NASA SP-7037 (283)
October 1992

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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(NASA-SP-7037(283)) AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 283) (NASA) 160 p

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NASA SP-7037 (283)
October 1992

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC
1992

INTRODUCTION

This issue of *Aeronautical Engineering—A Continuing Bibliography* (NASA SP-7037) lists 615 reports, journal articles, and other documents originally announced in September 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-26171 — N92-28222
IAA (A-10000 Series)	A92-40950 — A92-44894

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 publication 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.

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

A cumulative index for 1992 will be published in early 1993.

Information on availability of documents listed, addresses of organizations, and CASI price schedules are located at the back of this issue.

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

Category 03 Air Transportation and Safety 723
Includes passenger and cargo air transport operations; and aircraft accidents.

Category 04 Aircraft Communications and Navigation 724
Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

Category 05 Aircraft Design, Testing and Performance 729
Includes aircraft simulation technology.

Category 06 Aircraft Instrumentation 733
Includes cockpit and cabin display devices; and flight instruments.

Category 07 Aircraft Propulsion and Power 736
Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

Category 08 Aircraft Stability and Control 743
Includes aircraft handling qualities; piloting; flight controls; and autopilots.

Category 09 Research and Support Facilities (Air) 747
Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

Category 10 Astronautics 751
Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

Category 11 Chemistry and Materials 754
Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

Category 12 Engineering 757
Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

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Category 13 Geosciences 774
Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

Category 14 Life Sciences N.A.
Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

Category 15 Mathematical and Computer Sciences 775
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.

Category 16 Physics 778
Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

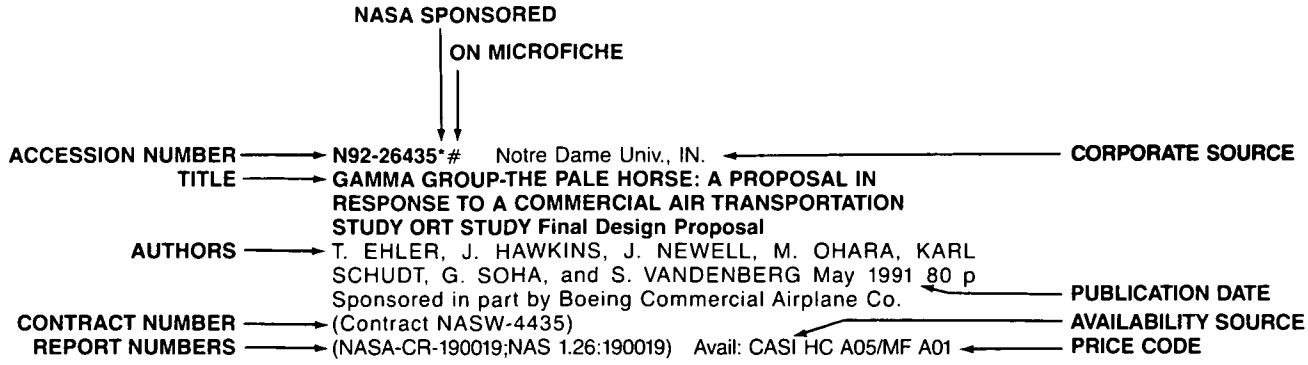
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Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

Category 18 Space Sciences N.A.
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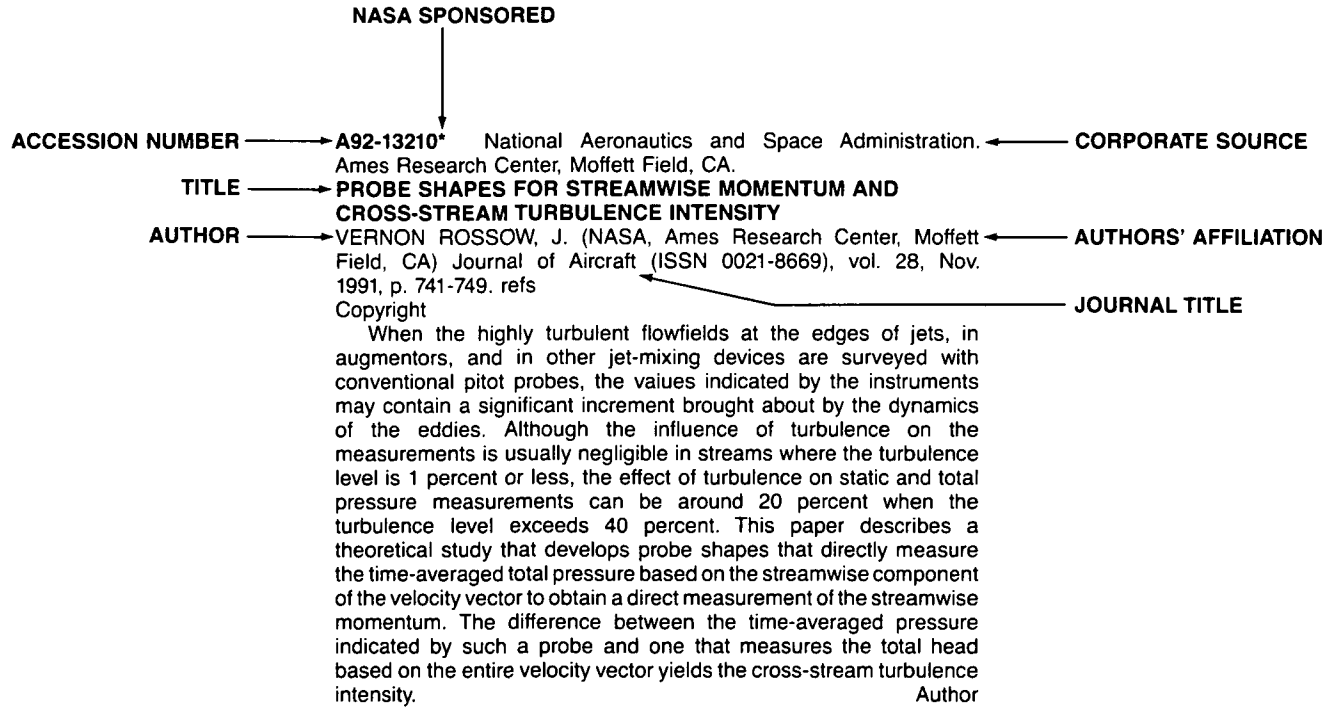
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TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 283)

October 1992

01

AERONAUTICS (GENERAL)

A92-41177
THE EVOLUTION FROM BONDED F27 AIRCRAFT TO ARALL STRUCTURES
L. H. VAN VEGGEL (Fokker Aircraft, Amsterdam, Netherlands) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 65-79. refs

The paper describes the applications of the adhesive bonded structures in Fokker F27 and F28 aircraft and the evolution to the use of fiber-reinforced Aramid aluminum laminates (Arall) in more advanced Fokker aircraft. Special attention is given to the material properties and the allowables in the Arall 1 and Arall 2 materials, the Arall wing structures, the end-fitting panels, the designs of the Arall F27 wing panel, and the Fokker 50 flying access doors. Results of design studies performed on an Arall F50 wing structure are presented, with particular consideration given to the Arall F50 wing compression test panel, Fokker 50 spars, and the Fokker 50 fatigue panel. The quality assurance aspects of Arall structures are discussed. I.S.

A92-41237
COMPOSITE MATERIAL REPAIRS TO METALLIC AIRFRAME COMPONENTS
T. F. CHRISTIAN, JR., D. O. HAMMOND (USAF, Warner Robins Air Logistics Center, Robins AFB, GA), and J. B. COCHRAN (Lockheed Aeronautical Systems Co., Marietta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 470-476. *Previously cited in issue 12, p. 1775, Accession no.* A89-30881. refs

A92-41534
ENVIRONMENTAL EVALUATION OF REPAIRS TO FUSELAGE LAP JOINTS
L. MOLENT, N. BRIDGFORD, D. REES, and R. JONES (Defence Science and Technology Organisation, Aeronautical Research Laboratory, Victoria, Australia) Composite Structures (ISSN 0263-8223), vol. 21, no. 2, 1992, p. 121-130. refs
Copyright

This paper presents the results of a fatigue test program undertaken to investigate repairs to multisite damage in aircraft fuselage lap joints. It is demonstrated that a boron/epoxy composite doubler bonded over the joint should significantly increase the fatigue life of the structure and that environmental effects are negligible. Author

A92-41781
ENGINEERING AND TECHNOLOGY JAPANESE AIRCRAFT/SPACECRAFT
TADAYUKI TANIOKA (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 17-22. In Japanese.

Comparisons of aeronautical and astronautical industrial scales and performance among the industrial countries are presented. Composite materials for aircraft fuselage skin and rocket tank wall are discussed. Y.P.Q.

A92-42054
MAINTENANCE SCHEDULING FOR CRITICAL PARTS OF AIRCRAFT
NASSER S. FARD and EMANUEL MELACHRINOUDIS (Northeastern University, Boston, MA) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 44-47. refs
Copyright

A mathematical model for determining the best schedule for maintenance of aircraft is presented. The objective is to improve safety, avoid breakdowns, avert catastrophe, and keep costs down. Cracks, corrosion, and metal fatigue, or malfunctions of a hydraulic cable are among major reasons behind catastrophic failures. Early detection of a failure and replacement or repair of the failed unit will help to prevent further deterioration which could become much more costly or even result in a catastrophic failure. The stochastic optimization model developed in this paper has a nonlinear objective function and a single set of simple bound constraints on integer decision variables. Author

A92-43095
AIRCRAFT SYMPOSIUM, 28TH, TOKYO, JAPAN, NOV. 7-9, 1990, PROCEEDINGS
Symposium sponsored by Japan Society for Aeronautical and Space Sciences and Japan Aeronautical Engineers' Association. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, 681 p. In Japanese and English. For individual items see A92-43096 to A92-43248.

Papers are presented on such topics as hypersonic test facilities, helicopter rotor aeroelastic stability and response, the evaluation of the structural integrity of aging aircraft, the effect of temperature on composite panel flutter, and the dynamic response and aeroelastic analysis of a propeller blade. Consideration is also given to the optimization of blade structure to reduce rotor vibration, a method for the evaluation of runway roughness, the inspection of composite materials with an advanced ultrasonic flaw detector, the characteristics of a liquid crystal flat panel display, cockpit display trends, and the aerodynamic design of a nonplanar airfoil using the inverse method with Navier-Stokes equations. B.J.

A92-43137
THE PROGRESS OF A STOL PROJECT
MIKIHIKO MORI, YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan), ISAO KAGEYAMA, and NOBUYUKI TAKASAKI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 196-199. In Japanese.

The development of the STOL research aircraft Asuka is presented. The system functions, aerodynamic characteristics, and flight performance have been tested. The preparation of the data base system for STOL has been completed. The system includes design, wind tunnel test, and flight test data. Y.P.Q.

A92-43141
AIRCRAFT RELIABILITY AND MAINTAINABILITY
Y. KAWASHIMA (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 212-219. In Japanese.

An aircraft reliability management system and safety design standard are discussed. The inspection of structural fatigue damage and fault monitoring and maintenance of aircraft engines are described and an aircraft condition monitoring system is outlined. Y.P.Q.

A92-43147
A STUDY OF AIRCRAFT SURFACE COATING TECHNOLOGY
TAKIHIKO SORAKU (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 248-251. In Japanese.

A surface coating technology especially suitable for helicopter surfaces is described. The operational conditions are given, such as room temperature and ventilation. The steps of the coating technology are described and illustrated. Y.P.Q.

A92-43148
STUDY ON THE MAINTAINABILITY AND INSPECTION OF THE STOL RESEARCH AIRCRAFT ASUKA
MASATAKA HAKUI (National Aerospace Laboratory, Chofu, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 252-255. In Japanese.

Ground and flight tests of the STOL research aircraft Asuka are discussed. The phased flight tests are emphasized, and the application of the stability and control augmentation system (SCAS) for the tests is discussed. Y.P.Q.

A92-43153
REPAIR OPERATION ON A COMPOSITE MATERIAL STRUCTURE
AKIO SATO (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 272-275. In Japanese.

The structure of the damaged section of composite materials is examined. The repair operation for a carbon fiber reinforced plastic plate is described. Y.P.Q.

A92-43157
UTILIZING THE FAULT MONITORING SYSTEM FOR THE A320 AIRCRAFT
K. TANIKAWA and ICHIRO BABA (All Japan Air Transportation, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 288-291. In Japanese.

The structure and functions of the centralized fault display system (CFDS) are presented. The airborne integrated data system (AIDS) and the aircraft communications addressing and reporting system (ACARS) are discussed. The electronic centralized aircraft monitor system is also outlined. Y.P.Q.

A92-43246
STRINGER SUBSYSTEM AUTOMATION
KIYATAKA ABE and W. TANABE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 648-651. In Japanese.

A test facility for stringer subsystem automation is described. Test results are analyzed, including positioning accuracy and processing quality. Y.P.Q.

A92-43247
DEVELOPMENT OF AN AUTOMATIC METAL SHEET WORKING MACHINE FOR INTERIOR STRUCTURE
M. WATANABE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 656-659. In Japanese.

The characteristics of an automatic sheet metal working machine are described. Application to the 767 airframe panel structure is discussed. Y.P.Q.

A92-43248
AUTOMATION OF COMPOSITE MATERIAL STRUCTURE INSTALLATION
H. SANO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 660-663. In Japanese.

The carbon fiber reinforced plastics for YXX horizontal tail wing structures are presented. The design technology for automatic operation is discussed. The safety requirement for automatic operation is reviewed. Y.P.Q.

02

AERODYNAMICS

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

A92-41178
PREDICTION OF SEPARATION POINT IN COMPRESSIBLE TURBULENT BOUNDARY LAYERS BY GREEN'S LAG-ENTRAINMENT METHOD
V. RAMESH and M. A. RAMASWAMY (Indian Institute of Science, Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 87-91. refs

Green's lag entrainment method for computing the development of turbulent boundary layers has been applied to a number of test cases where experimental pressure distribution over the surface of the aerofoils were available under different Mach number and incidence conditions. In all the cases, the location of the separation point of the turbulent boundary layer could be either inferred from the pressure distribution or were given. Using the C(f) distribution obtained for these pressure distributions, a criteria to predict the location of the separation point has been established. It is indicated that use of this criteria would be helpful in computing the flow over aerofoils under separated flow conditions using Carlson's (1980) method. Author

A92-41179
A CORRELATION STUDY OF THE WING-BODY INTERFERENCE FACTOR FOR HIGH ANGLES OF ATTACK
M. KRISHNAMURTHY (National Aeronautical Laboratory, Bangalore, India) and S. VENUGOPAL (Defence Research and Development Laboratory, Hyderabad, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 93-99. Research sponsored by Defence Research and Development Laboratory. refs

The paper describes a method for estimating the wing-body interference factor, Kw, for slender configurations, through subsonic, transonic, and supersonic speed ranges. It is shown that the method can predict Kw values for angles of attack up to about 30 deg. The factor Kw obtained by this method accounts for the effects due to the loss of upwash and to the decrease in dynamic pressure at higher angles of attack and Mach numbers. However, the method is limited to wings with aspect ratios less than 0.4 (typical of fins used in conventional missiles) with zero or small trailing-edge sweep angles. I.S.

A92-41188
ESTIMATION OF OVERALL DRAG COEFFICIENT OF AN AEROSPACE PLANE
R. ANILKUMAR, K. A. DAMODARAN (Indian Institute of

Technology, Madras, India), and R. RATHINAM (Hindustan Aeronautics, Ltd., Aircraft Design Bureau, Bangalore, India) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 159-163. refs

Results of studies covering 5000 trajectory-optimization runs on an interactive mission analysis computer model are presented. The vehicle trajectory was divided into seven segments, namely take-off, subsonic pull-up, climb out, levelling-off, cruise, hypersonic pull-up and levelling-off to orbit. The drag coefficient was assumed to be constant for each segment. A computer code for estimating the drag coefficient of a hypersonic airplane of a given geometry at any operating condition is developed. It is found that, at supersonic and low hypersonic speeds, the computer code gives very accurate values of an overall drag coefficient. O.G.

A92-41196
CURRENT GROWTH IN THE AERONAUTICS
S. C. GUPTA (Air Force Technical College, Bangalore, India) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 221-232. refs

Modern trends in the aircraft design philosophy aimed at meeting the requirements of light weight, agility, and supermaneuverability for combat aircraft are considered. The development of CFD algorithms for aerospace applications is reviewed, and the impact of these algorithms on numerical efficiency and high speed computations based on parallel computers is discussed. It is concluded that state-of-the-art computers for CFD provide high speed parallel vector processing with a certain amount of artificial intelligence (AI) base. The limitation in parallel processing lies in reaching a high speedup ratio. Algorithms describing conflict-free data accessing, reasoning-based data management, and data storage are aimed at the achievement of a high speedup ratio. It is noted that knowledge based on reasoning and a certain amount of AI are essential for the framework of computers used for CFD. O.G.

A92-41197
MULTI-CONSTRAINT WING OPTIMIZATION
S. C. GUPTA (Air Force Technical College, Bangalore, India) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 233-240. refs

Wing optimization aimed at maintaining maximum aerodynamic efficiency over the entire range of flight envelope is considered. Since the perturbation velocity peaks of wings with optimal configurations are less than those of flat plate models, warp wings and wings with leading edge deflections can be studied using linearized potential flow theory. The mission adaptive profile, leading edge flaps, and a conically cambered leading edge flap are considered to be essential for the large drag reduction in combat aircraft. O.G.

A92-41207
CURVATURE EFFECTS FOR THREE-DIMENSIONAL COMPRESSIBLE BOUNDARY-LAYER STABILITY
G. SCHRAUF (Deutsche Airbus GmbH, Bremen, Federal Republic of Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 16, no. 2, 1992, p. 119-127. refs
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The physical meaning of the curvature terms in the stability equations for 3D compressible boundary layers along curved surfaces is discussed in detail. A new method is presented for calculating the stability characteristics of a boundary-layer flow, including surface and wavefront curvature. In contrast to other methods, the wavefront curvature is not determined iteratively within the solution process. Thus, the inclusion of curvature does not increase the computation time, making this method very efficient and suitable for design purposes. C.D.

