0171-1342 ISSN-0171-1342	p 636 p 653	N85-27862 #		p 01.	
ASME PAPER 84-WA/HT-8	p 698		ISSN-0171-1342	p 676	N85-27881 #	NASA-TM-77651	p 683	N85-27914 * #
ASME PAPER 84-WA/NCA-19	p 690	A85-39913 #	ISSN-0171-1342	p 684	N85-27920 #	NASA-TM-77837 .	p 702	N85-29432 * #
			ISSN-0171-1342	p 702	N85-28471 #	NASA-TM-83556	p 641	N85-27839 * #
AVSCOM-TM-85-B-1	p 683	N85-27916 * #	ISSN-0176-7739	p 657	N85-27864 #	NASA-TM-86378	p 683	N85-27915 * #
AVSCOM-TR-85-B-2	0 627	N85-28923 * #	ISSN-0176-7739	p 684	N85-27921 #	NASA-TM-86383 NASA-TM-86418	р 683 р 652	N85-27916 * # N85-27852 * #
ATOOM 11-03-0-2 .	P 03/	105-20823 #	ISSN-0176-7739 ISSN-0340-7608	р 701 р 672	N85-29313 # N85-27874 #	NASA-TM-86687	p 652	N85-27854 * #
BMFT-FB-T-84-302	p 672	N85-27874 #	ISSN-0340-7608	p 691	N85-29066 #	NASA-TM-86689	p 654	N85-28937 * #
BMFT-FB-T-84-303		N85-29066 #	ISSN-0389-4010	p 637	N85-28925 #	NASA-TM-86713 .	p 635	N85-27828 * #
	-		ISSN-0389-4010 .	p 684	N85-28952 #	NASA-TM-86730	p 704	N85-29686 * #
B8476490	p 685		ISSN-0389-4010	p 684	N85-28953 #	NASA-TM-87033 .	p 673	N85-28945 * #
B8560217 B8560426	p 644 p 653				NOE 20104 + 4	NASA-TM-87049 .	p 671	N85-27870 * #
B8561153	p 700		JPL-PUB-85-12	p 699	N85-28191 * #	NASA-TP-2420	p 637	N85-28923 * #
B8561154	p 700		JPRS-UTR-84-025	p 641	N85-27841 #	NASA-TP-2432	p 637	N85-28924 * #
B8561897	p 704	N85-28712 #				NASA-TP-2434	p 634	N85-27822 * #
B8561898	p 705		L-15890	p 637	N85-28924 * #	NASA-TP-2445	p 681	N85-28949 * #
B8580072	p 645		L-15895	p 637	N85-28923 * #	NASA-TP-2463	p 673	N85-28944 * #
B8580073 B8580074	p 672 p 653		L-15896	p 681	N85-28949 * # N85-27916 * #	NASA-TP-2469 NASA-TP-2485	р 704 р 634	N85-28708 * # N85-27823 * #
B8580074	p 653			.р683 .р683		11200-11-2403	p 004	100-27020 #
B8580077	p 636		L-15927	p 634		NLR-MP-84001-U	p 700	N85-28430 #
B8580078	p 699	N85-28140 #		F		NLR-MP-84002-U	p 700	N85-28431 #
B8580080	p 700	N85-28432 #	LC-83-26912 .	p 617	N85-28912 * #	NLR-MP-84021-U		N85-27847 #
CA-8421	- 604	NOE 07000 #			NOT 00700 + "	NLR-MP-84029-U	p 645	N85-27848 #
CA-8435	p 634	N85-27826 # N85-27827 #	M-485	p 704	N85-28708 * #	NLR-TR-83042-U	p 653	N85-27860 #
CA-8505 .		N85-27853 #	MBB/LFA33/CFK/PUB/007	p 690	N85-27976 #		p 000	
	•		MBB/LFA34/CFK/PUB/006	p 690		NRC-24173	p 652	
CNA-PP-432	p 684	N85-28954 #	MBB/LFA34/CFK/PUB/008	p 651	N85-27851 #	NRC-24262	p 635	
CONE 8410103 6		NOF 00054 #				NRC-24336	p 635	N85-27829 #
CONF-8410103-6 CONF-8410103-9	p 691 p 700	N85-29054 # N85-28380 #	MRC-TSR-2782	p 700	N85-29186 #	NRL-8869	n 692	N85-29074 #
CONF-8505116-1		N85-28935 #	MTB-7610-VOL-7	n 683	N85-27917 #	1112-0003	p 032	100-20014 #
	P		MITH-7010-VOL-7	p 000	1105-21517 #	NWC-TP-6612 .	p 702	N85-28450 #
DE85-005238	p 691		NAE-AN-26	p 652	N85-27857 #			
DE85-006209	p 700		NAE-AN-27		N85-27830 #	ORNL/TM-8959		N85-29053 #
DE85-006495 DE85-008411	p 700		NAE-AN-28	p 635	N85-27829 #	ORNL/TM-9497	p 691	N85-29052 #