A92-41211* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SUBSONIC AND TRANSONIC LOW-REYNOLDS-NUMBER AIRFOILS WITH REDUCED PITCHING MOMENTS
J. REUTHER, C. P. VAN DAM (California, University, Davis), and R. HICKS (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 297, 298. Abridged. Previously cited in issue 22, p. 3486, Accession no. A90-48838. refs
Copyright

A92-41213
NUMERICAL SIMULATION OF LEADING-EDGE VORTEX BREAKDOWN USING AN EULER CODE
P. J. O'NEIL, R. M. BARNETT, and C. M. LOUIE (McDonnell Aircraft Co., Saint Louis, MO) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 301-307. Previously cited in issue 21, p. 3251, Accession no. A89-47650. refs
Copyright

A92-41214
DATA ANALYSIS FOR UNSTEADY TURBULENCE MEASUREMENTS OVER AIRFOILS
DONALD K. JOHNSON, RICHARD M. HOWARD, and PAUL N. ILACQUA (U.S. Naval Postgraduate School, Monterey, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 308-313. refs
Copyright

Studies of unsteady flows about pitching airfoils and flows with unsteady freestream components require a consistent method of nonstationary data analysis for proper characterization of unsteady turbulent behavior. A method has been developed for data analysis of flows composed of high-frequency turbulence fluctuations superimposed upon a time-dependent low-frequency component or ensemble-averaged mean velocity with the goal of establishing a consistent method for the presentation of results from varying tests and flow situations. A nonstationary mean was determined by ensemble-averaging and frequency-domain low-pass filtering. Turbulence intensities were calculated based on a local mean using frequency-domain low-pass filtering methods. A nonstationary power spectral density estimator was developed to estimate the time-varying spectral characteristics of a turbulent boundary layer subjected to an unsteady freestream disturbance. A discussion concerning the choice of cutoff frequencies and digital filters is included. Author

A92-41217* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRANSONIC NAVIER-STOKES COMPUTATIONS FOR AN OSCILLATING WING USING ZONAL GRIDS
NEAL M. CHADERJIAN and GURU P. GURUSWAMY (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 326-335. Previously cited in issue 08, p. 1102, Accession no. A90-22197. refs
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A92-41219* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DESIGN OPTIMIZATION OF NATURAL LAMINAR FLOW BODIES IN COMPRESSIBLE FLOW
SIMHA S. DODBELE (Vigyan, Inc., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 343-347. Previously cited in issue 06, p. 763, Accession no. A90-19784. refs
(Contract NAS1-18585)

A92-41223
UNSTEADY AERODYNAMIC LOADING PRODUCED BY A SINUSOIDALLY OSCILLATING DELTA WING

S. A. HUYER, M. C. ROBINSON, and M. W. LUTTGES (Colorado, University, Boulder) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 366-373. Previously cited in issue 16, p. 2482, Accession no. A90-38680. refs
(Contract F49620-84-C-0065)
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A92-41224* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXTENSION AND VALIDATION OF AN UNSTEADY WAKE MODEL FOR ROTORS
AY SU, KYUNG M. YOO, and DAVID A. PETERS (Georgia Institute of Technology, Atlanta) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 374-383. Research supported by U.S. Army. refs
(Contract NAG2-462)
Copyright

A new three-dimensional, finite-state induced-flow model is extended to treat nonlinearities associated with the mass flow induced through the rotor plane. This new theory is then applied to the correlation of a recent set of unsteady, hover laser Doppler velocimetry inflow measurements conducted in the Aeroelastic Rotor Test Chamber at Georgia Institute of Technology. Although the model is intended primarily as a representation of unsteady aerodynamics for aeroelasticity applications, the results show that it has an excellent capability in predicting the inflow distribution in hover except near the root and tip. In addition, the computed unsteady spanwise lift distribution of a rotor is compared with that from an unsteady vortex lattice method for pitch oscillations at various frequencies. The new model is shown to be capable of prediction of unsteady loads typical of aeroelastic response.
Author

A92-41227* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NUMERICAL STUDY OF VORTEX-DOMINATED FLOWS FOR WINGS AT HIGH INCIDENCE AND SIDESLIP
C.-H. HSU (Vigyan, Inc., Hampton, VA) and C. H. LIU (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 396-403. Previously cited in issue 21, p. 3292, Accession no. A90-45936. refs
(Contract NAS1-18585)
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A92-41228* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PREDICTION OF VORTEX SHEDDING FROM FOREBODIES WITH CHINES
MICHAEL R. MENDENHALL and DANIEL J. LESIEUTRE (Nielsen Engineering & Research, Inc., Mountain View, CA) (ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 404-412. Research supported by Nielsen Engineering & Research, Inc. Previously announced in STAR as N90-28494. refs
(Contract NAS1-17077)
Copyright

An engineering prediction method and associated computer code VTXCHN to predict nose vortex shedding from circular and noncircular forebodies with sharp chines edges in subsonic flow at angles of attack and roll are presented. Axisymmetric bodies are represented by point sources and doublets, and noncircular cross sections are transformed to a circle by either analytical or numerical conformal transformations. The lee side vortex wake is modeled by discrete vortices in crossflow planes along the body; thus the three-dimensional steady flow problem is reduced to a two-dimensional, unsteady, separated flow problem for solution. Comparison of measured and predicted pressure distributions, flow field surveys, and aerodynamic characteristics are presented for noncircular bodies alone and forebodies with sharp chines.
Author

A92-41229
FLOW OVER A TWIN-TAILED AIRCRAFT AT ANGLE OF ATTACK. I - SPATIAL CHARACTERISTICS
N. M. KOMERATH, S. G. LIOU, R. J. SCHWARTZ, and J. M. KIM (Georgia Institute of Technology, Atlanta) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 413-420. Research supported by USAF. refs
Copyright

A quantitative study is reported on the low-speed flow environment of scale models of a twin-tailed fighter aircraft at high angles of attack. Laser sheet flow visualization is used to observe the various sources of vortex generation, and the evolution of these vortex flows. Surface tufts are used to observe the nature of flow separation on the vertical tails as angle of attack is varied. Laser Doppler velocimetry is used to quantify the time-averaged three-dimensional velocity field, and histograms of velocity, in selected planes proceeding from the inlets to the vertical tails. No concentrated vortex is observed near the vertical tails, however, the tails are seen to be immersed in a vortex flow of large radius. Flow separation propagates up the outside surfaces of the vertical tails, with increasing angle of attack; however, the flow on the inside surface of the tails remains largely attached. The flow angularity at the tails varies widely along the tail span, is sensitive to angle of attack, and fluctuates over a wide range at each location. These results are found to be relatively insensitive to the precise modeling of inlet through-flow and inlet attitude. Contours of the root-mean-square velocity fluctuations indicate that the largest fluctuations occur in the separated flow immediately above the wing surfaces.
Author

A92-41231
DRAG REDUCTION OF BLUFF BODIES THROUGH MOMENTUM INJECTION
V. J. MODI, E. SHIH, B. YING (British Columbia, University, Vancouver, Canada), and T. YOKOMIZO (Kanto Gakuin University, Yokohama, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 429-436. Previously cited in issue 21, p. 3291, Accession no. A90-45922. refs
(Contract NSERC-A-2181)
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A92-41232
WAKE EFFECTS ON THE PREDICTION OF TRANSONIC VISCOUS FLOWS AROUND AIRFOILS
D. P. COIRO, P. DE MATTEIS, and M. AMATO (Centro Italiano Ricerche Aerospaziali, Capua, Italy) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 437-443. Previously cited in issue 21, p. 3292, Accession no. A90-45933. refs
Copyright

A92-41235
DOWNWASH FOR JOINED-WING AIRFRAME WITH CONTROL SURFACE DEFLECTIONS
JOHN E. BURKHALTER, DONALD J. SPRING, and M. K. KEY (Auburn University, AL) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 458-464. refs
Copyright

An experimental and theoretical investigation of the downwash effects for a joined-wing aircraft was conducted. The investigation included the development of an analytical technique using control surface deflections of both the fore and aft wings instead of the usual tail deflection classical approach. Modifications to the basic equations are presented followed by a comparison with experimental data to validate the procedure. The results indicate differences between experiment and the resulting semiempirical method of less than 12 percent.
Author

A92-41236
IMPROVED MEASUREMENT OF THE DYNAMIC LOADS ACTING ON ROTATING PARACHUTES
Z. SHPUND and D. LEVIN (Technion Foundation for Research and Development, Haifa, Israel) Journal of Aircraft (ISSN

0021-8669), vol. 29, no. 3, May-June 1992, p. 465-469. Previously cited in issue 03, p. 286, Accession no. A87-13807. refs
Copyright

A92-41246 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ACCURATE PREDICTION OF DRAG USING EULER METHODS
C. P. VAN DAM and K. NIKFETRAT (California, University, Davis) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 516-519. Previously cited in issue 06, p. 798, Accession no. A91-19240. refs
(Contract NCA2-397; NAS1-18240)
Copyright

A92-41247
COMMENT ON 'TRANSITION EFFECTS ON AIRFOIL DYNAMICS AND IMPLICATIONS FOR SUBSCALE TESTS'
D. G. MABEY and P. R. ASHILL (Royal Aerospace Establishment, Bedford, England) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 519, 520; Author's Reply, p. 520. refs
Copyright

Ericcson (1988) is presently noted to have misinterpreted an unpublished report of Mabey and Ashill (1984) that furnished static/total pressure representations of wing pressure distributions. Ericcson replies that the pressure distributions in question support the physical flow configuration reported in both Mabey et al. (1987) and Ericcson (1989). O.C.

A92-41261* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DOMAIN-DECOMPOSITION ALGORITHM APPLIED TO MULTIELEMENT AIRFOIL GRIDS
MARK E. M. STEWART (NASA, Lewis Research Center, Cleveland, OH; Princeton University, NJ) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1457-1461. Previously cited in issue 16, p. 2484, Accession no. A90-38737. refs
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A92-41264* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HYPERSONIC SHOCK-WAVE TURBULENT-BOUNDARY-LAYER INTERACTION FLOWS
C. C. HORSTMAN (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1480, 1481. Abridged. Previously cited in issue 17, p. 2858, Accession no. A91-42578. refs
Copyright

A92-41265* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODERN DEVELOPMENTS IN SHEAR FLOW CONTROL WITH SWIRL
S. FAROKHI, R. TAGHAVI (Kansas, University, Lawrence), and E. J. RICE (NASA, Lewis Research Center, Cleveland, OH) (ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990, Proceedings. Vol. 2, p. 2111-2122) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1482, 1483. Abridged. Previously cited in issue 09, p. 1311, Accession no. A91-24519. refs
Copyright

A92-41267* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF ACOUSTIC EXCITATION ON STALLED FLOWS OVER AN AIRFOIL
K. B. M. Q. ZAMAN (NASA, Lewis Research Center, Cleveland, OH) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1492-1499. Previously cited in issue 02, p. 140, Accession no. A91-12521. refs
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A92-41268* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RENORMALIZATION GROUP BASED ALGEBRAIC TURBULENCE MODEL FOR THREE-DIMENSIONAL TURBOMACHINERY FLOWS
K. R. KIRTLEY (Sverdrup Technology, Inc., Brook Park, OH) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1500-1506. Previously cited in issue 07, p. 970, Accession no. A91-21393. refs
(Contract NAS3-25266)

A92-41269
NEWTON'S METHOD SOLVER FOR THE AXISYMMETRIC NAVIER-STOKES EQUATIONS
PAUL D. ORKWIS and D. S. MCRAE (North Carolina State University, Raleigh) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1507-1514. Previously cited in issue 17, p. 2848, Accession no. A91-40728. refs
(Contract DAAL03-86-G-0039)
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A92-41271
NAVIER-STOKES SIMULATION FOR CONE-DERIVED WAVERIDER
JIUN-RONG LIAO, KAKKATTUKUZHY M. ISAAC (Missouri-Rolla, University, Rolla), JOHN B. MILES, and BOR-JANG TSAI (Missouri-Columbia, University, Columbia) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1521-1528. Research supported by University of Missouri. refs
Copyright

The three-dimensional, laminar flowfield associated with conical waveriders, whose cross-plane lower surface is derived from an ellipse, has been analyzed in the present study by numerical simulation of the Navier-Stokes equations. The numerical method uses the flux difference splitting algorithm. Both Euler and viscous solutions have been obtained. Results of zero angle-of-attack and 5-deg angle-of-attack cases, respectively, are presented. The analysis to date has dealt with the forebody only. Surface pressure coefficients are compared with experimental data. Skin friction coefficients are calculated and lift and drag values are estimated. The skin friction, lift, and drag values are compared with previous analytic estimates and they are found to be in reasonably good agreement. The study provides valuable preliminary insight into the feasibility of using waverider configurations for aircraft design. Author

A92-41276* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPUTATION OF SADDLE POINT OF ATTACHMENT
CHING-MAO HUNG (NASA, Ames Research Center, Moffett Field, CA), CHAO-HO SUNG (U.S. Navy, David W. Taylor Naval Ship Research and Development Center, Bethesda, MD), and CHUNG-LUNG CHEN (Rockwell International Science Center, Thousand Oaks, CA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1561-1569. Previously cited in issue 18, p. 3056, Accession no. A91-43608. refs
Copyright

A92-41278
SYMMETRY BREAKING IN VORTEX FLOWS ON CONICAL BODIES
M. V. LOWSON and A. J. C. PONTON (Bristol, University, England) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1576-1583. Previously cited in issue 06, p. 797, Accession no. A91-19214. refs
Copyright

A92-41279
EFFECT OF TUNNEL WALLS ON VORTEX BREAKDOWN LOCATION OVER DELTA WINGS
ZVI WEINBERG (Pennsylvania State University, University Park) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p.

1584-1586. refs
Copyright

Vortex breakdown has been the subject of many investigations during the past few decades. Many of the investigations were performed by visualizing the vortical flowfield above delta wings in water or wind tunnels. In spite of the extensive use of this technique, little attention has been paid to the possible influence of the test section walls on the measured location of the vortex breakdown. The present work suggests a possible model by which the walls may affect the vortex breakdown location. The suggested model is associated with the upwash induced on the wing surface due to the presence of the walls. This upwash was found to be relatively small near the wing's apex and larger on the trailing edge, thus creating an effectively cambered wing. The effective camber tends to shift the vortex breakdown location downstream as compared to a flat wing with the same projected geometry. The influence of the walls was tested in a series of experiments in a water tunnel using delta wings with different sizes, relative to the test section dimensions. The anticipated trend was observed in the experimental results. Author

A92-41289
EXTRAPOLATION PROCEDURES FOR THE TIME-DEPENDENT NAVIER-STOKES EQUATIONS
JAN NORDSTROM (Aeronautical Research Institute of Sweden, Bromma) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1654-1656. Previously cited in issue 17, p. 2851, Accession no. A91-40777. refs
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A92-41291
STABILITY OF PLANE NONORTHOGONAL STAGNATION FLOW
J. M. FLORYAN (Western Ontario, University, London, Canada) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1659-1662. refs
Copyright

A nonorthogonal stagnation flow is linearly stable with respect to three-dimensional disturbances; the stability characteristics are shown to be identical to those describing orthogonal stagnation flow. The stagnation lines' shape-changes due to disturbances contrasts with the orthogonal stagnation-flow case, where the stagnation line remains straight. The form of the disturbance flowfield is a function of the nonorthogonality of the mean flow, thereby promising to be the bases of nonlinear interaction phenomena. O.C.

A92-41314#
NAVIER-STOKES CAVITY SOLUTIONS BASED ON SECOND-ORDER TURBULENCE MODELING
LEONARD WALITT, MARTIN ROSENBLATT (California Research and Technology, Inc., Chatsworth), and JAMES E. DAYWITT (General Electric Co., Re-Entry Systems Dept., Philadelphia, PA) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 13 p. Research supported by U.S. Army. refs
(AIAA PAPER 92-2765) Copyright

The rigorous second-order closure turbulence model (SOCTM) (embodied in the MAZ Navier-Stokes flowfield code) is applied, for the first time, to compute the flow in an optical-seeker cavity located on a slender sphere-cone. The analyses address both non-ablated and ablated (simulating shape-change effects) cavity geometries under hypersonic flow conditions. The SOCTM predicted aero-optical and aerothermodynamic effects of the cone and cavity flowfield are discussed. Limited comparisons are made with results from mixing-length models for similar configurations and an empirically based method for density fluctuations. A planned cavity- and aero-optical experiment will serve to calibrate the SOCTM predictions. Author

A92-41317#
PREDICTION OF SHOCK PATTERN DYNAMICS AT HYPERSONIC ANGLE OF ATTACK MANEUVERS OF ENDO-KEW MISSILE FOREBODIES
H. Q. YANG and A. J. PRZEKWAS (CFD Research Corp., Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 15 p. Research supported by CFD Research Corp. refs
(AIAA PAPER 92-2768) Copyright

CFD solutions have been obtained for 3D separated flows over missile bodies at several angles of attack and density and pressure solution methods. It is shown that when the total variation diminishing (TVD) concept with flux limiters is incorporated into the pressure-based method, the accuracy of the computational results is almost equal to that of well-established high-order accuracy density-based TVD methods. Excellent agreement is obtained for transonic flows over airfoils as well as very good shock capturing capability. Successful demonstration are reported for a recently developed density-based FASTRAN code and for the pressure-based REFLEQS code. C.D.

A92-41318#
EVALUATION OF THE ATD-GASP FOR ENDO-LEAP APPLICATIONS
A. DANG, F. P. TSAI (Physical Research, Inc., Irvine, CA), and R. CHAMBERLAIN (Adaptive Research Corp., Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 15 p. refs
(Contract DASG60-90-C-0134)
(AIAA PAPER 92-2771) Copyright

The Aerothermal Technology Development (ATD) version of the Generalized Aerodynamic Simulation Programs (GASP) has been applied to several sample problems representative of the Endo-Leap flow conditions. Selected test cases are used to address the basic physics of hypersonic interceptors: hypersonic conditions, chemical and thermal nonequilibrium, and turbulence. The simulation of two key thermal management features of hypersonic vehicles, transpiration cooling and film cooling, is verified. Satisfactory comparison between code prediction and experimental data are obtained. The results provide a partial certification/verification of the ATD-GASP code for Endo-Leap applications. C.D.

A92-41320#
VISUALIZATION AND ANALYSIS OF HYPERSONIC FLOWS AND COMPARISON TO EXPERIMENTAL DATA
M. Z. PINDERA, G. MO, V. J. HARRAND (CFD Research Corp., Huntsville, AL), and K. FICKIE (U.S. Army, Ballistic Research Laboratory, Aberdeen Proving Ground, MD) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 11 p. refs
(Contract DAAA15-91-C-0096)
(AIAA PAPER 92-2774) Copyright

This paper contains comparisons of numerical simulations and experimental data for shock reflections in air and argon. The numerical results wre generated using a modified second order extension to Godunov's method, while the experimental data was taken from published results. The comparisons are performed by direct superposition of numerical and experimental images using a newly developed comparison software tool, CFD-Image. The results indicate that the direct comparison capability is indispensable in the evaluation of numerical algorithms and interpretation of data. Author

A92-41322#
ADAPTIVE MESH FOR TURBULENT HYPERSONIC FLOW
LAI-CHEN CHIEN and KAI-PIN CHEN (Academia Sinica, Institute of Physics, Taipei, Republic of China) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 11 p. refs
(AIAA PAPER 92-2776) Copyright

An adaptive method is applied to solve the thin layer Navier-Stokes (TLNS) equations for chemical equilibrium viscous

hypersonic flow. The chemical equilibrium gas formulated by pair of state quantities by polynomial curve fitting is incorporated for the equation of state. In order to simulate the boundary layer effect, besides the laminar term, the turbulent model developed by Baldwin and Lomax is considered in this study. The unsteady TLNS equations are solved using an explicit upwind second-order predictor-corrector scheme. Then, adaptive method is utilized to modify the TLNS solver. The numerical experiment shows the accuracy and efficiency of the adaptive method. More accurate results are obtained for the hypersonic flow over blunt bodies compared with the existing solutions. Author

A92-41348#
TRANSIENT AERODYNAMICS OF A HIGH DYNAMIC PRESSURE SHROUD SEPARATION FOR A GROUND-BASED INTERCEPTOR MISSILE
S. B. LUMB (McDonnell Douglas Space Systems Co., Huntington Beach, CA) and ROBERT W. CAYSE (SY Technology, Inc., Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 7 p. refs
(Contract DASG60-86-C-0013)
(AIAA PAPER 92-2820) Copyright

A protective shroud for an endoatmospheric ground-based interceptor has been designed and tested. The separation process is presented and shown to consist of three periods: a fill period, a venting period, and a high-pressure pulse period. The test description and results from three separation tests are presented. It is proposed that to scale the data between the tests and flight conditions properly, the separation event should be considered transient. Steady and unsteady aerodynamic time scaling parameters are derived and calculated for each test. The data are normalized using the derived time scalar. The results show the best comparison for the data that have nearly equal steady and unsteady time scalars. Author

A92-41536
NAVIER-STOKES COMPUTATIONS FOR POINTED, SPHERICAL, AND FLAT TIPPED SHELL AT MACH 3
BERNARD J. GUIDOS, PAUL WEINACHT (U.S. Army, Ballistic Research Laboratory, Aberdeen Proving Ground, MD), and DAVID S. DOLLING (Texas, University, Austin) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 305-311. Previously cited in issue 06, p. 760, Accession no. A90-19934. refs

A92-41537
HYBRID NAVIER-STOKES/MONTE CARLO METHOD FOR REACTING FLOW CALCULATIONS
FREDERIK J. DE JONG, JAYANT S. SABNIS, RICHARD C. BUGGELN, and HENRY MCDONALD (Scientific Research Associates, Inc., Glastonbury, CT) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 312-318. Previously cited in issue 16, p. 2477, Accession no. A90-38394. refs
(Contract F08635-87-C-0003; DAAL03-88-C-0028)
Copyright

A92-41538* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PLASMADYNAMIC EFFECTS IN THERMOCHEMICAL NONEQUILIBRIUM AEROBRAKE FLOWS
R. A. MITCHELTREE and J. V. SHEBALIN (NASA, Langley Research Center, Hampton, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 319-326. Previously cited in issue 10, p. 1549, Accession no. A92-26980. refs
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A92-41539* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ENGINEERING AERODYNAMIC HEATING METHOD FOR HYPERSONIC FLOW
CHRISTOPHER J. RILEY (NASA, Langley Research Center, Hampton, VA) and FRED R. DEJARNETTE (North Carolina State University, Raleigh) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 327-334. Previously cited in issue 09, p. 1355, Accession no. A92-26327. refs
(Contract NCC1-100)
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A92-41540* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FREE-FLIGHT TRIM-ANGLE PREDICTIONS FOR THE AEROASSIST FLIGHT EXPERIMENT
LESLIE A. YATES and ETHIRAJ VENKATAPATHY (Eloret Institute, Palo Alto; NASA, Ames Research Center, Moffett Field, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 335-343. Previously cited in issue 18, p. 3053, Accession no. A91-43561. refs
(Contract NCC2-583; NCC2-420)

A92-41541* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LOCAL BRIDGING TO PREDICT AERODYNAMIC COEFFICIENTS IN HYPERSONIC, RAREFIED FLOW
J. L. POTTER and STEVEN W. PETERSON (Vanderbilt University, Nashville, TN) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 344-351. Previously cited in issue 06, p. 798, Accession no. A91-19238. refs
(Contract NAG1-878; NAG1-921)
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A92-41542
SUPERSONIC FLOW OVER AN AXISYMMETRIC BACKWARD-FACING STEP
E. LOTH (Illinois, University, Urbana), K. KAILASANATH (U.S. Navy, Naval Research Laboratory, Washington, DC), and R. LOEHNER (George Washington University, Washington, DC) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 352-359. Previously cited in issue 16, p. 2483, Accession no. A90-38717. refs

A92-41545
BASIC EXPERIMENT ON A SUPERSONIC VORTEX FLOW AROUND A MISSILE BODY
DIDIER PAGAN, PASCAL MOLTON, and JEAN DELERY (ONERA, Chatillon, France) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 373-378. Research supported by DRET. Previously cited in issue 06, p. 797, Accession no. A91-19220. refs
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A92-41653
THE FLOW OVER A BACKWARD-FACING STEP UNDER CONTROLLED PERTURBATION - LAMINAR SEPARATION
M. A. Z. HASAN (King Fahad University of Petroleum and Minerals, Dhahran, Saudi Arabia) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 238, May 1992, p. 73-96. Research supported by King Fahad University of Petroleum and Minerals. refs
Copyright

The nature of the instability wave, its roll-up into an organized large-eddy structure, and the subsequent evolution of this structure in a flow over a backward-facing step under controlled perturbation were investigated for a Reynolds number of 11,000, in experiments performed in a subsonic wind tunnel. Results show that the reattaching shear layer had two distinct modes of instability: the 'shear layer mode' and the 'step mode'. It was found that, compared to the unperturbed flow, the perturbation increased the shear layer growth rate and the turbulence intensity and decreased the reattachment length. I.S.

A92-41817
MODELS OF TURBULENCE IN A HYPERSONIC BOUNDARY LAYER [MODELES DE TURBULENCE EN COUCHE LIMITE HYPERSONIQUE]
B. AUPOIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) Revue Scientifique et Technique de la Defense

(ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 71-88. In French. refs
Copyright

Various aspects of the application of turbulence models to hypersonic flows are examined, with particular attention given to boundary layer flows. Various turbulence models, the turbulence transport equations used in these models, and modifications introduced to account for compressibility effects are investigated. Consideration is then given to the application of turbulence models to the prediction of a high-Mach-number zero-pressure-gradient boundary layer and a strongly decelerated and then accelerated boundary layer. These examples indicate the key problems encountered in hypersonic turbulence modeling. Finaly, a novel two-layer model currently under development at ONERA/CERT is discussed. L.M.

A92-41926
STUDY ON CALCULATING THE SUBSONIC AND SUPERSONIC AERODYNAMIC CHARACTERISTICS OF SLENDER WING-BODY COMBINATIONS AT LARGE ANGLES OF ATTACK

LIANGYI WANG (Nanjing Aeronautical Institute, People's Republic of China) Nanjing Aeronautical Institute, Journal (ISSN 1000-1956), vol. 24, no. 2, April 1992, p. 193-197. In Chinese. refs

A method for calculating subsonic and supersonic aerodynamic characteristics of slender wing-body combinations at large angles of attack is presented. The method is highly accurate and may be applicable to the first design of missiles and aircraft. Vortex lift at a large angle of attack is calculated using the suction analogy principle, and potential lift is computed using the numerical method of basic solution distribution. The effects of round leading edge and vortex breakdown on the wing vortex lift is determined empirically. The contribution of body carryover effects on the aerodynamic characteristics of the wing-body combination is addressed by the interference coefficients of the combination. C.D.

A92-42124
SECONDARY FLOW INVESTIGATION INSIDE THE PASSAGE OF A COMPRESSOR CASCADE

A. SALAM (Brussel, Vrije Universiteit, Brussels, Belgium) and M. Q. ISLAM (Bangladesh University of Engineering and Technology, Dhaka) Institution of Engineers (India), Journal, Mechanical Engineering Division (ISSN 0020-3408), vol. 72, pt. MC 1, May 1991, p. 11-18. refs
Copyright

In this paper a carefully planned experimental investigation of secondary flowfield inside the passage of a compressor cascade is presented. An on-frame experimental setup with an advanced data acquisition facility was utilized. A rotating slanted hot wire measurement technique was applied to determine the magnitude and direction of the velocity of the flow in the space. An existing two-dimensional processing code which read the periodic averaged data and processed them to obtain a two-dimensional flow structure was modified and made usable for the three-dimensional flowfield. Spanwise variation of pitch averaged outlet flow angles was checked by the Horlock's simplified inviscid secondary flow theory. Generally, there was a fair agreement between the theory and experiment. The trailing vortices were detected experimentally at some distance away from the trailing edge. The sense of these vortices were found to be opposite to that of the passage vortices which was in agreement with the theory. Author

A92-42531
OPTIMUM HYPERSONIC WINGS AND WAVE RIDERS

J. D. COLE (Rensselaer Polytechnic Institute, Troy, NY) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989. A92-42529 17-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, p. 577-587. refs
(Contract AF-AFOSR-88-0037)
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The inviscid theory of hypersonic small-disturbance flows (Hayes and Probstein, 1966) is applied to problems in the design of efficient hypersonic lifting surfaces, in a brief analytical review of recent investigations. The case of plane flow is outlined, and perturbations of wedge flow are examined, indicating that a flat-plate airfoil is nonoptimum in hypersonic inviscid flow. Concave airfoils are found to be somewhat better, and a subset generated by shock waves of exponential shape is shown to produce significant improvements over the flat plate. A three-dimensional wave-rider configuration defined on the basis of the two-dimensional flow behind an exponential shock is briefly characterized. T.K.

A92-42533
WIND TUNNEL WALL CORRECTIONS FOR UNSTEADY FLOW APPLYING STEADY WALL ADAPTATION AND CFD-TECHNIQUES

H. FOERSCHING (DLR, Institut fuer Aeroelastik, Goettingen, Federal Republic of Germany) (Biennial Fluid Dynamics Symposium on Advanced Problems and Methods in Fluid Mechanics, 19th, Kozubnik, Poland, Sept. 3-8, 1989. A92-42529 17-34) Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, p. 603-622. refs
Copyright

With the recent development of adaptive wind tunnel walls by which steady wall effects are eliminated or significantly reduced by actively controlling flow near the walls, new possibilities for correction of wind tunnel wall interference have also emerged for unsteady flow. In the present paper, prospects and concepts of experimental and analytical techniques for correction of unsteady wind tunnel wall effects, in the context of aerodynamic and aeroelastic wind tunnel investigation of oscillating lifting systems and bodies, are presented. First, some fundamental relations of motion-induced unsteady flowfields, basic to a physical understanding and analytical treatment of unsteady flow phenomena, are explained. Then the principal causes of unsteady wind tunnel interference are described and the practicability of adaptive wind tunnel walls to eliminate wall interference effects in aeroelastic wind tunnel model measurements is discussed. Finally, prospective wind tunnel wall corrections for motion-induced unsteady flow, applying steady flow wall adaptation and advanced CFD-techniques, are outlined. Such a hybrid correction technique for 2D unsteady flow taking into account measured unsteady wind tunnel wall data from experiment to formulate precise tunnel wall boundary conditions is highlighted. Elaboration of such hybrid correction techniques is a challenging field of future aerodynamic research and would contribute substantially to a new generation of wind tunnel technology. Author

A92-42680
A NUMERICAL STUDY OF FLOW OF A VISCOUS GAS IN A LAVAL NOZZLE IN THE NARROW CHANNEL APPROXIMATION [CHISLENNOE ISSLEDOVANIE TECHENIIA VIAZKOGO GAZA V SOPLE LAVALIA V PRIBLIZHENII UZKOGO KANALA]

P. A. SKOVORODKO and V. A. IAKOVENKO (Rossiiskaia Akademiia Nauk, Institut Teplofiziki, Novosibirsk, Russia) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), no. 1, Jan.-Feb. 1992, p. 17-23. In Russian. refs
Copyright

An approach is proposed for calculating viscous flows in a Laval nozzle in the narrow channel approximation for a wide range of the governing parameters. In accordance with the approach proposed here, the direct problem is solved by using an iteration algorithm for solving a sequence of inverse problems. This approach makes it possible to calculate flows for relatively low Reynolds numbers and to significantly reduce the computation time. V.L.

A92-42682
A METHOD FOR DETERMINING THE INTERNAL FORCE CHARACTERISTICS OF A MODEL IN EXTERNAL SUPERSONIC FLOW [METOD OPREDELENIIA VNUTRENNIKH SILOVYKH KHARAKTERISTIK MODELI V USLOVIIAKH OBDUVA EE VNESHNIM SVERKHZVUKOVYM POTOKOM]

A. V. LOKOTKO (Rossiiskaia Akadimiia Nauk, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, Russia) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), no. 1, Jan.-Feb. 1992, p. 53-60. In Russian. refs
Copyright

A method for determining the internal force characteristics (e.g., thrust, lift force, and moment) of a nozzle in external supersonic flow is proposed which is based on the well-known doubling approach. The internal thrust of the model is determined from two consecutive measurements of the weight characteristics, with and without thrust, and calculation of the difference of the two measurements. The model used in such tests is a full configuration where the nozzle is an integral part of the model and is not weighed separately. A wind tunnel implementation of the method is described, and test results obtained for a supersonic passenger aircraft model are presented. V.L.

A92-42683
AERODYNAMICS OF TWO-SHOCK BODIES DERIVED BY THE GASDYNAMIC DESIGN METHOD [AERODINAMIKA DVUKHSKACHKOVYKH TEL, POSTROENNYKH METODOM GAZODINAMICHESKOGO KONSTRUIROVANIIA]
I. I. MAZHUL' and I. I. IAKOVLEV (Rossiiskaia Akademiia Nauk, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, Russia) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), no. 1, Jan.-Feb. 1992, p. 61-65. In Russian. refs
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Results of a comparative aerodynamic analysis are presented for several configurations constructed by the gasdynamic design method using samples of supersonic plane flows for air intakes of hypersonic flight vehicles. The configurations considered include a plane two-shock air intake, a two-shock V-shaped wing, and two-shock convergent air intakes based on a spatial combination of elementary V-shaped wings. The results obtained in the Mach number range 4-15 suggest that configurations of this kind are characterized by a nonmonotonic dependence of the drag coefficient, an increase of the drag coefficient with the free-stream Mach number, and absence of stabilization with respect to free-stream Mach. V.L.

A92-42684
A STUDY OF AEROPHYSICAL AND DYNAMIC CHARACTERISTICS USING AN AXISYMMETRIC FLIGHT TEST VEHICLE WITH A REUSABLE NOSE SECTION [ISSLEDOVANIE AEROFIZICHESKIKH I DINAMICHESKIKH KHARAKTERISTIK NA LETNOM OSESIMMETRICHNOM KOMPLEKSE S GOLOVNOI CHAST'IU MNOGORAZOVOGO ISPOL'ZOVANIIA]
A. M. PAVLIUCHENKO (Rossiiskaia Akademiia Nauk, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, Russia) and O. A. BRAGIN (Novosibirskii Gosudarstvennyi Universitet, Novosibirsk, Russia) Sibirskii Fiziko-Tekhnicheskii Zhurnal (ISSN 0869-1339), no. 1, Jan.-Feb. 1992, p. 66-76. In Russian. refs
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Results of a program of aerophysical flight experiments using an M 100 meteorological rocket with a recoverable nose section equipped with electronic measuring and telemetry systems are reported. The program included measurement of temperature profiles in a compressible turbulent boundary layer at the cylindrical part of the nose section under conditions of aerodynamic heating and operating solid-propellant rocket engines; measurement of the amplitude-frequency characteristics of pressure fluctuations at the nose section during the launch of the rocket at Mach less than 0.1; and measurements of the longitudinal and transverse acceleration loads. One of the objectives of the program was also to develop a method for measuring the angle of attack in flight using a Hall transducer. V.L.

A92-42726
CONSTRUCTION OF A WING PROFILE WITH A FLAP MODELED BY A POINT VORTEX [POSTROENIE KRYLOVOGO PROFILIA S ZAKRYLKOM, MODELIRUEMYM TOCHECHNYM VIKHREM]
N. B. IL'INSKII and A. V. POTASHEV Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 3-9. In Russian. refs
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The method of quasi-solutions of inverse boundary value problems is used to solve the problem of constructing an airfoil with a flap, modeled by a fixed vortex, from a specified velocity distribution over the main area of the wing profile. The method is demonstrated for several specific wing profiles. The effect of the flap (vortex) on the shape and aerodynamic properties of a high-lift wing is discussed. V.L.

A92-42730
SUSCEPTIBILITY OF A SUPERSONIC BOUNDARY LAYER TO ACOUSTIC PERTURBATIONS [VOSPRIIMCHIVOST' SVERKHZVUKOVOGO POGRANICHNOGO SLOIA K AKUSTICHESKIM VOZMUSHCHENIIAM]
A. V. FEDOROV and A. P. KHOKHLOV Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 40-47. In Russian. refs
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Reference is made to a previous study (Fedorov and Khokhlov, 1991) in which the excitation mechanisms of the first and second modes of a boundary layer near the sharp leading edge of a plate with an incident acoustic wave were investigated for the case of a zero incidence angle. Here, the results of this study are generalized to arbitrary incidence angles of the acoustic wave. Two excitation channels are identified, one of which is related to acoustic wave diffraction by a three-dimensional inhomogeneity, and the other to the formation of concentrated acoustic field sources due to wave scattering at the leading edge. Composite formulas for the initial amplitudes of unstable modes are obtained which are equally applicable to all incidence angles. V.L.

A92-42735
AERODYNAMIC DRAG OF A CYLINDER IN TWO-PHASE FLOW [AERODINAMICHESKOE SOPROTIVLENIE TSILINDRA V DVUKHFAZNOM POTOKE]
V. A. LASHKOV Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 123-129. In Russian. refs
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Results of a wind-tunnel study of the aerodynamic drag of a circular cylinder in transverse flow of air with suspended synthetic-corundum particles are reported. Velocity and solid phase density measurements were conducted by laser methods. It is found that the addition of small amounts of the solid phase to the flow may significantly reduce (sometimes, by more than a factor of 2) the aerodynamic drag of the cylinder in the Reynolds number range investigated (from 0.6 x 10 exp 5 to 3 x 10 exp 5). The decrease in drag is attributed to the destabilizing effect on the particles on boundary layer flow. V.L.

A92-42736
FLOW AND SHAPE CORRECTION PROBLEMS FOR THIN PROFILES IN INCOMPRESSIBLE STREAM [ZADACHI OBTEKANIIA I KORREKTSII FORMY TONKIKH PROFILEI V NESZHIMAEMOM POTOKE]
V. E. SAREN Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 130-137. In Russian. refs
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Flow and shape correction problems for slender airfoils in a stream of an ideal fluid are solved within the framework of the first approximation of the theory of flow perturbation near infinitely thin airfoil sections. A general statement of the linear problem of flow boundary correction is presented, and a solution algorithm is proposed. Calculations are carried out for several specific examples, and it is shown that the proposed solutions are sufficiently accurate for practical applications. V.L.

A92-42737
NONSTATIONARY VISCOUS SHOCK LAYER IN SUPERSONIC MOTION OVER AN INHOMOGENEITY [NESTATSIONARNYI VIAZKII UDARNYI SLOI PRI SVERKHZVUKOVOM DVIZHENII CHEREZ NEODNORODNOST']
A. A. MARKOV Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 138-145. In Russian. refs
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Nonstationary effects arising in a viscous shock layer near the critical flow line in the vicinity of the nose section of a rotating blunt body in an inhomogeneous external flow with pressure and temperature gradients and vorticity are modeled numerically using an ideal gas model. The evolution of nonlinear perturbations associated with the motion of the heated zone and a change in the injection mode is examined. The analysis employs a divergent second-order finite difference scheme across the shock layer. V.L.