DE85-008411		N85-28935 # N85-28463 #	NAK TO BE	a 601	NR5 29050 #	R-85-02	n 657	N85-28941 * #
DE85-008475	. p702		NAK-TR-86	h 001	N85-28950 #		2 557	π
DE85-008744		N85-28276 #	NAL-TR-842-PT-3	p 684	N85-28952 #	REPT-84-23	p 635	N85-27834 #
DE85-008755	p 691	N85-29052 #	NAL-TR-845 .	p 637	N85-28925 #	REPT-85140		N85-27854 * #
DE85-008759	p 691	N85-29053 #	NAL-TR-847	p 684	N85-28953 #	REPT-85146		N85-28937 * #
DFVLR-FB-84-12	n 676	N85-27880 #	NAC 1 15 77651		N95 27014 * #	REPT-85209	h 032	N85-27828 * #
DFVLR-FB-84-48		N85-27881 #	NAS 1 15 77651 . NAS 1 15 77837		N85-27914 * # N85-29432 * #	SAE PAPER 841457	p 650	A85-39202 * #
DFVLR-FB-84-49	p 636	N85-27837 #	NAS 1 15 83556	p 641		SAE PAPER 841478	p 627	A85-39058 #
		N85-27862 #	NAS 1 15 86378 .	p 683	N85-27915 * #	SAE PAPER 841479		A85-39059 * #
DFVLR-FB-84-52		N85-27882 #	NAS 1 15 86383		N85-27916 #	SAE PAPER 841480 .		A85-39060 * #
DFVLR-FB-85-01-PT-2 DFVLR-FB-85-03		N85-27833 # N85-28471 #	NAS 1 15 86418		N85-27852 * #	SAE PAPER 841495 SAE PAPER 841496		A85-39203 # A85-39204 #
		N85-27920 #	NAS 1 15 86687 NAS 1 15 86689		N85-27854 * # N85-28937 * #	SAE PAPER 841497		A85-39205 * #
DFVLR-FB-85-05		N85-27838 #	NAS 1 15 86713		N85-27828 * #	SAE PAPER 841498		A85-39206 #
			NAS 1 15 86730	p 704	N85-29686 * #	SAE PAPER 841503	p 695	A85-39061 #
DFVLR-IB-222-84-A-37 .	p 683	N85-27912 #	NAS 1 15 87033		N85-28945 * #	SAE PAPER 841504		A85-39062 #
DFVLR-MITT-84-21	n 70+	N85-29313 #	NAS 1 15 87049 .		N85-27870 * #	SAE PAPER 841508 SAE PAPER 841509		A85-39152 # A85-39153 #
		N85-29313 #			N85-28912 * # N85-27855 * #	SAE PAPER 841511	p 661	
		N85-27921 #	NAS 1 26 132732-1 NAS 1 26 132732-2		N85-27856 * #	SAE PAPER 841512		A85-39284 * #
					N85-27843 * #	SAE PAPER 841520	p 688	A85-39291 #
DOE/CE-T11	p 702	N85-28463 #	NAS 1 26 172584	. p 634	N85-27824 * #			A85-39063 #
DOE/ER-10687/T2	n 600	N85-28276 #			N85-27825 * #	SAE PAPER 841540 . SAE PAPER 841541 .		A85-39064 # A85-39065 * #
DOE/ER-1068//12	h 033	1103-202/0 #	NAS 1 26 172589		N85-28941 * # N85-28109 * #			A85-39065 * # A85-39066 * #
DOE/NASA/0005-1	p 702	N85-29364 * #	NAS 1.26 174715 NAS 1.26 174916 .		N85-28109 #			A85-39156 #
		N85-28109 * #	NAS 1.26 174920		N85-29364 * #	SAE PAPER 841547	. p 662	A85-39157 #
D190 29205 4		NOC 00 100 "	NAS 1 26:175856 .	p 690	N85-28127 * #			A85-39158 #
D180-28285-1	p 690	N85-28129 #			N85-28191 * #	SAE PAPER 841555		A85-39207 #
E-1935	n 641	N85-27839 * #			N85-27868 * # N85-28923 * #	SAE PAPER 841556	000 µ 000	A85-39208 * # ~A85-39209 #
E-2434		N85-28944 * #	NAS 1 60 2420		N85-28924 * #	SAE PAPER 841566		A85-39067 #
E-2588		N85-28945 * #						A85-39068 #
	p 0/3	1103-20943 #	NAS 1 60 2434 .	p 634	N85-27822 * #	SAE PAPER 841567	p 010	A03-39000 #
E-2612	-	N85-27870 * #			N85-27822 * # N85-28949 * #	SAE PAPER 841569	-	A85-39167 #