A92-42738
FLOW OF A RAREFIED GAS OVER A CYLINDER AT ANGLE OF SIDESLIP [OBTEKANIE TSILINDRA RAZREZHENNYM GAZOM POD UGLOM SKOL'ZHENIIA]
K. V. NIKOLAEV Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 146-154. In Russian. refs
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Hypersonic flow of a rarefied monotomic gas over the upwind section of the side surface of an infinite circular cylinder is investigated numerically using direct statistical modeling by the Monte Carlo method for free-stream Mach 2, sideslip angles of 0, 30, 60, and 75 deg, and Re up to 30. Results of calculations of the characteristics, drag coefficient, and heat transfer are presented in graphic form. V.L.

A92-42777
GASDYNAMIC DESIGN [GAZODINAMICHESKOE KONSTRUIROVANIE]
VLADIMIR A. SHCHEPANOVSKII Novosibirsk, Russia, Izdatel'stvo Nauka, 1991, 201 p. In Russian. refs
(ISBN 5-02-029715-1) Copyright

The theoretical principles and applications of gasdynamic design are presented in a systematic manner. In particular, consideration is given to the design of three-dimensional flow over individual components of a flight vehicle and applicability of various computational methods. The discussion also covers approximate methods for calculating wave drag, mathematical modeling of the aerodynamics of star-shaped configurations, mathematical modeling of lift systems in the hypersonic velocity range, and a computational experiment in the aeromechanics of a hypersonic flight vehicle. V.L.

A92-43055
CALCULATION OF THREE-DIMENSIONAL TURBULENT FLOW IN WIND TUNNEL ENTRY SECTION [BERECHNUNG DER DREIDIMENSIONALEN TURBULENTEN STROEMUNG IN WINDKANALVORSTRECKEN]
W. MEILE and W. GRETLER (Graz, Technische Universitaet, Austria) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 303-T 305. In German. refs
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A numerical simulation of the flow in the entry sections of boundary layer wind tunnels is presented. Surface roughnesses and appropriate combinations of tunnel entry sections were determined in order to create and maintain a velocity profile up to the measuring section. C.D.

A92-43060
NUMERICAL APPROXIMATION OF HYPERSONIC SHOCKS IN A FINITE-ELEMENT METHOD USING FLUX-CORRECTED TRANSPORT (FCT)
E. LAURIEN, M. BOEHLE, and H. HOLTHOFF (Braunschweig, Technische Universitaet, Federal Republic of Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 320-T 322. refs
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The numerical approximation of hypersonic shocks, e.g., the bow shock in front of a blunt body, requires special techniques to prevent unphysical oscillations of the numerical scheme. Here, flux-corrected transport (FCT) is used in a 2D Taylor-Galerkin FEM for the Euler equations, and the optimal choice of these parameters is investigated. C.D.

A92-43065
SIMILARITY AND RESISTANCE IN NEAR-SONIC FLOWS FOR GIVEN HEAT CONDUCTION [AEHNLICHKEIT UND WIDERSTAND IN SCHALLNAHEN STROEMUNGEN BEI VORGEGEBENEN WAERMEZUFUHREN]
GUENTER H. SCHNERR and GERD MUNDINGER (Karlsruhe, Universitaet, Federal Republic of Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 342-T 346. In German. refs
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The similarity law of Zierep (1965) for transonic flows with heat conduction is applied to numerical results from the Euler DGL. The thickness parameter of a NACA profile is varied between 6 and 14 percent. The reduced pressure distributions obtained from the similarity law agree with five different profile thicknesses, especially wtih regard to shock layers. It is shown that the similarity law for disturbance potential is appropriate for results obtained with the Euler DGL when there is heat conduction. The potential effects of pressure resistance due to heat conduction is demonstrated along a profile with constant inflow Mach number using a stepwise shifting of a rigid source distribution. A considerable increase in resistance of up to 120 percent in the case of heat conduction is obtained which starts at 10 percent of profile length. Heat conduction in the area of the forward and rear stagnation points show a resistance decrease of up to 50 percent. C.D.

A92-43067
CALCULATION OF TRANSONIC FLOW IN TURBOMACHINE CASCADES [ZUR BERECHNUNG DER TRANSSONISCHEN STROEMUNG IN TURBOMASCHINENGITTERN]
HANS-JOERG PREISIGKE (Hannover, Universitaet, Hanover, Federal Republic of Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 356-T 358. In German. refs
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The parameter constellations of isentropic wake flow Mach numbers 1.2, 1.0, 0.8, and 0.6 are investigated. Good agreement with experimental results is found for isentropic Mach numbers. C.D.

A92-43071
UPWIND SCHEMES FOR NAVIER-STOKES COMPUTATIONS AT SUBSONIC THROUGH HYPERSONIC SPEEDS
D. DRIKAKIS and S. TSANGARIS (Athens, University, Greece) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 385-T 388. refs
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Improvements of the Flux Vector Splitting method for solving the Euler equations are proposed. One modification involves defining the inviscid fluxes on cell faces instead of on the center of the volume. The second modification involves splitting the eigenvalues and improving results in the sonic point region. Finally, the improvement of the FVS method is completed by a hybrid five-point extrapolation scheme for calculating conservative variables on the cell faces. C.D.

A92-43072
THE DESIGN OF FULLY-OPTIMIZED CONFIGURATIONS BY USING THE ITERATIVE OPTIMUM-OPTIMORUM THEORY
ADRIANA NASTASE (Aachen, Rheinisch-Westfaelische Technische Hochschule, Federal Republic of Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 388-T 392. refs
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According to the Classical Optimum-Optimorum Theory (COOT), the camber, twist, and thickness distributions and the similarity parameters of the planprojection of a configuration are simultaneously optimized in order to reach a minimum drag at cruising Mach number. Also, the configuration must fulfill some local or global auxiliary conditions of a geometrical aerodynamical, thermal, and structural nature. The resulting global optimized shape of the configuration obtained using the COOT depends on the chosen 'start' software for calculating the velocity field around the configuration and on the chosen set of auxiliary conditions. For realistic viscous start software and supplementary thermal and structural conditions, it is too complicated to use COOT in one step because the shape of the configuration is a priori unknown. Therefore, an iterative optimum-optimorum theory is proposed here. C.D.

A92-43073
THREE-DIMENSIONAL VISUALIZATIONS OF THE AERODYNAMIC CHARACTERISTICS OF DELTA WINGS FOR THE TRANSITION FROM SUBSONIC TO SUPERSONIC LEADING EDGES IN SUPERSONIC-HYPERSONIC FLOW
ADRIANA NASTASE and ANDREAS HONERMANN (Aachen, Rheinisch-Westfaelische Technische Hochschule, Federal Republic of Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Krakow, Poland, Apr. 1-5, 1991, Vortraege) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 72, no. 5, 1992, p. T 392-T 395. refs
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3D representations of aerodynamic characteristics are applied here to the delta wing with supersonic leading edges. The surfaces of the lift and pitching moment coefficients are presented in a unified form which includes ranges of Mach numbers in supersonic-hypersonic flow. C.D.

A92-43101
EXPERIMENTAL STUDIES ON AERODYNAMIC HEATING AND THERMAL PROTECTION IN HYPERSONIC FLIGHT
SHIGEAKI NOMURA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 48-51. In Japanese.

The aerodynamic heating distribution of the HOPE (H-II orbiting plane) and space plane are presented. The aerodynamic heating test in a shock tunnel is discussed. The thermal protection test for heat resisting tile is given and carbon/carbon composite materials for thermal protection are examined. Y.P.Q.

A92-43102
AERODYNAMIC HEATING MEASUREMENT IN HYPERSONIC FLOW
SHIGERU ASO (Kyushu University, Fukuoka, Japan) and M. HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 52-55. In Japanese. refs

An aerodynamic heating measuring method for hypersonic flow is described. Gauge theory of the thin film heat transmission and a calorimeter method are discussed. The theory of a multilayer thin film thermal flow sensor is presented. Y.P.Q.

A92-43103
A THIN METAL MODEL FOR AERODYNAMIC HEATING TESTS OF SHOCK WAVE INTERACTION
HIROICHI HOZUMI, AKIRA YOAHIZAWA, YASUTOSHI INOUE (National Aerospace Laboratory, Chofu, Japan), M. KAZAHARA, T. ABE, and YOSHIHARU TANAHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 56-59. In Japanese. refs

Shock wave interaction patterns for aerodynamic heating tests are described. The performance of the thin metal model is given and the test requirements are discussed. Test results show the effectiveness of the shock wave interaction. Y.P.Q.

A92-43119
ANALYSIS OF THE AERODYNAMIC PERFORMANCE OF ROTORS WITH THE BOUNDARY ELEMENT METHOD
TOMOARI NAGASHIMA, H. NAKAGAWA, and GIZO HASEGAWA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 124-127. In Japanese. refs

Rotor aerodynamic performance in low-velocity flight is evaluated. The computational model for hovering is given, and inviscid flow and incompressible flow around rotors are calculated. Y.P.Q.

A92-43132
RESEARCH ON STATE EQUATIONS OF UNSTEADY AERODYNAMICS
SHINJI SUZUKI and T. KONDO (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 176-179. In Japanese. refs

Computational methods of unsteady aerodynamics are presented. Calculations of the velocity potential on the wing surface and pressure distribution and aerodynamic coefficients are emphasized. Y.P.Q.

A92-43144
THE MAIN WING BOUNDARY LAYER SEPARATION PATTERN OF STOL RESEARCH AIRCRAFT ASUKA
YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan), MASAKI SAITO, and TAKASHI INOUE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 232-235. In Japanese.

The airflow system monitoring instrument and its recording method for the flight test of the quiet STOL research aircraft Asuka are presented. The separation pattern is illustrated and the effectiveness of engine operation state, engine power and boundary layer control (BLC) are discussed. Y.P.Q.

A92-43145
AERODYNAMIC DRAG AS DETERMINED FROM FLIGHT TEST DATA OF THE STOL RESEARCH AIRCRAFT ASUKA
MASAAKI YANAGIHARA, SHUICHI SASA (National Aerospace Laboratory, Chofu, Japan), and YOICHI TAKEI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 236-239. In Japanese. refs

The aerodynamic drag determination for the STOL research

aircraft Asuka is presented. STOL landing and takeoff states data are obtained. Y.P.Q.

A92-43166
EXPERIMENTAL AND NUMERICAL INVESTIGATIONS ON SEPARATED FLOWS AROUND PITCHING AIRFOILS
SHIGERU ASO, NORIYUKI KANEHIRA (Kyushu University, Fukuoka, Japan), ATSUSHI FUJIMOTO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 326-329. *refs*

Separated flows around wing sections at pitching motion have been investigated experimentally and numerically. In the experiments, the unsteady flow around oscillating airfoils are visualized by a smoke wire method in order to investigate the detailed flow structure and the mechanism of the dynamic stall. In the experiments, a wing section of NACA0012, whose span is 1250 mm and chord is 250 mm, is used. The experiments are carried out under the testing conditions of freestream velocity of 4 m/s and Reynolds number of 6.8 - 7.2 x 10 exp 4. The wing section is oscillated sinusoidary at reduced frequency of 0.2 with an amplitude of 4 deg around mean attack angles of 14, 16, and 18 deg. Significant changes of the extent of separated region behind a wing section at increasing and decreasing process of the attack angle are observed. The results suggest that the characteristics of dynamic stall are well captured in the experiments. In the numerical investigations, separated flow are simulated numerically by a discrete vortex method combined with a panel method. The potential flows around wing sections is expressed by vortex sheets and separated shear layers are expressed by discrete vortices. For lower mean attack angles calculated results show good agreements with experiments qualitatively. Author

A92-43167
COMPUTER SIMULATION OF AN UNSTEADY FLOW AROUND AN AIRFOIL WITH A SPOILER
C. R. KAYKAYOGLU and KEMAL KAYA (Istanbul Technical University, Turkey) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 330-333. refs

The scope of this computer simulation is to study the unsteady flow past an airfoil which is perturbed by a full span plain type spoiler protruding from the upper surfaces. Numerical simulation is based on the combined discrete-vorticity and auxiliary-source point methods, which is an innovative grid-free approach to study separated flows. Both unsteady wake development and surface pressure distributions are revealed. The new method is developed not only to represent the vortex shedding in the near wake but also to simulate the interaction between the body and its wake without the need for a transformation. The periodic shedding of vortices from two separation points continues as the flow progresses. The computer flow visualization via velocity vectors and the point vortices shows the details of different flow mechanisms. The present computational predictions are in agreement with experimental results. Author

A92-43169
DIRECT SIMULATION OF HYPERSONIC RAREFIED FLOWS ABOUT ATMOSPHERIC RE-ENTRY VEHICLES
TORU SHIMADA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 338-341. refs

Hypersonic rarefied flows about atmospheric reentry vehicles (capsules) are investigated by the direct simulation Monte Carlo method combined with general body-fitted grid systems generated along with the multiblock concept. The null-collision technique is employed for collision sampling and the real air model includes the variable hard-sphere molecular model, Borgnakke-Larsen's concept of handling molecular internal degrees of freedom, and the steric factor of Bird for chemical reactions. The obtained flowfield structure shows variations of the rarefaction effect and chemical activities with flight altitudes and body shapes. Surface pressure distribution is in fair agreement with theoretical references. Heat transfer coefficients are compared with a bridging formula, and good agreement is found for cases of a Gemini-type capsule, while disagreement is seen for cases of a blunt-cone capsule. Author

A92-43170
NUMERICAL SIMULATION OF UNSTEADY HYPERSONIC VISCOUS FLOWS IN SHOCK TUNNEL
YNGHWAN BYUN (Kon-Kuk University, Seoul, Republic of Korea) and JOHN D. ANDERSON (Maryland, University, College Park) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 342-345. *refs*

The hypersonic viscous flow over a 2D circular cylinder in shock tunnel has been solved by a numerical method. The objectives of this research are to access the flow establishment time around an aerodynamic model in impulse facilities and study the physical nature of the transient phenomena. Numerical schemes are MacCormack's explicit time-dependent, predictor-corrector method and implicit ADI TVD method. Each method is applied to different cases for the same problem. Analysis shows that, for the shock tunnel whose exit Mach number and nozzle length are 6 and 4.58 m, respectively, the unsteady start-up wave structure consists of two different families of shock wave and the flow establishment time required to reach quasi-steady state around the circular cylinder is about 9.5 msec. Author

A92-43174
DESIGN - ANALYSIS AND EXPERIMENTAL VERIFICATION OF A PROPELLER WORKING IN THE LOW REYNOLDS NUMBER RANGE
KINGO TAKASAWA and MASATAKA HASHIDATE (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 358-361. refs

An optimum propeller for a microwave-powered airplane (MPA) whose chord-based representative Reynolds number is in 1-2x10 exp 5 range was designed according to Adkins and Liebecks' theory. In order to evaluate the theoretical prediction of both design point and off-design performance, a model propeller working in the same Reynolds number range was purposely fabricated and tested in the NAL low speed wind tunnel. Theoretical predictions are compared with test results. Thrust predictions show very good coincidence with test results. Torque predictions show fairly good coincidence. The difference between the theoretical predictions and experimental measurements is thought to be partially attributed to the shrinkage of the drag bucket in propeller blade sections, comparing with that of the two-dimensional airfoil data. The methods for aerodynamic design and off-design prediction were quantitatively established. Author

A92-43191
ANALYSIS OF THE AERODYNAMIC CHARACTERISTICS OF A SIMPLE REMOTELY PILOTED RESEARCH VEHICLE (RPRV)
AKIRA SAKURAI, CHUICHI NAKAYAMA, MANABU MATSUBARA, and NATSUKO KUDO (Kyushu University, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 428-431. In Japanese. refs

The aerodynamic model for the flight test of a simple remotely piloted research vehicle (RPRV) is presented. The data processing approach is described, and sensor configurations are discussed. Y.P.Q.

A92-43194
THE FLUID-DYNAMIC MEASUREMENT OF THE FLING MOTION OF A THREE-DIMENSIONAL FLAT PLATE
S. SUNADA, T. WATABE, and H. KAWAUCHI (Tokyo, University,

Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 440-443. In Japanese. refs

The fling and near-fling motion of a wing are observed. The requirements and configurations of the facility for this observation are given; the wing motion is recorded by a video camera. Y.P.Q.

A92-43197
AERODYNAMIC DESIGN OF A NONPLANAR AIRFOIL BY AN INVERSE METHOD WITH NAVIER-STOKES EQUATIONS
T. UMIDA, JUN OGINO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and SUSUMU TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 452-455. In Japanese. refs

The aerodynamic design for the primary shape of HOPE (H-II orbiting plane) is discussed. Computational grids for the HOPE airfoil and computing methods are described. A comparison of the surface pressure distribution of HOPE between the primary shape and the improved shape is presented. Y.P.Q.

A92-43198
AERODYNAMIC DESIGN TOOL DEVELOPMENT FOR THE CALCULATION CODE OF HYPERSONIC FLOW
M. NAKAO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) and KOZO FUJII (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 456-459. In Japanese. refs

The variable equivalent gamma method (VEG) is used for the analysis of hypersonic flow. The computational results are given, and pressure distribution and surface temperature distribution are evaluated. Y.P.Q.

A92-43201
BGK AIRFOIL OIL FLOW TEST IN A TWO-DIMENSIONAL TRANSONIC WIND TUNNEL
MAMORU SATO, H. KANDA, S. SAYA, and IWAO KAWAMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 468-471. In Japanese. refs

A two-dimensional transonic high Reynolds number wind tunnel test is presented. The configuration of the BGK model is discussed. Test results show the effect of the boundary layer separation on the side wall. Y.P.Q.

A92-43202
BUFFETING CHARACTERISTICS OF A TRANSONIC AIRFOIL
MAMORU SATO, H. KANDA, S. SAYA, and IWAO KAWAMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 472-475. In Japanese. refs

The nonstationary pressure and Cp distribution on an airfoil were evaluated by flow visualization. The buffeting boundary and heavy buffeting are discussed, and power spectral density functions are presented. Y.P.Q.

A92-43203
THE EFFECTIVENESS OF THE WARP SHAPE AIRFOIL OF A SUPERSONIC TRANSPORT
T. YOSHIDA and S. HAYAMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 476-479. In Japanese. refs

A method for the design of the warp shape airfoil of a supersonic aircraft is presented. The chord pressure distribution is emphasized. The vortex lattice method (VLM) is employed. Y.P.Q.

A92-43204
EXPERIMENTAL STUDY OF THE AERODYNAMIC CHARACTERISTICS AT MACH 3 OF AN AIR-INTAKE MODEL
A. MURAKAMI, R. YANAGI, S. SHINDO (National Aerospace Laboratory, Tokyo, Japan), S. HANAMI (Tokyo, Science University, Japan), ATSUSHIGE TANAKA, and KAZUO SHIRAISHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 480-483. In Japanese. refs

The configurations of a supersonic intake at Mach 3 are examined. The cross section of the intake model is presented and the test method is described. The performance of the supersonic intake is evaluated. Y.P.Q.

A92-43205
WIND TUNNEL TEST OF A SUPERSONIC AIR INTAKE
HIDEKI NOMOTO and M. KUZUHARA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 484-487. In Japanese. refs

A Mach 3.5 mixed compression air intake model is introduced. The characteristics of the supersonic air intake are discussed. The wind tunnel test is described, and the results of static pressure distribution measurement are analyzed. Y.P.Q.

A92-43226
AERODYNAMIC CHARACTERISTICS OF A HYPERSONIC AIRCRAFT
Y. OHAMA and K. WAKANA (Tohoku University, Sendai, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 568-571. In Japanese. refs

Wind tunnel testing and visualization of vortical flow over a delta wing is reported. The test results are given and flow visualization of a leading edge vortex is analyzed. The velocity distribution and spectral energy level distribution are presented. Y.P.Q.

A92-43227
STUDY OF THE FLOW FIELD AND MOLECULAR RADIATION HEATING AROUND A REENTRY VEHICLE
S. CHANG, T. MURAYAMA, and T. FUJIWARA (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 572-575. In Japanese. refs

A nonequilibrium air model for the AOTV (aeroassisted orbital transfer vehicle) is presented. Chemical reactions around the vehicle behind the shock wave are examined. The freestream properties and normalized distance along the stagnation streamline are evaluated. Y.P.Q.

A92-43228
LOW-SPEED WIND TUNNEL TESTING OF THE LATERAL CONTROL FORCE FOR THE UPPER RUDDER SURFACE OF A JOINED-WING AIRFOIL
TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 576-579. In Japanese. refs

A low-speed wind tunnel test of the lateral control force is reported. The configurations of the upper surface model are considered, and the control effectiveness of the upper surface is analyzed. Y.P.Q.

A92-43229
LOW-SPEED WIND TUNNEL TESTING OF A JOINED-WING AIRFOIL
TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9,

1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 580-583. In Japanese. refs

A low-speed wind tunnel test for direct lateral control force of an aircraft is reported. The configurations of the joined-wing airfoil model are described, and both longitudinal and lateral aerodynamic characteristics are discussed. Oil flow photographs of the airfoil are presented. Y.P.Q.

A92-43230
EFFECTIVENESS OF AIRCRAFT AERODYNAMIC PERFORMANCE ON EACH PART OF A JOINED WING

TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 584-587. In Japanese. refs

The configurations of a joined wing model are presented. The lateral force coefficients of the horizontal tail span are examined. The characteristics of the joined wing airfoil are described, and oil flow visualization results are reported. Y.P.Q.

A92-43231
AERODYNAMIC CHARACTERISTICS OF A HIGH-SPEED COMPOSITE AIRFOIL

Y. KOSHIOKA and HIDEO ISO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 588-591. In Japanese. refs

The aerodynamic characteristics of a supersonic composite airfoil are examined. The aerodynamic shape design of a high-speed composite airfoil is described. A wind tunnel test of aerodynamic characteristics and the performance of a delta wing are reported. Y.P.Q.

A92-43447
AN EXPERIMENTAL INVESTIGATION OF THE OBLIQUE BLADE-VORTEX INTERACTION

M. B. HORNER, E. SALIVEROS, and R. A. MCD. GALBRAITH (Glasgow, University, Scotland) (European Rotorcraft Forum, 17th, Berlin, Federal Republic of Germany, Sept. 24-26, 1991) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 955, May 1992, p. 184-191. Research supported by Ministry of Defence of England and Royal Aerospace Establishment. refs
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Improvements in the Glasgow University blade-vortex interaction (BVI) wind tunnel facility, as well as in the data-reduction methods applied, are reflected in the quality of the present BVI experimental investigation results. These data are noted to be both qualitatively and quantitatively similar to those collected in corresponding parallel interactions, where said interactions are within +/- 30 deg of parallel. Attention is given to the effects of 3D interactions which are not accounted for in the nondimensionalization conventionally used in the analysis of parallel blade-vortex interactions. O.C.

A92-44121
AERODYNAMIC CHARACTERISTICS OF CURVED DELTA WINGS IN THE CASE OF SUBSONIC SEPARATED FLOW [AERODINAMICHESKIE KHARAKTERISTIKI IZOGNUTYKH TREUGOL'NYKH KRYL'EV PRI DOZVUKOVOM SRYVNOM OBTEKANII]

V. I. VORONIN, G. C. UL'IANOV, and A. I. SHVETS Moskovskii Universitet, Vestnik, Seriia 1 - Matematika, Mekhanika (ISSN 0579-9368), no. 3, May-June 1992, p. 32-35. In Russian. refs
Copyright

The aerodynamic characteristics of low-aspect-ratio delta wings with geometric twist in the case of subsonic separated flow were investigated experimentally and theoretically. It was found that, at subsonic speeds, low-aspect-ratio delta wings with geometric twist had higher lift-drag ratios than planar wings with the same (70 deg) sweep angle. I.S.

A92-44125
AERODYNAMICS OF LIFTING CONFIGURATIONS [AERODINAMIKA NESUSHCHIKH FORM]

ALEKSANDR I. SHVETS and IVAN T. SHVETS Kiev, Izdatel'stvo Vishcha Shkola, 1985, 263 p. In Russian. refs
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Results of studies of the aerodynamics of lifting configurations of various kinds are presented in a systematic manner. In particular, comprehensive experimental data and calculation methods are presented for two classes of aerodynamic configurations: lifting axisymmetric, conical, and pyramidal airframes and curved delta wings. The entire range of velocities, from subsonic to hypersonic, is covered. The aerodynamic characteristics and designs of elastic parawings are also discussed. V.L.

A92-44127
A MATHEMATICAL MODEL FOR THE HYDROELASTICITY PROBLEM CONCERNING THE MOTION OF TWO FLEXIBLE PROFILES IN AN IDEAL INCOMPRESSIBLE FLUID. I [MATEMATICHESKAIA MODEL' ZADACHI GIDROUPRUGOSTI O DVIZHENII DVUKH GIBKIKH PROFILEI V IDEAL'NOI NESZHIMAEMOI ZHIDKOSTI. I]

B. A. ERSHOV and I. I. STRELKOVSKAIA Sankt-Peterburgskii Universitet, Vestnik, Seriia 1 - Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), no. 1, Jan. 1992, p. 23-29. In Russian. refs
Copyright

The plane coupled hydroelasticity problem is formulated for two flexible profiles moving in an ideal incompressible fluid. The unsteady motion of the profiles is represented by their deflections resulting from the interaction between the lifting surfaces and the flow. The perturbed velocity potential is determined by generalizing the results of Sedov (1966); the hydrodynamic pressure on the profiles is determined analytically by describing it in terms of a linearized Lagrange-Cauchy integral. A mathematical model for the problem is developed in the form of a system of integro-differential equations. V.L.

A92-44328
FLOW AND ACOUSTIC FEATURES OF A SUPERSONIC TAPERED NOZZLE

E. GUTMARK, H. L. BOWMAN, and K. C. SCHADOW (U.S. Navy, Naval Weapons Center, China Lake, CA) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 1, May 1992, p. 49-55. refs
Copyright

The acoustic and flow characteristics of a supersonic tapered jet were measured for free and shrouded flow configurations. Measurements were performed for a full range of pressure ratios including over- and underexpanded and design conditions. The supersonic tapered jet is issued from a converging-diverging nozzle with a 3:1 rectangular slotted throat and a conical diverging section leading to a circular exit. The jet was compared to circular and rectangular supersonic jets operating at identical conditions. The distinct feature of the jet is the absence of screech tones in the entire range of operation. Its near-field pressure fluctuations have a wide band spectrum in the entire range of measurements, for Mach numbers of 1 to 2.5, for over- and underexpanded conditions. The free jet's spreading rate is nearly constant and similar to the rectangular jet, and in a shroud, the pressure drop it is inducing is linearly proportional to the primary jet Mach number. This behavior persisted in high adverse pressure gradients at overexpanded conditions, and with nozzle divergence angles of up to 35 deg, no inside flow separation was observed. Author

A92-44363* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE INVISCID STABILITY OF SUPERSONIC FLOW PAST HEATED OR COOLED AXISYMMETRIC BODIES

STEPHEN J. SHAW and PETER W. DUCK (Manchester, Victoria University, England) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 7, July 1992, p. 1541-1557. Research supported by Department of Education of Northern Ireland and Victoria University of Manchester. Previously announced in STAR as N91-14307.

refs
(Contract NAS1-18605; SERC-GR/E/25702)
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The inviscid, linear, nonaxisymmetric, temporal stability of the boundary layer associated with the supersonic flow past axisymmetric bodies (with particular emphasis on long thin, straight circular cylinders), subject to heated or cooled wall conditions is investigated. The eigenvalue problem is computed in some detail for a particular Mach number or 3.8, revealing that the effect of curvature and the choice of wall conditions both have a significant effect on the stability of the flow. Both the asymptotic, large azimuthal wavenumber solution and the asymptotic, far downstream solution are obtained for the stability analysis and compared with numerical results. Additionally, asymptotic analyses valid for large radii of curvature with cooled/heated wall conditions are presented. In general, important differences were found to exist between the wall temperature conditions imposed and the adiabatic wall conditions considered previously. Author

A92-44367 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DIRECT SIMULATION OF RE-ENTRY FLOWS WITH IONIZATION
ANN B. CARLSON (NASA, Langley Research Center, Hampton, VA) and H. A. HASSAN (North Carolina State University, Raleigh) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 400-404. Research supported by USAF and U.S. Navy. Previously cited in issue 06, p. 755, Accession no. A90-19705. refs
(Contract NCC1-112; NAGW-1022; NAGW-1331)
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A92-44368* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THERMOCHEMICAL NONEQUILIBRIUM FLOW COMPUTATIONS OF FLOW AROUND THE AEROASSIST FLIGHT EXPERIMENT
GRANT PALMER (NASA, Ames Research Center, Moffett Field, CA) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 405-411. Previously cited in issue 16, p. 2478, Accession no. A90-38405. refs
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A92-44371
SOLUTION OF THE PARABOLIZED NAVIER-STOKES EQUATIONS USING OSHER'S UPWIND SCHEME
R. A. GERBSCH and R. K. AGARWAL (McDonnell Douglas Research Laboratories, Saint Louis, MO) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 426-432. Research supported by McDonnell Douglas Corp. Previously cited in issue 06, p. 758, Accession no. A90-19830. refs
Copyright

A92-44372
LAMINAR HEAT TRANSFER TO BLUNT CONES IN HIGH-ENTHALPY HYPERVELOCITY FLOWS
S. L. GAI (University College, Canberra, Australia) and W. S. JOE (Australian National University, Canberra, Australia) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 433-438. refs
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Laminar heating rates on cones of various bluntness ratios in high-enthalpy, hypervelocity airflows typical of spacecraft reentry have been obtained. The stagnation enthalpy range considered was 14-20 MJ/kg, giving equivalent reentry speeds in the 4-6 km/s range. The corresponding equilibrium stagnation temperatures were in the range 7000-9000 K. Comparison of the measured data with the well-known theory of Lees (1956) showed reasonable agreement for small bluntness ratios while the large bluntness ratio results compared well with the empirical theory of Griffith and Lewis (1964). C.D.

A92-44513* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL ANALYSIS OF FLOW THROUGH OSCILLATING CASCADE SECTIONS
DENNIS L. HUFF (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 815-822. Previously cited in issue 10, p. 1431, Accession no. A89-28413. refs

A92-44515
NAVIER-STOKES SOLUTIONS OF TRANSONIC NOZZLE FLOW WITH SHOCK-INDUCED FLOW SEPARATIONS
CHIH F. SHIEH (Rohr Industries, Inc., Chula Vista, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 829-835. Previously cited in issue 20, p. 3345, Accession no. A88-48900. refs
Copyright

A92-44518
SUBCRITICAL FLOW STUDIES ON TWO-DIMENSIONAL EXTERNAL COMPRESSION SUPERSONIC INLETS
K. KAPOOR, T. G. PAI, and B. N. PAMADI (Indian Institute of Technology, Bombay, India) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 849-856. Research supported by Aeronautical Research and Development Board of India. refs
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An experimental study has been carried out to develop a subcritical flow model to predict the additive drag and stable flow range of two-dimensional external compression supersonic inlets. Two variable geometry inlet models have been tested in a 0.3-m trisonic wind tunnel at Mach number varying from 1.6 to 2.2. The inlet mass flow was varied in the steady subcritical flow range and the total pressure recovery, ramp pressure distribution and mass flow ratio were measured. The corresponding shock stand-off distance was obtained from schlieren pictures. Based on these experimental data, a new subcritical flow model that correlates the inlet geometry, shock stand-off distance, and freestream Mach number has been developed. Author

A92-44519
NUMERICAL INVESTIGATION OF SUPERSONIC INLET WITH REALISTIC BLEED AND BYPASS SYSTEMS
AKIRA FUJIMOTO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), NOBUO NIWA (Kawasaki Heavy Industries, Ltd., Seishin, Japan), and KEISUKE SAWADA (Tohoku University, Sendai, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 857-861. Research sponsored by Society of Japanese Aerospace Companies and Kawasaki Heavy Industries, Ltd. Previously cited in issue 06, p. 794, Accession no. A91-19150. refs
Copyright

A92-44520* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
BLEED-BOUNDARY CONDITIONS FOR NUMERICALLY SIMULATED MIXED-COMPRESSION SUPERSONIC INLET FLOW
W. J. CHYU, G. W. HOWE, and T. I-P. SHIH (NASA, Ames Research Center, Moffett Field, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 862-868. refs
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A numerical study was performed to investigate boundary conditions for bleed openings that are needed in the numerical simulation of critical flow through turbojet inlets with bleed. Nine different boundary conditions (BCs) were devised and examined. Of the BCs examined, three were able to stabilize the terminal shock near the inlet's throat. This numerical study was based on the ensemble-averaged, unsteady, three-dimensional, compressible Navier-Stokes equations closed by the Baldwin-Lomax algebraic turbulence model. Solutions to the Navier-Stokes equations were obtained by using a hybrid implicit-explicit method (Beam and

Warming/MacCormack). The multiblock grid system used in the solution procedure was generated by solving a set of elliptic partial differential equations. Solutions obtained were compared with available experimental data. Author

A92-44528
INDICIAL METHOD CALCULATING DYNAMIC STALL ON A VERTICAL AXIS WIND TURBINE
STEPHANE R. MAJOR and ION PARASCHIVOIU (Ecole Polytechnique, Montreal, Canada) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 909-911. refs
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A novel computational subroutine is presented for the prediction of vertical-axis wind turbine dynamic stall on the basis of the indicial method. Representative cases are computed, and the results obtained are compared with both those of other models and with the experimental data obtained on a 17-m wind turbine. In addition to offering a superior representation of dynamic stall, the indicial method yields the best overall power-output prediction. O.C.

A92-44531
NOZZLE DESIGN USING GENERALIZED ONE-DIMENSIONAL FLOW
E. W. BEANS (Toledo, University, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 917-920. refs
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An approach is presented for the solution of generalized, 1D, compressible flow in nozzles where such performance parameters as mass flow and thrust are either 1D or bulk parameters. The approach is easily implemented and can solve a large number of arbitrary inputs in nozzle shape, fluid friction, and heat transfer. The ability to determine the initial Mach number for choked flow with friction and heat transfer allows a realistic set of initial conditions to be used. O.C.

A92-44671* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VISCOUS SIMULATION METHOD FOR UNSTEADY FLOWS PAST MULTICOMPONENT CONFIGURATIONS
KAMRAN FOULADI and OKTAY BAYSAL (Old Dominion University, Norfolk, VA) ASME, Transactions, Journal of Fluids Engineering (ISSN 0098-2202), vol. 114, no. 2, June 1992, p. 161-169. refs
(Contract NAG1-664)
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The present algorithm for the numerical simulation of flows about complex configurations (whose multiple and nonsimilar components have arbitraty geometries) employs a hybridization of the domain decomposition techniques for grid generation as well as to reduce computer-memory requirements. A fully vectorized, finite-volume, upwind-biased, approximately factored multigrid method is used to solve 3D Reynolds-averaged unsteady and compressible Navier-Stokes equations simulating supersonic flows past an ogive-nose-cylinder near or within a cavity. The time-averaged surface pressures obtained compare favorably with the wind tunnel data. O.C.

A92-44865
INTEGRATED ELECTRIC DENSITY AND SCALING LAW FOR HYPERSONIC BLUNT-BODY WAKES
XUEHUA ZHOU (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) Chinese Society of Astronautics, Journal (ISSN 1000-1328), no. 2, 1991, p. 38-44. In Chinese. refs

A simplified flowfield model and simple air-chemical model for the chemical-nonequilibrium trailing wakes of a hypersonic nonablating blunt-body are presented. The models are applied to calculate the integrated electric density. The calculated results are compared to the wake measurements in the ballistic region, and the agreement between them is good. Based on the results, the applicability of a binary scaling law is researched to follow the example of P(infinity) x DN = 375. It provides the exact direction for ballistics-range models experimental measurements. Author

N92-26585 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THREE-DIMENSIONAL UPWIND SCHEME FOR SOLVING THE EULER EQUATIONS ON UNSTRUCTURED TETRAHEDRAL GRIDS Ph.D. Thesis
NEAL TILSON FRINK 1991 129 p
Avail: Univ. Microfilms Order No. DA9209606

A new upwind scheme is developed for solving the three-dimensional Euler equations on unstructured tetrahedral meshes. The method yields solution accuracy and efficiency comparable to that currently available from similar structured-grid codes. The key to achieving this result is a novel cell reconstruction process which is based on an analytical formulation for computing solution gradients within tetrahedral cells. Prior methodology requires the application of cumbersome numerical procedures to evaluate surface integrals around the cell volume. The result is that higher-order differences can now be constructed more efficiently to attain computational times per cell comparable to those of structured codes. The underlying philosophy employed in constructing the basic flow solver is to draw on proven structured-grid technology whenever possible in order to reduce risk. Thus, spatial discretization is accomplished by a cell-centered finite-volume formulation using flux-difference splitting. Solutions are advanced in time by a 3-stage Runge-Kutta time-stepping scheme with convergence accelerated to steady state by local time stepping and implicit residual smoothing. The flow solver operates at a speed of 34 microseconds per cell per cycle on a CRAY-2S supercomputer and requires 64 words of memory per cell. Dissert. Abstr.

N92-26612*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HELIUM BUBBLE FLOW VISUALIZATION OF THE SPANWISE SEPARATION ON A NACA 0012 WITH SIMULATED GLAZE ICE
M. KERHO, M. BRAGG (Illinois Univ., Urbana.), and J. SHIN Jan. 1992 17 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA Previously announced in IAA as A92-28192
(Contract RTOP 505-68-10)
(NASA-TM-105742; E-7147; NAS 1.15:105742; AIAA PAPER 92-0413) Copyright Avail: CASI HC A03/MF A01

Research was performed to experimentally visualize and document the flow separation due to simulated glaze ice accretion on a NACA 0012 semispan with 30 deg sweep using helium bubbles as flow tracers. Results are compared to Navier-Stokes computational simulations for different angles of attack. Prior to acquiring data for the semispan model, a two dimensional experiment was conducted to determine the accuracy of using the helium bubbles as flow tracers. Results from the three dimensional experiment compare well to the computational simulations. Author

N92-26616 Virginia Polytechnic Inst. and State Univ., Blacksburg.
OBSERVATION AND MEASUREMENTS OF FLOW STRUCTURES IN THE STAGNATION REGION OF A WING-BODY JUNCTION Ph.D. Thesis
SANGHO KIM 1991 280 p
Avail: Univ. Microfilms Order No. DA9208424

The behavior of a junction vortex formed around an obstacle in a boundary layer flow was studied experimentally in a water tunnel for two low speed cases. A wing consisting of a 3:2 elliptical nose and an NACA 0020 tail was used to simulate the function vortex. A visual study using a hydrogen bubble technique was extensively conducted to investigate the flow structures in the stagnation region of the wing. It was observed that a multiple vortex system exists in this region and shows an acyclic flow pattern. LDV measurements were performed in the plane of

symmetry upstream of the wing. The visual evidence of acyclic flow pattern was consistent with the LDV measurements, and revealed that aperiodic stretching of the junction vortex appears responsible for the bimodal structure in the velocity histograms. An attempt to measure the three dimensional instantaneous velocity field in this region was made. A stereo vision approach was implemented to capture two orthogonal views simultaneously for three dimensional motion analysis. Dissert. Abstr.