REPORT NUMBER INDEX

SAE PAPER 841570	p 662	A85-39160 #	
SAE PAPER 841571	p 662	A85-39161 #	
SAE PAPER 841572	p 662	A85-39162 #	
	p 682	A85-39274 #	
SAE PAPER 841599	p 659	A85-39069 #	
SAE PAPER 841601	p 659	A85-39071 #	
SAE PAPER 841603	p 662	A85-39163 #	
SAE PAPER 841604	p 650	A85-39164 #	
SAE PAPER 841605	p 696	A85-39165 #	
SAE PAPER 841607			
SAE PAPER 841607	p 662	A85-39166 #	
SAE SP-591	p 616	A85-39201 #	
SAE SP-594	p 659	A85-39057 #	
SAE SP-598	p 661	A85-39151 #	
SAND-84-0941	p 702	N85-28458 #	
SAND-85-0223C	p 645		
SAND-05-02230 .	p 645	1103-20935 #	
	.		
T-3771	p 644	N85-27843 * #	
UILU-ENG-84-4001	p 691	N85-29073 #	
US-PATENT-APPL-SN-256880	p 670	N85-27866 #	
US-PATENT-APPL-SN-382070	p 691	N85-29045 #	
US-PATENT-APPL-SN-434671	p 705	N85-28784 #	
US-PATENT-APPL-SN-484390	p 672	N85-28943 #	
US-PATENT-APPL-SN-534996	p 654	N85-28936 #	
US-PATENT-APPL-SN-578304	p 670	N85-27865 #	
US-PATENT-APPL-SN-739792	p 700	N85-29150 * #	
	F		
US-PATENT-CLASS-343-872	p 691	N85-29045 #	
US-PATENT-CLASS-356-376		N85-28784 #	
	p 705		
US-PATENT-CLASS-415-189	p 670	N85-27866 #	
US-PATENT-CLASS-60-39 32	p 672	N85-28943 #	
US-PATENT-CLASS-60-739	p 670	N85-27865 #	
US-PATENT-CLASS-62-180	p 654	N85-28936 #	
	P		
US-PATENT-4,499,735	p 670	N85-27865 #	
US-PATENT-4,500,206	p 705	N85-28784 #	
US-PATENT-4,500,255	p 670	N85-27866 #	
US-PATENT-4,503,668	p 672	N85-28943 #	
US-PATENT-4,505,124	p 654	N85-28936 #	
US-PATENT-4,506,269	p 691	N85-29045 #	
	P ** ·		
USAAVSCOM-TM-85-B-2	p 652	N85-27852 * #	
00004000040-140-00-0-2	p oue	103-27032 #	
	- 074	NOC 07070 + #	
USAAVSCOM-TR-85-C-11	p 671	N85-27870 * #	
USAVSCOM-TR-85-C-10	p 673	N85-28945 * #	
VTH-LR-402	p 636	N85-27835 #	
	•		
VUB-STR-14	p 637	N85-28926 #	
	φ 00'		

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.

ACCESSION NUMBER INDEX

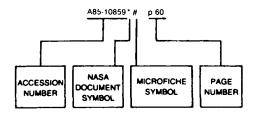
AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 192)

OCTOBER 1985

A85-39163 #

p 662

Typical Accession Number Index Listing



Listings in this index are arranged alphanumencally by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche

.