N92-26651*# Vigyan Research Associates, Inc., Hampton, VA.
HIGH-ALPHA VORTEX DECOUPLING INVESTIGATIONS ON A CHINE FOREBODY/DELTA WING CONFIGURATION AT TRANSONIC MACH NUMBERS
DHANVADA M. RAO and M. K. BHAT Jun. 1992 45 p
(Contract NAS1-18856; RTOP 505-68-30-03)
(NASA-CR-189642; NAS 1.26:189642) Avail: CASI HC A03/MF A01

A test program conducted in the LaRC 8-foot Transonic Pressure Tunnel on a blended chine/delta wing model to verify the concept of controlled vortex decoupling via inboard leading-edge flaps for improved high-alpha lateral/directional characteristics is discussed. This test extended the Mach number range of a data base previously generated in a LaRC 7 ft. by 10 ft High Speed Tunnel investigation. Six-component force/moment, forebody surface pressures, and central and twin tall static and dynamic loads were measured at Mach numbers of 0.4 to 1.2; laser light-sheet visualizations were also performed. Selected data are analyzed and discussed, emphasizing lateral/directional improvements and tail environment enhanced attainable by leading-edge flaps in the maximum lift region. Author

N92-26652*# Vigyan Research Associates, Inc., Hampton, VA.
SUBSONIC INVESTIGATIONS OF VORTEX INTERACTION CONTROL FOR ENHANCED HIGH-ALPHA AERODYNAMICS OF A CHINE FOREBODY/DELTA WING CONFIGURATION
DHANVADA M. RAO and M. K. BHAT Jun. 1992 56 p
(Contract NAS1-18856; RTOP 505-68-30-03)
(NASA-CR-189641; NAS 1.26:189641) Avail: CASI HC A04/MF A01

A proposed concept to alleviate high alpha asymmetry and lateral/directional instability by decoupling of forebody and wing vortices was studied on a generic chine forebody/ 60 deg. delta configuration in the NASA Langley 7 by 10 foot High Speed Tunnel. The decoupling technique involved inboard leading edge flaps of varying span and deflection angle. Six component force/moment characteristics, surface pressure distributions and vapor-screen flow visualizations were acquired, on the basic wing-body configuration and with both single and twin vertical tails at M sub infinity = 0.1 and 0.4, and in the range alpha = 0 to 50 deg and beta = -10 to +10 degs. Results are presented which highlight the potential of vortex decoupling via leading edge flaps for enhanced high alpha lateral/directional characteristics. Author

N92-26947# Aeronautical Research Labs., Melbourne (Australia).
F-111C FLIGHT DYNAMIC MODEL AERODYNAMIC DATA-BASE DEVELOPMENT AND VERIFICATION
R. W. EUSTACE, M. I. COOPER, and C. A. MARTIN Dec. 1991 32 p
(AD-A246356; ARL-FLIGHT-MECH-TM-437; DODA-AR-006-595)
Avail: CASI HC A03/MF A01

A description is given of the process used to develop and verify the aerodynamic data-base of the F-111C flight dynamic computer model. The process uses stability and control derivatives obtained from flight trials performed at the RAAF's Aircraft Research and Development Unit (ARDU). Model response has been verified against aircraft time histories measured during the trials. The results presented compare the aircraft response in lateral maneuvers, at various wing sweeps. A very good degree of matching is possible, although further investigation should correct inaccuracies which can cause poor estimation of yaw rate. GRA

N92-27054 Pennsylvania State Univ., University Park.
TURBULENT MIXING IN SUPERSONIC JETS Ph.D. Thesis
KRISHNAMURTHY VISWANATHAN 1991 326 p
Avail: Univ. Microfilms Order No. DA9204307

A clear understanding of supersonic shear layers and the physics of supersonic mixing are vital to the development of high-speed flight vehicles. This computational study examines the stability and mixing characteristics of high-speed jets, both in the presence and absence of confining walls. The unsteady motion of the shear layer is described using instability wave modeling. Two models are developed for turbulent mixing in axisymmetric jets, taking into account the importance of the large scale structures. The current models emphasize the time-dependent motion of the shear layer, and a notable feature of these models is the absence of any model constants. The instabilities of highly supersonic jets are examined and classified. The modifications of these instabilities by the presence of an external stream and an outer wall are studied in detail. The instability wave modes of supersonic jets of arbitrary cross sections confined in arbitrary-shaped ducts are analyzed by a boundary integral formulation of the inviscid, compressible perturbation equations. A numerical method, using the boundary element method, is developed to treat this problem. The results of this study indicate that the mixing and development of free shear layers are related closely to the spatial stability characteristics of the mean flow. The effects of compressibility are quite pronounced. Even small changes in the duct geometry have a significant impact on the instability modes of the confined jet. Dissert. Abstr.

N92-27172# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
AERODYNAMIC INTERFERENCE BETWEEN STORES Final Report, 1 Feb. 1989 - 30 Jun. 1991
F. C. DOUGHERTY 30 Jan. 1992 19 p
(Contract AF-AFOSR-0235-89)
(AD-A247207; AFOSR-92-0086TR) Avail: CASI HC A03/MF A01

Five tasks were initiated to study the aerodynamic interference between stores and aircraft. Both viscous and inviscid calculations were made. Steady state interference calculations matched well with experimental results and with other computational results. Unsteady time-accurate inviscid results showed the feasibility of using the Chimera scheme to simulate store separation. Free-fall calculations were made, demonstrating the ability to compute the new position of the store from the aerodynamic forces and moments on the store after its release from the aircraft. GRA

N92-27191*# Vanderbilt Univ., Nashville, TN. Dept. of Mechanical Engineering.
RAREFIED-FLOW AERODYNAMICS Final Report, 1 Jan. 1989 - 31 May 1992
J. LEITH POTTER 31 May 1992 21 p
(Contract NAG1-921)
(NASA-CR-190452; NAS 1.26:190452) Avail: CASI HC A03/MF A01

Means for relatively simple and quick procedures are examined for estimating aerodynamic coefficients of lifting reentry vehicles. The methods developed allow aerospace designers not only to evaluate the aerodynamics of specific shapes but also to optimize shapes under given constraints. The analysis was also studied of the effect of thermomolecular flow on pressures measured by an orifice near the nose of a Space Shuttle Orbiter at altitudes above 75 km. It was shown that pressures corrected for thermomolecular flow effect are in good agreement with values predicted by independent theoretical methods. An incidental product was the insight gained about the free molecular thermal accommodation coefficient applicable under 'real' conditions of high speed flow in the Earth's atmosphere. The results are presented as abstracts of referenced papers. One reference paper is presented in its entirety. Author

N92-27344# Institute for Aerospace Research, Ottawa (Ontario).
TRAJECTORIES AND STABILITY OF TRAILING VORTICES VERY NEAR THE GROUND [TRAJECTORIES ET STABILITE DES VORTEX DE BOUT D'AILE A PROXIMITE DU SOL]
A. M. DRUMMOND, R. ONNO, and B. PANNETON Dec. 1991 57 p
(NRC-32151; IAR-AN-74; CTN-92-60537; AD-A250782) Avail: CASI HC A04/MF A01

The behavior of the trailing vortices of a Harvard aircraft used as the spraying vehicle during a set of experiments in aerial spraying over flat terrain for agricultural applications is discussed. The aircraft flew at a nominal altitude of 10 feet above ground at a speed of 110 knots. The stability and trajectory of a chosen element of the trailing vortices were measured by analyzing movie films taken by a ground-based camera and by a helicopter mounted camera at 800 feet above the aircraft. The vortices decayed by core bursting in every case and the time to burst was usually in agreement with other published data for a light aircraft out of ground effect. The downwind vortex almost always burst before the upwind vortex and in most cases both vortices exhibited about the same amount of rebound even though the downwind vortex generally had a shorter lifetime. The classical inviscid theory for vortex descent was not a good model for these experiments but it was able to predict, with some success, the lateral separation between the vortices when the aircraft wingtip height was arbitrarily reduced by a factor of 0.85. It was concluded that vortex core bursting and rebound must be included in any procedure for calculating aerial spray deposit on the ground. Author (CISTI)

N92-27376*# Toledo Univ., OH.
USERS MANUAL AND MODELING IMPROVEMENTS FOR AXIAL TURBINE DESIGN AND PERFORMANCE COMPUTER CODE TD2-2 Final Report
ARTHUR J. GLASSMAN Mar. 1992 29 p
(Contract NAG3-1165; RTOP 505-69-50)
(NASA-CR-189118; E-6828; NAS 1.26:189118) Avail: CASI HC A03/MF A01

Computer code TD2 computes design point velocity diagrams and performance for multistage, multishaft, cooled or uncooled, axial flow turbines. This streamline analysis code was recently modified to upgrade modeling related to turbine cooling and to the internal loss correlation. These modifications are presented in this report along with descriptions of the code's expanded input and output. This report serves as the users manual for the upgraded code, which is named TD2-2. Author

N92-27377*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TURBULENT HEAT FLUX MEASUREMENTS IN A TRANSITIONAL BOUNDARY LAYER
K. H. SOHN, K. B. M. Q. ZAMAN, and E. RESHOTKO (Case Western Reserve Univ., Cleveland, OH.) Apr. 1992 20 p
(Contract NCC3-124; RTOP 505-62-52)
(NASA-TM-105623; E-6962; NAS 1.15:105623) Avail: CASI HC A03/MF A01

During an experimental investigation of the transitional boundary layer over a heated flat plate, an unexpected result was encountered for the turbulent heat flux (bar-v't'). This quantity, representing the correlation between the fluctuating normal velocity and the temperature, was measured to be negative near the wall under certain conditions. The result was unexpected as it implied a counter-gradient heat transfer by the turbulent fluctuations. Possible reasons for this anomalous result were further investigated. The possible causes considered for this negative bar-v't' were: (1) plausible measurement error and peculiarity of the flow facility, (2) large probe size effect, (3) 'streaky structure' in the near wall boundary layer, and (4) contributions from other terms usually assumed negligible in the energy equation including the Reynolds heat flux in the streamwise direction (bar-u't'). Even though the energy balance has remained inconclusive, none of the items (1) to (3) appear to be contributing directly to the anomaly. Author

N92-27399*# Eloret Corp., Sunnyvale, CA.
AN EXPERIMENTAL INVESTIGATION OF THE SEPARATING/REATTACHING FLOW OVER A BACKSTEP Progress Report, 1 Sep. 1991 - 29 Feb. 1992
SRBOLJUB JOVIC 23 Jun. 1992 17 p
(Contract NCC2-465)
(NASA-CR-190426; NAS 1.26:190426) Avail: CASI HC A03/MF A01

Transport characteristics of the turbulent kinetic energy, k, and the shear stream, bar(-uv), were studied in an incompressible boundary layer downstream of the reattachment of the separated flow behind a backward facing step. Hot-wire measurement techniques were used to measure three Reynolds stresses and higher order mean products of velocity fluctuations. These quantities were used to evaluate advection, turbulent diffusion, and production terms of the k and bar(-uv) transport equations. The dissipation rate and pressure-strain terms were obtained as the difference of all the other terms. The Reynolds number based on the step height was 37,000 and the upstream oncoming flow was fully developed turbulent boundary layer with the R(sub theta) = 3600. H.A.

N92-27558*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
MODELING OF HEAVY-GAS EFFECTS ON AIRFOIL FLOWS Final Report
MARK DRELA 11 May 1992 54 p
(Contract NAG2-708)
(NASA-CR-190357; NAS 1.26:190357) Avail: CASI HC A04/MF A01

Thermodynamic models were constructed for a calorically imperfect gas and for a non-ideal gas. These were incorporated into a quasi one dimensional flow solver to develop an understanding of the differences in flow behavior between the new models and the perfect gas model. The models were also incorporated into a two dimensional flow solver to investigate their effects on transonic airfoil flows. Specifically, the calculations simulated airfoil testing in a proposed high Reynolds number heavy gas test facility. The results indicate that the non-idealities caused significant differences in the flow field, but that matching of an appropriate non-dimensional parameter led to flows similar to those in air. Author

N92-27624# Toronto Univ. (Ontario).
PITCH-HEAVE DYNAMICS MODELS FOR AN AIR CUSHION VEHICLE Ph.D. Thesis
TERENCE ARTHUR GRAHAM 8 Mar. 1989 379 p
(ISBN-0-315-51095-1; CTN-92-60471) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $45.00 CAN, MF $15.00 CAN

The pitch-heave dynamics of an air cushion vehicle with an uncompartmented segmented skirt system were investigated through experiments on two craft and through simulation. The experiments show that this type of craft can exhibit a pure heave instability at higher fan speeds and a combined pitch-heave instability when released from large initial pitch angles. The response in both cases is strongly affected by the type of material used in the skirt. Results presented show that the heave instability is strongly affected by skirt material extensibility which allows cushion volume and exit-airflow area modulation with cushion pressure. The volume modulation gives an additional cushion capacitance which is seen to decrease the stability whereas the airflow area modulation increases stability. The important skirt-related factors in the dynamics of the segmented skirt cushion are determined through a simulation of the nonlinear dynamics and a linearized analysis. Both the nonlinear and linearized analyses include a detailed model of the skirt geometry which uses an elastic membrane model of the skirt. The simulation results show that the pitch-heave instability occurs as a result of coupling which arises from the dependence of the exit-airflow area geometry on both the pitch and heave position. The static hysteresis models

produce enough damping to suppress the instability at small initial angles but not larger ones, as seen in the experiments.
Author (CISTI)

N92-27706# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
SPECIAL COURSE ON SKIN FRICTION DRAG REDUCTION
Mar. 1992 284 p Course held in Rhode-Saint-Genese, Belgium, 2-6 Mar. 1992; sponsored in cooperation with VKI
(AGARD-R-786; ISBN-92-835-0661-8) Copyright Avail: CASI HC A13/MF A03

Lecture notes for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Skin Friction Drag Reduction' have been assembled in this report. The aim and scope of this course was to provide an overview of the state of the art of current technology programs focused on reducing aircraft drag caused by skin friction. This report provides a review of recent progress in the field of skin friction drag reduction for transport aircraft. It provides a general introduction to the technology and then focuses on two specific aspects of drag reduction: maintaining laminar flow by controlling transition and manipulating the turbulence structure in boundary layers to help reduce skin friction. Technology associated with the use of riblets, LEBU, polymers, additives, etc., is also reviewed.

N92-27707# Centre d'Etudes et de Recherches, Toulouse (France).
BASIC CONCEPTS ON BOUNDARY LAYERS
JEAN COUSTEIX *In* AGARD, Special Course on Skin Friction Drag Reduction 39 p Mar. 1992
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At the present time drag reduction is an industrial challenge in aeronautics which justifies the efforts devoted to this topic. One facet of this effort deals with the skin friction drag reduction. Two directions are followed. The first one is the manipulation of turbulent boundary layers, by altering the formation of turbulence or by modifying its characteristics it is hoped to decrease the turbulent skin friction. The second direction concerns the action on laminar-turbulent transition, by delaying the occurrence of the turbulent regime, enormous skin friction reductions are possible. It is believed that the improvements in the field are based on a better knowledge of the basic phenomena. Author

N92-27708# Airbus Industrie, Blagnac (France).
DRAG REDUCTION: AN INDUSTRIAL CHALLENGE
J. P. ROBERT *In* AGARD, Special Course on Skin Friction Drag Reduction 15 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

Over the last few decades all civil aircraft manufacturers have made great efforts to reduce aircraft drag. The long term aim of the operation is to reduce the specific fuel consumption of aircraft, the potential reduction of over 10 percent would represent savings of several million dollars for the airlines. The fuel crises have increased the need for developing new technologies to be applied on the new aircraft; retrofits, however, also have their uses. Estimating the drag of a transport aircraft through calculation or wind tunnel tests must come as close as possible to the value obtained in flight. H.A.

N92-27709* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRCRAFT DRAG REDUCTION
D. M. BUSHNELL *In* AGARD, Special Course on Skin Friction Drag Reduction 16 p Mar. 1992
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This paper reviews aerodynamic drag reduction for friction, wave and vortex drag associated with supersonic cruise aircraft and suggests approaches and research directions which cover the spectrum from possibly significant to revolutionary. Various synergisms are also included, especially in regard to suction laminar flow control and flow separation control at cruise. The former may also enable improved low speed, high lift systems, lift to drag ratio for subsonic cruise, reduced parasitic viscous drag for favorable interference wave drag reduction approaches, and turbulent skin friction reduction via slot injection. Flow separation control at cruise proffers opportunities for increased leading edge thrust, increased lift increment from upper surface, increased fuselage lift/camber for wave drag due to lift reduction, improved performance of various favorable interference wave drag reduction schemes, as well as possibly better low speed, high-schemes and wing cruise performance. More speculative approaches include multi-stage aircraft, thrust vectoring for lift augmentation, as well as trim, and a number of conceptual wave and vortex drag reduction schemes. Author

N92-27710# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
LAMINAR-TURBULENT TRANSITION: FUNDAMENTALS
WILLIAM S. SARIC *In* AGARD, Special Course on Skin Friction Drag Reduction 32 p Mar. 1992
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The basic instability mechanisms are discussed from an elementary standpoint considering only boundary layers in external flows. The objective of this report is to provide the basic ideas and results of boundary layer stability in order that one can understand transition mechanics, transition control, and transition prediction for aircraft systems. The current state of the art boundary layer stability is reviewed and by using recent results, it is shown that a number of unique transition mechanisms exist and each play a different role in the breakdown to turbulence. The control of the stability and transition characteristics of a particular flow field requires thoroughly understanding the details of these breakdown mechanisms. Author

N92-27711# Centre d'Etudes et de Recherches, Toulouse (France). Dept. of Aerothermodynamics.
BOUNDARY LAYER TRANSITION: PREDICTION, APPLICATION TO DRAG REDUCTION
D. ARNAL *In* AGARD, Special Course on Skin Friction Drag Reduction 59 p Mar. 1992
Copyright Avail: CASI HC A04/MF A03

This paper describes the practical calculation methods which are currently available to predict the transition location in two and three dimensional flows. Emphasis is given to the problem of skin friction drag reduction on swept wings at subsonic and transonic speeds. The so called e(sup n) method, which is deduced from the linear stability theory is widely used in the case of 'natural' transition, but simpler techniques (empirical criteria) are useful in more complex situations such as boundary layer tripping or leading edge contamination. The simulation of flight in wind tunnels is also discussed. Wind tunnel/flight correlation includes comparisons between the free stream disturbance environment, the transition Reynolds number, and the n factor at transition onset. Author

N92-27712# University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
THE EDDY STRUCTURES IN BOUNDED SHEAR FLOWS
RON F. BLACKWELDER *In* AGARD, Special Course on Skin Friction Drag Reduction 18 p Mar. 1992
(Contract N00014-82-K-0084; N00014-86-K-0679; F49620-85-C-0080)
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The near wall turbulent eddies consist of streamwise vortices, low speed streaks, intense shear layers, inflectional velocity profiles, oscillations and ejections of low speed fluid out into the logarithmic layer. Away from the wall, large scale three dimensional outer structures dominate the flow. A mass of data has been accumulated over the past 25 years concerning these eddies and their interaction. These eddies and events will be discussed as well as their Reynolds number dependence. Author

N92-27713*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STUDY OF TURBULENCE STRUCTURE THROUGH NUMERICAL SIMULATIONS: THE PERSPECTIVE OF DRAG AND REDUCTION

J. J. KIM *In* AGARD, Special Course on Skin Friction Drag Reduction 14 p Mar. 1992
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The first part of this note concerns organized structures in the near-wall region of a turbulent boundary layer. A particular emphasis is given to those organized motions believed to be responsible for the turbulence production process in the wall region, and hence, indirectly responsible for the viscous drag. Examples are selected to illustrate how the analyses of numerically generated databases have contributed to improve our understanding of the organized structures of turbulent boundary layers. In the second part, results from an exploratory study based on the direct numerical simulation of the concepts for active control of turbulent boundary layers are presented. A significant drag reduction is achieved when the surface boundary condition is modified such that it could suppress the organized motion in the wall region. This drag reduction is accompanied by a significant reduction in the intensity of the organized structures and in the magnitude of Reynolds stresses throughout the flow. Author

N92-27714# Centre d'Etudes et de Recherches, Toulouse (France). Aerothermodynamics Dept.
TURBULENT SKIN-FRICTION DRAG REDUCTION BY ACTIVE AND PASSIVE MEANS, PART 1
E. COUSTOLS and A. M. SAVILL (Cambridge Univ., England) *In* AGARD, Special Course on Skin Friction Drag Reduction 80 p Mar. 1992 Sponsored in part by Rolls-Royce Ltd.; Cambridge Univ.; Airbus Industrie; Aerospatiale; British Aerospace Aircraft Group; BACC; and BMT
(Contract SERC-GR/E/06824; SERC-GR/E/77039)
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The purpose of this paper is to provide a current overview of turbulent skin friction drag reduction concepts which have potential for reducing aircraft fuel consumption. These lectures are organized around four topics. First, after briefly reviewing what is known about the structure of the turbulent boundary layer, possible mechanisms for both active and passive will be discussed; concentrating on techniques offering net drag benefits, either through inner or outer layer manipulation. Both experimental and numerical results will be presented for these boundary layer manipulators. Available data and computer model predictions for low and high subsonic speeds, transonic conditions, and supersonic flow will be reviewed. The aim will be to outline the most important results obtained in terms of drag reduction, and to emphasize the most recent developments. Finally, the combination of passive devices with polymers, suction, blowing, microbubbles, or acoustic forcing will be discussed along with studies of alternative drag reducing surfaces. Author

N92-27936# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
TRANSONIC UNSTEADY AERODYNAMICS AND AEROELASTICITY
Mar. 1992 396 p In ENGLISH and FRENCH The 73d meeting was held in San Diego, CA, 7-11 Oct. 1991 Original contains color illustrations
(AGARD-CP-507; ISBN-92-835-0660-X) Copyright Avail: CASI HC A17/MF A04

Given here are papers presented at a Specialists' Meeting organized by the Structures and Materials Panel of AGARD and held at its Fall 1991 Meeting. Topics covered include transonic unsteady aerodynamics, aeroelasticity, various methods of calculation, and engineering-level aeroelastic prediction techniques.

N92-27937*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CURRENT STATUS OF COMPUTATIONAL METHODS FOR TRANSONIC UNSTEADY AERODYNAMICS AND AEROELASTIC APPLICATIONS
JOHN W. EDWARDS and JOHN B. MALONE *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 24 p Mar. 1992 Previously announced as N92-21432
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The status of computational methods for unsteady aerodynamics and aeroelasticity is reviewed. The key features of challenging aeroelastic applications is discussed in terms of the flowfield state - low angle high speed flows and high angle vortex dominated flows. The critical role played by viscous effects in determining aeroelastic stability for conditions of incipient flow separation is stressed. The need for a variety of flow modeling tools, from linear formulations to implementations of the Navier-Stokes equations, is emphasized. Estimates of computer run times for flutter calculations using several computational methods are given. Applications of these methods for unsteady aerodynamic and transonic flutter calculations for airfoils, wings, and configurations are summarized. Finally, recommendations are made concerning future research directions. Author

N92-27938*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
UNSTRUCTURED-GRID METHODS DEVELOPMENT FOR UNSTEADY AERODYNAMIC AND AEROELASTIC ANALYSES
JOHN T. BATINA, ELIZABETH M. LEE, WILLIAM L. KLEB, and RUSS D. RAUSCH (Purdue Univ., West Lafayette, IN.) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 10 p Mar. 1992 Previously announced as N91-32084
Copyright Avail: CASI HC A02/MF A04

The current status of unstructured grid methods developed in the Unsteady Aerodynamics Branch at NASA Langley Research Center is described. These methods are being developed for unsteady aerodynamic and aeroelastic analyses. Flow solvers that have been developed for the solution of unsteady Euler equations are highlighted. The results demonstrate two and three dimensional applications for both steady and unsteady flows. Comparisons are also made with solutions obtained using a structured grid code and with experimental data to determine the accuracy of the unstructured grid methodology. These comparisons show good agreement which thus verifies the accuracy. Author

N92-27939# Wright Lab., Wright-Patterson AFB, OH. Aeroelasticity Group.
UNSTEADY AERODYNAMICS FOR AEROELASTICITY AT THE FLIGHT DYNAMICS DIRECTORATE
M. BLAIR, L. J. HUTTSELL, W. A. SOTOMAYER, and T. M. HARRIS *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 10 p Mar. 1992
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An overview is presented of the recent in-house and contractual efforts in the area of transonic unsteady aerodynamics for aeroelasticity at the Flight Dynamics Directorate of the USAF Wright Laboratory. Three major topics are discussed. The first topic, analytical unsteady aerodynamics, involves the application of both transonic small disturbance and Euler/Navier-Stokes codes to fighter-type aircraft. Aeroelastic calculations made with these codes are compared with test results. The second topic involves a description of unsteady pressure testing in the NLR tunnel in the Netherlands. Finally, the plan for incorporating transonic unsteady aerodynamics into structural redesign is presented. Author

N92-27940# Saab Aircraft Co., Linkoping (Sweden). Dept. of Aeroelasticity.
RECENT APPLICATIONS OF LINEAR AND NONLINEAR UNSTEADY AERODYNAMICS FOR AEROELASTIC ANALYSIS
BENGT WINZELL *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 10 p Mar. 1992 Sponsored in part by Swedish Defence Administration
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Results of unsteady linear and full potential theory are used for analysis of wings and aircraft configurations. In particular, the details of unsteady pressure distributions at the trailing edge are investigated, aiming at better representation of control surface hinge moments. The importance of viscous effects are observed

and a comparison between potential theory and Navier-Stokes predictions is made. Author

N92-27941# Alberta Univ., Edmonton. Dept. of Mathematics.
A TIME-LINEARIZATION APPROACH FOR UNSTEADY TRANSONIC FLOWS
Y. S. WONG, B. H. K. LEE, and H. S. MURTY (Ottawa Univ., Ontario) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 22 p Mar. 1992 Sponsored by Dept. of National Defence and Natural Sciences and Engineering Research Council
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The development of a time-linearization approach for solving the unsteady transonic small disturbance equation is described in UST3D simulation code (UnSteady Transonic code for a 3D isolated wing). The accuracy of the method was examined by comparing the unsteady pressure distributions with those obtained from XTRAN3S code and experiments carried out on the F-5 wing at subsonic and transonic wings to show the deficiencies of the method. Using the UST3D code, flutter analysis was carried out on the AGARD 445.6 wing. The flutter boundaries were compared with experimental results and those from CAP-TSD code. Author

N92-27942# Rome Univ. (Italy).
A BOUNDARY INTEGRAL FORMULATION FOR UNSTEADY TRANSONIC POTENTIAL FLOWS
U. IEMMA, F. MASTRODDI, L. MORINO, *and* M. PECORA (*Alenia* Spazio S.p.A., Rome, Italy) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 11 p Mar. 1992 Sponsored by Italian Aerospace Research Center
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A boundary integral formulation for the analysis of unsteady potential transonic flows around airplanes is presented. The formulation is applied to steady and to unsteady two dimensional and three dimensional configurations under the small perturbation assumption. The results are compared with existing numerical and/or experimental results, and demonstrate that the algorithm is capable of capturing shocks. However, the location predicted appears to be ahead of that predicted by conservative finite difference schemes; nevertheless, considering the preliminary nature of this work, the agreement obtained is quite satisfactory. Author

N92-27943# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Inst. of Aeroelasticity.
COMPARISON OF EULER AND FULL POTENTIAL METHODS FOR UNSTEADY TRANSONIC FLOW CALCULATIONS
R. VOSS and W. WEGNER *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 17 p Mar. 1992
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Presented here are the results of unsteady transonic flow calculation methods developed at the DLR Institute of Aeroelasticity for oscillating airfoils and wings. The 2D Euler and Full Potential calculations in the nonlinear regime with pronounced shock dynamics at the conventional NACA0012 and the supercritical NLR7301 airfoil show that the unsteady pressure distributions agree well, whereas the unsteady lift and moment curves are not always in good agreement. The 3D results are obtained with a 3D Full potential code and a 3D time linearized TSD method for a swept NACA0012 wing and for a LANN wing, an AGARD standard test wing, both oscillating with small amplitudes. The agreement of the first harmonics of pressure distribution indicates that the time linearized approach may be sufficient for low amplitudes. For higher amplitudes, however, the appearance of pronounced higher harmonics indicates strong nonlinear behavior combined with complicated shock motions. Author

N92-27944# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Inst. of Aeroelasticity.
COMPUTATION OF THE UNSTEADY TRANSONIC 2D CASCADE FLOW BY AN EULER ALGORITHM WITH INTERACTIVE GRID GENERATION
V. CARSTENS *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 14 p Mar. 1992
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Numerical results of a code for computing the unsteady transonic flow in a 2D cascade of harmonically oscillating blades are given. The calculation of the flow field is based on a Euler code using flux vector splitting. After a description of the basic equations and the special numerical techniques applied to the code, results are presented for the first harmonics of pressure, lift, and moment coefficients. For the present investigations, two basic oscillation modes were chosen: tuned modes where all blades perform oscillations with the same frequency, same amplitude and a constant interblade phase angle, and mistuned modes, where all blades are oscillating with the same amplitude, but with varying frequency from one blade to another. The computed results refer to two standard configurations: a subsonic-transonic turbine cascade and a subsonic-transonic compressor cascade. In the case of tuned bending modes, the theoretical results are compared with the experimental data from the turbine standard configuration. Special attention is directed to the occurrence of aerodynamic instability in the oscillating cascade. It can be shown that the interblade phase angles at which the above mentioned experimental test case shows unstable behavior are generally well-reproduced by the computational results. Author

N92-27945# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
EVALUATION OF AN UNSTEADY IMPLICIT EULER CODE AGAINST TWO AND THREE-DIMENSIONAL STANDARD CONFIGURATIONS
A. BRENNEIS and A. EBERLE *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 15 p Mar. 1992
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The numerical simulation of the unsteady Euler equations in conservative form for time-accurate problems using a relaxation method is considered. The unfactored implicit equations are solved by applying a nonlinear Newton method. Relaxation is performed with a point Gauss-Seidel algorithm ensuring a high degree of vectorization by employing the so-called checkerboard scheme. The fundamental feature of the Euler solver is a characteristic variable splitting scheme (Godunov-type averaging procedure, linear locally one-dimensional Riemann solver) based on an Eigenvalue analysis for the calculation of fluxes. Singular behavior of the coefficient matrix is evaded by a simple matrix conditioning needing only a few operations. Numerical results are presented for two and three dimensional standard AGARD configurations. The airfoils and wings at sub and transonic flows perform harmonically pitching oscillations or trailing edge flap oscillations. Comparisons with experiments show good agreement except in regions where viscous effects are evident. Author

N92-27946# Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid (Spain).
UNSTEADY TRANSONIC AERODYNAMICS OF POINTED BODIES OF REVOLUTION IN SUPERSONIC FREESTREAM
P. GARCIAFOGEDA and A. SANZ *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 9 p Mar. 1992 Sponsored by Polytechnical Univ. of Madrid
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A method was developed to determine the aerodynamic forces acting on oscillating bodies of revolution in transonic-supersonic flight. The nonlinear equation for the mean flow perturbation potential and the time linearized equation for the cross flow perturbation are both of hyperbolic type, for the Mach number range of interest, and have been solved by the method of characteristics. The method is valid for arbitrary frequencies of oscillation and can be applied for rigid or flexible body motions. Results are presented for the stability force coefficients, unsteady pressure distributions, and shock deformations for various body shapes and Mach numbers. Author

N92-27947# National Aerospace Lab., Amsterdam (Netherlands).
NLR INVISCID TRANSONIC UNSTEADY LOADS PREDICTION METHODS IN AEROELASTICITY
M. H. L. HOUNJET *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 16 p Mar. 1992 Sponsored in part by Royal Dutch Airforce
(Contract NIVR-01904N)
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An overview is presented of unsteady inviscid calculation methods at the National Aerospace Laboratory (NLR), which are primarily based on the full potential equation for the prediction of airloads on oscillating structures in transonic flow. Attention is given to experience with entropy/vorticity corrections and a procedure which removes the frequency barrier associated with time-linearized modelings. This procedure has a favorable effect on computer cost such that transonic flutter boundaries can be obtained in acceptable turn-around times on current workstations. A method for transonic aeroelastic analysis of complete aircraft which is now in the stage of development is introduced, and attention is given to its grid generation procedure. The methods are demonstrated by showing results of unsteady loads and pressure coefficients applications in 2D and 3D transonic flow and an aeroelastic application to a 3D AGARD standard aeroelastic case in transonic flow. Author

N92-27948# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.). Numerical Fluid Mechanics Div.
COMPUTATIONS OF UNSTEADY FLOWS AROUND AIRFOIL SECTIONS BY EXPLICIT AND IMPLICIT METHODS SOLVING THE EULER AND NAVIER-STOKES EQUATIONS
EDGAR A. GERTEISEN *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 13 p Mar. 1992
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A Euler/Navier Stokes solution algorithm is presented for unsteady aerodynamic analysis of flows around airfoil sections. Several numerical methods have been involved in the flow solver, beginning with an explicit Runge-Kutta time-stepping scheme. Two methodological closely connected moving mesh algorithms were implemented, concerning the mesh adaption for improved accuracy with a minimal number of mesh points, and the body conforming mesh movement which is completely general and can treat realistic configurations. A description is given of the latest version of the developed implicit solving algorithm which can be used as a direct method, but also includes an option for iterating the unsteady residual to enhance the time accuracy. The included moving mesh methods for solution adapting and body conforming the grid are summarized. Numerical simulations of steady and unsteady well known flow phenomena, comprising a shock/boundary interaction, a flow around a cylinder, an airfoil with oscillating flap, and a circular arc airfoil substantiate the above mentioned topics. Author

N92-27949# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.). Dept. Aeroelastics.
COMPUTATION OF VISCOUS PHENOMENA IN UNSTEADY TRANSONIC FLOW
U. R. MUELLER, H. HENKE, and K. DAU *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 16 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

Progress towards the development of a 3D viscous-inviscid strong interaction method for computing unsteady transonic wing flow is reported. In the current version, an ADI technique for solving the 3D unsteady Transonic Small Perturbation (TSP) equation has been extended by incorporating an unsteady 2D integral boundary layer method and then simultaneously solving the viscous and inviscid flow equations in a stripwise fashion. Here attention is focused on the viscous part of the method, and a 3D boundary layer version is introduced. Detailed calculations of 2D unsteady and 3D incompressible/compressible turbulent boundary layers were performed by the integral methods and also by a finite difference solver, and the results are compared to experimental data. The strong interaction technique is validated by comparison with experimental pressure distributions on several airfoils and a wing for various transonic Mach numbers. For steady and unsteady flows, the computed influence of viscous displacement on the pressure distribution is demonstrated in contrast to purely inviscid calculations. Author

N92-27950# British Aerospace Aircraft Group, Kingston-upon-Thames (England). Military Aircraft Div.
TRANSONIC AEROELASTIC CALCULATIONS IN BOTH THE TIME AND FREQUENCY DOMAINS
M. J. KNOTT *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 8 p Mar. 1992
Copyright Avail: CASI HC A02/MF A04

A method for exploring the flutter characteristics of wing-only configurations in the transonic flow regime is presented. At the heart of the method is the Unsteady Transonic Small Perturbation (UTSP) program, which solves the nonlinear transonic small perturbation equation with or without the simultaneous integration of the structural equations of motion. The aim here is to describe the functionality of the program, with a particular emphasis on its implementation within the existing aeroelastics analysis environment at the Kingston site of British Aerospace. Before demonstrating the use of the UTSP program on a production conbat wing, results for the AGARD Taileron and wing 445.6 models are presented, with the aim of validating the method. Author

N92-27951# McDonnell Aircraft Co., Saint Louis, MO.
AEROELASTIC CALCULATIONS FOR FIGHTER AIRCRAFT USING THE TRANSONIC SMALL DISTURBANCE EQUATION
DALE M. PITT and DENNIS F. FUGLSANG *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 11 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

The Transonic Small Disturbance (TSD) equation provides a fast and efficient tool for calculating both static and dynamic nonlinear aerodynamic effects. To become an accepted part of the aircraft design process, time-accurate TSD equation solvers for aeroelastic calculations now need to be evaluated on realistic aircraft configurations that have complex geometry. Discussed here is the application of NASA Langley's Computational Aeroelastic Program - Transonic Small Disturbance (CAP-TSD) code for both static and dynamic transonic aeroelastic calculations for McDonnell Aircraft Company's F-15 and F/A-18 fighter aircraft. The results for flutter speed and aileron reversal speed are compared with results from standard linear aerodynamic analysis. Author

N92-27952# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.). Dept. Aeroelastics.
COMPUTATION OF FLUTTER BOUNDARIES IN THE TIME AND FREQUENCY DOMAIN
H. ZIMMERMANN, S. VOGEL, H. HENKE, and B. SCHULZE *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 9 p Mar. 1992
Copyright Avail: CASI HC A02/MF A04

Computations of flutter boundaries in the time and frequency domain are presented using an interactive 3D Transonic Small Perturbation code. Results of conventional flutter calculations in the frequency domain are opposed to those of flutter simulations integrating the aerodynamic and structural equations of motion simultaneously in the time domain. Highlighted here are the basic properties of these two approaches and the results for a six and a two degrees of freedom model. A comparison of generalized airloads determined by harmonic and pulse excitation is presented. Author