		•	•
A85-36996 *	#	p 617	A85-37567 # p 658
A85-37049	 #	p 617	A85-37575 # p 658
A85-37074	#	p 692	A85-37580 * # p 620
A85-37176	#	p 615	A85-37582 * # p 658
			A85-37583 # p704
A85-37177	#	p 692	A85-37593 # p620
A85-37178	#	p 617	A85-37594 * # p 620
A85-37181	#	p 693	A85-37599 # p 685
A85-37182	#	p 645	A85-37621 # p 620
A85-37183 A85-37186	# #	р 615 р 693	A85-37622 # p 681
A85-37186 A85-37187	# #	p 693	A85-37623 # p 620
A85-37188	π #	p 645	A85-37625 # p 694
A85-37191	#	p 617	A85-37626 # p 620
A85-37192	#	p 693	A85-37640 # p 620
A85-37194	#	p 618	A85-37642 # p 621 A85-37643 # p 621
A85-37195	#	p 673	A85-37643
A85-37197	#	p 618	A85-37644 # p 581 A85-37645 # p 621
A85-37198	#	p 703	A85-37661 * # p 621
A85-37200	#	p 618	A85-37675 * # p 621
A85-37201	#	p 686	A85-37682 # p 658
A85-37203	#	p 618	A85-37693 # p 639
A85-37206	#	p 645	A85-37706 # p 694
A85-37209	#	p 704	A85-37720 # p 701
A85-37211	#	p 703	A85-37803 # p 642
A85-37212	#	p 618	A85-37808 # p 642
A85-37216	#	p 693	A85-37810 # p 642
A85-37233	#	p 657	A85-37825 * # p 642
A85-37323	#	p 646	A85-37829 # p 642
A85-37330	#	p 618	A85-37830 # p642
A85-37333	#	p 619	A85-37831 # p 643
A85-37335	#	p 619	A85-37832 # p 643
A85-37336	#	p 619	A85-37879 # p621
A85-37337 A85-37338	#	p 619	A85-37896 # p 655
A85-37339	# #	р 619 р 686	A85-37898 * # p 704
A85-37339 A85-37340	# #	p 600 p 619	A85-37925 # p.655
A85-37341	π #	p 619	A85-37927 # p 622
A85-37380	т #	p 686	A85-37928 # p 622
A85-37381	#	p 686	A85-37929 # p 622
A85-37396	#	p 703	A85-37930 # p622 A85-37931 # p622
A85-37407	#	p 686	A85-37931 # p 622
A85-37408	#	p 646	A85-37945 # p 646
A85-37415		p 686	A85-37946 # p 646
A85-37472	#	p 693	A85-37949 # p 681
A85-37484	*#	ρ 687	A85-37950 # p 705
A85-37488	#	p 646	A85-38069 # p 694
A85-37489	#	p 638	A85-38168 # p 674
A85-37491	#	p 681	A85-38169 # p 694
A85-37495	#	p 687	A85-38233 # p 694
A85-37540	#	p 638	A85-38236 # p 615
A85-37541	#	p 638	A85-38243 # p 646
A85-37542	#	p 638	A85-38244 # p 646
A85-37543	#	p 639	A85-38245 # p 646
A85-37544	#	p 639	
A85-37550	#	p 658	A85-38301 # p 615

A85-38302	#	p 646	
-	#	p 647	
A85-38304	#	р 639	
A85-38306	#	p 647	
A85-38307	#	p 639	
A85-38308	#	p 639	
A85-38309 * A85-38310	# #	р 639 р 640	
A85-38311	# #	p 640	
A85-38312 *	#	p 640	
A85-38313	#	p 643	
A85-38314 A85-38315	#	p 643 p 640	
A85-38316	# #	p 640	
A85-38319	#	p 655	
A85-38321	#	p 647	
A85-38352 A85-38353	# #	p 694 p 615	
A85-38355	π #	p 622	
A85-38357	#	p 674	
A85-38358	#	p 647	
A85-38360	# #	p 647	
A85-38361 A85-38362	# #	р 647 р 622	
A85-38363	#	p 655	
A85-38364	#	p 674	
A85-38365	#	p 647	
A85-38367 A85-38369	# #	р 622 р 674	
A85-38370	#	p 623	
A85-38371	#	p 623	
A85-38401	#	p 655	
A85-38403	# #	р 694 р 623	
A85-38430 A85-38432	# #	p 705	
A85-38434	#	p 647	
A85-38436	#	p 658	
A85-38437 A85-38438	#	p 648	
A85-38439	# #	р 648 р 615	
A85-38440	#	p 648	
A85-38481	#	p 623	
A85-38483	#	p 623	
A85-38488 A85-38510	# #	р 623 р 694	
A85-38526	#	p 643	
A85-38528	#	p 643	
A85-38529	#	p 643	
A85-38530 A85-38536	# #	р 644 р 694	
A85-38538	#	p 644	
A85-38541	#	p 644	
A85-38545 A85-38546	#	p 685	
A85-38551	•# #	р 685 р 623	
A85-38555	#	p 623	
A85-38559	#	p 624	
A85-38562	#	р 624 р 624	
A85-38563 A85-38564	# #	p 624	
A85-38600	#	p 695	
A85-38608	#	p 685	
A85-38610	# #	p 685	
A85-38641 A85-38647	# #	p 616 p 644	
A85-38748	#	p 687	
A85-38749	#	p 687	
A85-38775 A85-38776	# #	р 685 р 616	
A85-38777	#	p 640	
A85-38778	#	p 640	
A85-38779	#	p 640	
A85-38780 A85-38781	# #	p 624 p 648	
A85-38782	# #	p 624	
A85-38783	#	p 624	
A85-38784	#	p 648	
A85-38785 A85-38786	# #	р 641 р 648	
A85-38786 A85-38787	# #	р 648 р 648	
A85-38788	#	p 648	
A85-38789	#	p 624	
A85-38790	#	p 625	

A85-38791 A85-38792 A85-38794 A85-38794 A85-38794 A85-38796 A85-38797 A85-38797 A85-38797 A85-38796 A85-38974 A85-38974 A85-38951 A85-38951 A85-38951 A85-38952 A85-38951 A85-38952 A85-38953 A85-38953 A85-38953 A85-38953 A85-38953 A85-38953 A85-38953 A85-38953 A85-38953 A85-38963 A85-38963 A85-38966 A85-38967 A85-38967 A85-38972 A85-38972 A85-38975 A85-39	#######################################	$ p \ 649 \\ p \ 641 \\ p \ 674 \\ p \ 674 \\ p \ 674 \\ p \ 646 \\ p \ 649 \\ p \ 646 \\ p \ 649 \\ p \ 646 \\ p \ 649 \\ p \ 655 \\ p \ 655 \\ 655 \\ p \ 655 \\ 655 \\ p \ 655 \\ p$	
A85-39061 A85-39062 A85-39063 A85-39064 A85-39065	#####	p 695 p 695 p 627 p 627 p 659	
A85-39066 A85-39067 A85-39068 A85-39069 A85-39071	*#####	p 649 p 659 p 616 p 659	
A85-39101 A85-39103 A85-39104	# # #	p 659 p 687 p 659 p 659	
A85-39106 A85-39107 A85-39112 A85-39115	####	p 660 p 660 p 660 p 660	
A85-39117 A85-39118 A85-39119 A85-39120	####	p 695 p 660 p 660 p 660	
A85-39121 A85-39122 A85-39124 A85-39125	####	p 660 p 661 p 661 p 649	
A85-39126 A85-39131 A85-39151 A85-39152	####	p 661 p 695 p 661 p 661	
A85-39153 A85-39155 A85-39156 A85-39157	####	p 661 p 661 p 661 p 662	
A85-39158 A85-39160 A85-39161 A85-39162	# # #	p 662 p 662 p 662 p 662 p 662	

A85-39164 # p 650 A85-39165 p 696 # A85-39166 # p 662 A85-39167 #### p 663 A85-39170 p 696 A85-39175 p 687 A85-39200 p 627 A85-39201 # p 616 A85-39202 p 650 A85-39203 # p 663 p 650 A85-39204 # # A85-39205 p 627 A85-39206 A85-39207 # p 663 p 663 A85-39207 # A85-39208 * # p 650 A85-39209 A85-39210 # p 663 p 628 # A85-39211 *# p 650 A85-39211 * # A85-39212 * # A85-39213 # p 650 p 701 A85-39214 # p 616 A85-39216 ## p 628 A85-39217 * p 650 A85-39218 # p 701 A85-39219 * # A85-39220 # p 628 p 705 A85-39221 # p 650 A85-39223 p 628 # # A85-39224 p 628 A85-39225 A85-39226 ,, # p 628 p 628 A85-39228 # p 688 A85-39240 A85-39241 # # p 696 p 628 A85-39242 # p 628 A85-39243 # # p 682 A85-39245 p 629 A85-39274 # p 682 A85-39284 ## p 688 A85-39291 p 688 р 688 р 705 р 705 A85-39339 * # A85-39349 # # A85-39369 A85-39445 A85-39450 # p 629 p 696 p 644 # # A85-39458 A85-39459 A85-39492 # p 696 р 688 р 702 # # A85-39526 A85-39551 p 703 ### A85-39554 p 651 p 703 A85-39563 •# A85-39564 p 703 p 703 p 675 A85-39565 A85-39567 # ## p 663 A85-39577 p 629 A85-39578 A85-39580 # p 663 p 629 ## A85-39581 A85-39582 p 629 A85-39589 p 629 p 688 # # # A85-39598 A85-39600 p 688 A85-39605 A85-39606 # p 696 p 664 # A85-39613 # p 629 A85-39614 A85-39615 # # p 664 p 629 A85-39616 # p 651 p 630 p 696 A85-39618 # A85-39619 # A85-39620 # p 664 p 617 p 689 485-39621 # # A85-39640 A85-39643 # p 697 A85-39644 # # p 664 p 689 A85-39645 A85-39646 # p 664 p 664 A85-39647 # # A85-39648 p 665 p 665 A85-39649 ## A85-39654 p 665

A85-39655

ACCESSION NUMBER INDEX

A85-39655 #	p 665	N85-27839 * # p		N85-28379
A85-39656 #	p 665	N85-27840 # p		N85-28380
	p 665	N85-27841 # p		N85-28430
	р 630	N85-27842 # p		N85-28431
	p 630		C 4 4	N85-28432
	p 630		644	N85-28450
	p 689		644	N85-28458
	p 666		C/E	N85-28463 N85-28471
	p 666			N85-28708 *
	p 689			N85-28712
	р 666 р 630	N85-27852 * # p	652	N85-28784
	p 630		652	N85-28871
	p 631		652	N85-28912 *
	p 666		652	N85-28913
A85-39694 #	p 666		652	N85-28914
A85-39695 #	p 666		652 652	N85-28915
A85-39696 #	p 666		653	N85-28916
A85-39697 #	p 631		653	N85-28917 *
A85-39698 *#	p 651		653	N85-28918
A85-39699 #	p 667		653	N85-28919
A85-39700 *#	p 631		657	N85-28920
A85-39701 #	p 667		657	N85-28923 * N85-28924 *
A85-39702 #	p 667		670	N85-28925
A85-39703 * #	p 667	N85-27866 # p	670	N85-28926
A85-39704 # A85-39705 #	p 667 p 668		671	N85-28927
A85-39705 #	p 682		671	N85-28928
A85-39707 #	p 668		671	N85-28929
A85-39716 #	p 668		671	N85-28930
A85-39717 *#	p 668		671	N85-28932
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A85-39729 #	p 631		675 675	N85-28937 *
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A85-39738 *#	p 632		675	N85-28939
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A85-39740 #	p 632		676	N85-28941 *
A85-39741 #	p 632		676	N85-28942
A85-39742 #	p 697	N85-27882 # p	676	N85-28943 N85-28944 *
A85-39743 # A85-39744 #	р 669 р 689	N85-27883 # p	676	N85-28945
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A85-39765 #	p 669		677	N85-28947
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A85-39767 *#	p 632		677	N85-28949 *
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A85-39773 #	p 682		678	N85-28954
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A85-39790 #	p 670		679	N85-29099
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A85-39792 #	p 633		679	N85-29105
A85-39793 *#	p 633		679	N85-29116
A85-39794 #	p 670		6/9	N85-29150 *
A85-39796 * #	p 697		680 680	N85-29186
A85-39797 #	ρ 697		680	N85-29313
A85-39798 #	p 670		680	N85-29314
A85-39869 #	p 651		680	N85-29321
A85-39873 #	ρ 697 ο 692		683	N85-29325
A85-39874 #	p 633		683	N85-29364
A85-39875 #	p 633 p 634		683	N85-29432 ' N85-29686 '
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A85-39888 #	p 698		683	N85-29839
A85-39897 #	p 698		683 -	N85-29841
A85-39898 * #	p 698		684	N85-29844
A85-39899 #	p 698		684	
A85-39913 #	p 690		698	
			699	
N85-27822 * #	p 634		690	
N85-27823 * #	p 634		9 690 9 690	
N85-27824 * #	p 634	N85-28109 * # p	690	
N85-27825 * #	p 634		690	
N85-27826 #	p 634		690	
N85-27827 # N85-27828 * #	p 634 p 635		699	
	p 635 p 635	N85-28147 # p	672	
N85-27829 # N85-27830 #	p 635		672	
N85-27830 #	p 635	N85-28149 # p	672	
N85-27832 #	p 635		636	
N85-27833 #	p 635		636	
	p 635		699	
N85-27835 #	p 636			
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