N92-27953# Boeing Co., Seattle, WA.
ANALYSIS OF UNSTEADY AERODYNAMIC AND FLUTTER CHARACTERISTICS OF AN AEROELASTIC MODEL IN TRANSONIC FLOW
G. SENGUPTA, C. J. BORLAND, F. T. JOHNSON, J. E. BUSSOLETTI, R. G. MELVIN, D. P. YOUNG, M. B. BIETERMAN, and P. A. PALOTAS *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 18 p Mar. 1992 Original

contains color illustrations
Copyright Avail: CASI HC A03/MF A04

Prediction of unsteady pressure distributions is an important step towards analyzing the flutter characteristics of an airplane. For this purpose, the TRANSAIR code, originally developed for predicting steady transonic flow past bodies of complex geometry, was extended to handle unsteady problems, in which the unsteady solution could be viewed as an harmonic perturbation to the steady transonic flow. The predicted unsteady flow effects were compared with linear solutions for subsonic flow problems. The predicted results were also compared with available experimental data on unsteady pressure distributions on an oscillating wing in transonic flow. In all these cases, excellent agreements were obtained. The unsteady TRANSAIR code and a structural finite element code were then used to analyze the flutter characteristics of a three dimensional wing model. The predicted flutter speeds and frequencies, including nonlinear flow effects were significantly different than those predicted by linear analysis. Further analyses including the effects of nacelles and fuselage bodies are in progress. Author

N92-27954# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DIRECT COUPLING OF FLUID STRUCTURE IN TRANSONIC AEROELASTICITY [COUPLAGE DIRECT FLUIDE STRUCTURE EN AEROELASTICITE TRANSSONIQUE]
J. P. GRISVAL and J. L. MEURZEC *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 14 p Mar. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A91-16744
Copyright Avail: CASI HC A03/MF A04

Presented here is a numerical approach for transonic aeroelasticity studies called the direct coupling method. This direct coupling is realized between the computation of aerodynamic forces and the computation of displacements. The flow is modeled by using the Transonic Small Perturbation (TSP). In steady flow, we determine the static deformations of the structure. The strong coupling insures the equilibrium state between the aerodynamic forces and the static deformations and in the steady flow between the aerodynamic and the aeroelastic forces in the time domain. The analysis of the resulting displacements give the evolution of the structural modes and enable us to detect flutter. Numerical results are presented for a civil aircraft and are compared with other methods in the frequency domain. Author

N92-27955*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVESTIGATION OF THE AEROELASTIC STABILITY OF THE AFW WIND-TUNNEL MODEL USING CAP-TSD
WALTER A. SILVA and ROBERT M. BENNETT *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 11 p Mar. 1992 Previously announced as N92-11977
Copyright Avail: CASI HC A03/MF A04

The Computational Aeroelasticity Program - Transonic Small Disturbance (CAP-TSD) code is applied to the Active Flexible Wing (AFW) wind tunnel model for prediction of the model's transonic aeroelastic behavior. A semi-span computational model is used for evaluation of symmetric motions and a full span model is used for evaluation of antisymmetric motions. Static aeroelastic solutions using CAP-TSD are computed. Dynamic flutter analyses are then performed as perturbations about the static aeroelastic deformations and presented as flutter boundaries in terms of Mach number and dynamic pressure. Flutter boundaries that take into account modal refinements, vorticity, and entropy corrections, antisymmetric motions and sensitivity to the modeling of the wing tip ballast stores are also presented and compared with experimental flutter results. Author

N92-27957*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRANSONIC AEROELASTIC COMPUTATIONS ON WINGS USING NAVIER-STOKES EQUATIONS
GURU P. GURUSWAMY and SHIGERU OBAYASHI *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 22 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

Aeroelastic computations are made on fighter type wings in the transonic regime. The flow is modeled using the Navier-Stokes equations and is coupled with structural equations of motion. The flow equations are solved by a time accurate finite difference scheme with moving grids. The coupled aeroelastic equations of motion are solved using the linear acceleration method. The configuration adaptive dynamic grids are time-accurately generated using the aeroelastically deformed shape of the wing. Computations are made for oscillating rigid wings with moving shock waves in the presence of leading edge vortices. The computed results compare well with the experiment. Unsteady computations are made to demonstrate the shock-vortex interaction phenomenon on wings in ramp motion. Effects of flexibility and pitch rate are demonstrated for flows with vortices. Author

N92-27959# General Dynamics Corp., Fort Worth, TX.
TRANSONIC WIND TUNNEL INVESTIGATION OF LIMIT CYCLE OSCILLATIONS ON FIGHTER TYPE WINGS
ATLEE M. CUNNINGHAM, JR. and RUUD G. DENBOER (National Aerospace Lab., Amsterdam, Netherlands) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 14 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

A wind tunnel investigation was conducted to investigate the unsteady aerodynamic aspects of transonic Limit Cycle Oscillations (LCO) on fighter type aircraft wings. The first test, conducted with a wing body configuration with wing stores, was restricted to incidences below 10 deg. Test results are presented with the objective of obtaining unsteady pressure and forces necessary for identifying the aerodynamic nature of transonic LCO which is currently encountered on many fighter configurations. The wing panel was oscillated in pitch at amplitudes and frequencies typical of LCO for flow conditions in which significant shock-induced separation is encountered. Unsteady pressure data were obtained for the wing panel in terms of both harmonic components and time-histories to highlight the nonlinearities. Unsteady forces and moments measured on the wing panel as well as on each wing store were also obtained to indicate the level of contribution of each element to the overall unsteady wing loads for pitching motions. Author

N92-27960*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE BENCHMARK AEROELASTIC MODELS PROGRAM: DESCRIPTION AND HIGHLIGHTS OF INITIAL RESULTS
ROBERT M. BENNETT, CLINTON V. ECKSTROM, JOSE A. RIVERA, JR., BRYAN E. DANSBERRY, MOSES G. FARMER, and MICHAEL H. DURHAM *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 11 p Mar. 1992 Previously announced as N92-15049
Copyright Avail: CASI HC A03/MF A04

An experimental effort was implemented in aeroelasticity called the Benchmark Models Program. The primary purpose of this program is to provide the necessary data to evaluate computational fluid dynamic codes for aeroelastic analysis. It also focuses on increasing the understanding of the physics of unsteady flows and providing data for empirical design. An overview is given of this program and some results obtained in the initial tests are highlighted. The tests that were completed include measurement of unsteady pressures during flutter of a rigid wing with an NACA 0012 airfoil section and dynamic response measurements of a flexible rectangular wing with a thick circular arc airfoil undergoing shock boundary layer oscillations. Author

N92-27961# Queens Univ., Belfast (Northern Ireland).
FURTHER INVESTIGATION OF THE EFFECT OF MODEL COOLING ON PERIODIC TRANSONIC FLOW
S. RAGHUNATHAN, F. ZARIFI-RAD, and D. G. MABEY (Royal Aerospace Establishment, Bedford, England) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 13 p Mar.

1992
Copyright Avail: CASI HC A03/MF A04

An experimental investigation of the effect of model cooling on transonic periodic flows on biconvex airfoils is reported. The test conditions included shock interactions with laminar and turbulent boundary layers at a Reynolds number of 0.9 million and model wall temperature to tunnel total temperature ratios 0.5 to 1.0. The results show large effects of model cooling on transonic periodic flows. The effects observed are thought to correspond to what would happen at high Reynolds numbers at adiabatic wall temperatures. Author

N92-27962# Royal Aerospace Establishment, Bedford (England). Aerodynamics Dept.

A REVIEW OF SCALE EFFECTS ON SURFACES IN UNSTEADY MOTION

D. G. MABEY *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 19 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

The importance of scale effects is recognized generally in steady aerodynamics but is often ignored in unsteady aerodynamics. An attempt is made to remedy this situation by the compilation of a review of information on the influence of Reynolds number from a wide range of unsteady aerodynamic tests, with particular reference to wing flows. The unsteady tests considered here relate to surfaces in unsteady motion and include dynamic tests of airfoils and wings, pressure measurements, oscillatory control surface derivatives, and stability derivatives. Here, it is suggested that for the recommended model conditions with fixed transition, scale effects are small for fully attached or well-separated flows, but may be close to incipient separation. With fixed transition, extrapolation from model to full-scale Reynolds numbers is usually possible. In contrast, with free transition, scale effects can be large for both attached and separated flows, and extrapolation from model to full-scale Reynolds numbers is usually extremely difficult. Some test cases for the prediction of scale effects in unsteady aerodynamics are suggested. Author

N92-28102*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPARATIVE STUDY OF TURBULENCE MODELS IN PREDICTING HYPERSONIC INLET FLOWS

KAMLESH KAPOOR, BERNHARD H. ANDERSON, and ROBERT J. SHAW Jul. 1992 17 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Original contains color illustrations
(Contract RTOP 505-62-40)
(NASA-TM-105720; E-7116; NAS 1.15:105720; AIAA PAPER 92-3098) Avail: CASI HC A03/MF A01; 1 functional color page

A numerical study was conducted to analyze the performance of different turbulence models when applied to the hypersonic NASA P8 inlet. Computational results from the PARC2D code, which solves the full two-dimensional Reynolds-averaged Navier-Stokes equation, were compared with experimental data. The zero-equation models considered for the study were the Baldwin-Lomax model, the Thomas model, and a combination of the Baldwin-Lomax and Thomas models; the two-equation models considered were the Chien model, the Speziale model (both low Reynolds number), and the Launder and Spalding model (high Reynolds number). The Thomas model performed best among the zero-equation models, and predicted good pressure distributions. The Chien and Speziale models compared very well with the experimental data, and performed better than the Thomas model near the walls. Author

N92-28151# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

NACA0012 AIRFOIL DATA CORRECTED FOR SIDEWALL BOUNDARY-LAYER EFFECTS IN THE NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

NORIKAZU SUDANI, HIROSHI KANDA, MAMORU SATO, SHIGEO BABA, HITOSHI MIWA, and KENICHI MATSUNO Sep. 1991 75 p
(ISSN 0452-2982)
(NAL-TM-640T; JTN-92-80377) Avail: CASI HC A04/MF A01

An experimental study of NACA0012 airfoils at transonic speeds was conducted in order to acquire aerodynamic data for evaluating sidewall boundary layer effects. Measurements primarily consisted of static pressure on the airfoil and drag force coefficients determined using the wake rake. The tests were performed at free stream Mach numbers from approximately 0.65 to 0.8, at angles of attack from -2.0 deg to 2.0 deg, and at Reynolds numbers (based on airfoil chord) from 7(10)(exp 6) to 40(10)(exp 6). Mach number corrections for sidewall boundary layer effects were made, and tests were subsequently performed on two different chord airfoils to confirm the applicability of the correction to different airfoil aspect ratios. This is a supplementary report; it presents both uncorrected and corrected data which enables comparative studies to be conducted using computational fluid dynamics and other wind tunnel experimental results. Author (NASDA)

N92-28152# *National Aerospace Lab., Tokyo (Japan). Control* Systems Div.

ESTIMATION OF CABLE-MOUNTED MODEL INERTIA CHARACTERISTICS FOR DYNAMIC WIND-TUNNEL TEST

MASAAKI YANAGIHARA, MASAHIKO NAGAYASU, SHUUICHI SASA, and TAKASHI SHIMOMURA Oct. 1991 43 p In JAPANESE; ENGLISH summary
(ISSN 0452-2982)
(NAL-TM-641; JTN-92-80378) Avail: CASI HC A03/MF A01

The inertia characteristics of a cable mounted spaceplane model (1:20 scale), that is used for dynamic wind tunnel tests, were experimentally estimated. The estimated parameters consisted of the vertical position of the model's center of gravity, the inertia moments I(sub x), I(sub y) and I(sub z), and the product of inertia I(sub xz). The method was based on a bifilar pendulum system and estimation errors were evaluated. As a result, the moment of inertia I(sub y) and I(sub z) were estimated within approximately +/-1 percent error, although I(sub x) and the product of inertia I(sub xz) had larger errors. An analysis of the estimation error confirmed that the errors for I(sub x) and I(sub xz) can be improved by using a smaller suspension rig. Author (NASDA)

N92-28190# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

FORCE MEASUREMENTS ON AGARD CALIBRATION MODEL-B AT TRANSONIC SPEEDS IN THE NAL TWO-DIMENSIONAL WIND TUNNEL

MAMORU SATOU, HIROSHI KANDA, NORIKAZU SUDANI, SHIGEO BABA, HITOSHI MIWA, and IWAO KAWAMOTO Aug. 1991 15 p In JAPANESE; ENGLISH summary
(ISSN 0552-2982)
(NAL-TM-639; JTN-92-80376) Avail: CASI HC A03/MF A01

In order to investigate the capability of conducting force measurements of three dimensional (3-D) models in NAL's two dimensional (2-D) wind tunnel, force measurements on AGARD calibration Model-B (Mach numbers: from 0.5 to 1.1, Reynolds number: 3 x 10(exp 6) and 4 x 10(exp 6)). Full and half models were tested. Four different strut lengths having a circular arc cross section and stings were used to install the full model. For the half model, a plate was installed to remove the effects of the wind tunnel's sidewall boundary layer, as well as adding a small gap between the model and the plate to remove the effects of the plate's boundary layer. It was shown that force measurements of 3-D models are possible in NAL's 2-D wind tunnel, although improvements in the struts and stings are necessary to conduct tests at Mach numbers greater than 0.85. Author (NASDA)

N92-28192# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

A GUST GENERATION METHOD FOR FULL CONFIGURATION AIRCRAFT TESTS IN A LOW SPEED WIND TUNNEL. PART 1: DESIGN AND PRELIMINARY EXPERIMENTS

SEIZOU SUZUKI, SIGEO KAYABA, TADAO SAWAI, and NORIMASA YOSHIDA Jun. 1991 40 p In JAPANESE; *In*

JAPANESE; ENGLISH summary
(ISSN 0389-4010)
(NAL-TR-1115-PT-1; JTN-92-80383) Avail: CASI HC A03/MF A01

A gust generation method is described that uses vortices produced from four oscillating cantilever wings which were installed in a low speed wind tunnel upstream of the test section. In order to obtain uniform pulsating flow at the test model, the aspect ratio of the rectangular wings was theoretically determined. Preliminary experiments validation were performed in a pilot tunnel with results indicating a suitable design method which is appropriate for application in NAL's 6.5 m x 5.5 m Low Speed Wind Tunnel.
Author (NASDA)

03

AIR TRANSPORTATION AND SAFETY

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

A92-41262* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MEASUREMENTS IN A LEADING-EDGE SEPARATION BUBBLE DUE TO A SIMULATED AIRFOIL ICE ACCRETION
M. B. BRAGG, A. KHODADOUST (Illinois, University, Urbana), and S. A. SPRING (CFD Research Corp., Huntsville, AL) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1462-1467. refs
(Contract NAG3-28; NAG3-1134)
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The separation bubble formed on an airfoil at low Reynolds number behind a simulated leading-edge glaze ice accretion is studied experimentally. Surface pressure and split hot-film measurements as well as flow visualization studies of the bubble reattachment point are reported. The simulated ice generates an adverse pressure gradient that causes a laminar separation bubble of the long bubble type to form. The boundary layer separates at a location on the ice accretion that is independent of angle of attack and reattaches at a downstream location 5-40 percent chord behind the leading edge, depending on the angle of attack. Velocity profiles show a large region of reverse flow that extends up from the airfoil surface as much as 2.5 percent chord. After reattachment, a thick distorted turbulent boundary layer exists. The separation bubble growth and reattachment are clearly seen in the plots of boundary-layer momentum thickness vs surface distance. Local minima and maxima in the boundary-layer momentum thickness development compare well with the shear layer transition point as indicated by the surface pressures and the reattachment point as measured from surface oil flow, respectively. Author

A92-42500
WINDSCREEN DEPARTURE
Aerospace (UK) (ISSN 0305-0831), vol. 19, no. 6, June 1992, p. 8-14.
Copyright

A review is presented of a commercial aircraft incident that occurred in June 1990, involving the inflight blowout of a British Airways One-Eleven windshield as a result of its having been installed with the wrong bolts during maintenance. An analysis of the complex events leading to this human maintenance error is provided by the report of the accident review board. R.E.P.

A92-43155
NAVIGATION PREPARATIONS FOR PASSENGER HELICOPTERS
M. SUGANO (City Airlink, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 280-283. In Japanese.

The configuration of the BELL412 helicopter and preparation modes such as the condition monitoring modes are presented. Maintenance plans including aircraft scheduled inspection and engine periodic inspection are discussed. The navigational schedule for the Narita, Haneda and Yokohama airports is discussed.
Y.P.Q.

A92-43161
A HELICOPTER TRANSPORTATION SYSTEM
CHOJI TOMITA (City Airlink, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 306-309. In Japanese.

The use of helicopters for passenger and cargo transportation is discussed. Urban airlink development is addressed, and problems such as safety, noise, and air traffic control are discussed.
Y.P.Q.

A92-43162
USING HELICOPTERS FOR THE ERECTION OF POWER TRANSMISSION LINES
S. IZUMIDA (New Japan Helicopter Co., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 310-313. In Japanese.

A92-43163
HELICOPTERS FOR PUBLIC SERVICES, INCLUDING RESCUE, FIRE FIGHTING, AND MEDICAL EMERGENCY
YASUO TANAKA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 314-317. In Japanese.

The use of helicopters for police patrol, and traffic information collection, and fire fighting is addressed. Using helicopters for medical emergency services is also discussed. A statistical analysis of these applications of helicopters in Germany, Switzerland, and the United States is presented. Y.P.Q.

A92-43164
USING HELICOPTERS FOR COASTAL ALERT
A. KOBE and N. IWAMURA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 318-321. In Japanese.

The role of helicopters in coastal alert is discussed. The characteristics and structures of a new antisubmarine (XSH-60J) system are examined. The in-flight performance monitor system is reported. Y.P.Q.

A92-43219
AIRCRAFT ACCIDENTS AND HUMAN FACTORS
S. MURAKAMI and HIDETAKE SAKUMA (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 540-543. In Japanese.

Factors involved in aircraft accidents are discussed. Pilot evaluations are emphasized, and the NASA Aviation Safety Reporting System (ASRS) is introduced. Y.P.Q.

A92-43446
THE 1991 CIERVA LECTURE - ABERDEEN AND ITS INFLUENCE ON THE EVOLUTION OF THE COMMERCIAL IFR TWIN ENGINED HELICOPTER
ALASTAIR C. GORDON Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 955, May 1992, p. 169-183.
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The supplying of offshore oil rigs in the vicinity of Aberdeen, Scotland, has prompted significant developmental challenges for commercial helicopters in virtue of the severity of the regional climate, frequent night-flight requirement, and the need for maximum fuel loads as ranges to new oil fields increased. In particular, IFR-related avionics have been critical factors in the achievement of the requisite safety levels. Attention is given to

the weight growth incurred by helicopters in this service environment, as well as the management of helicopter maintenance operations and the character of training and simulation. O.C.

N92-26349# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere.
THE ICING OF THE WING UPPER SIDE AND BOTTOM SIDE OF THE ICING RESEARCH AIRCRAFT OF THE DLR [DIE VEREISUNG DER TRAGFLAECHENOBERSEITE UND -UNTERSEITE DES VEREISUNGSFORSCHUNGSFLUGZEUGS DER DLR]
HANS-EBERHARD HOFFMANN and JOHANN DEMMEL *In its* Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 215-222 Sep. 1991 In GERMAN; ENGLISH summary
Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

It is shown by photographs, that when the wing bottom side is strongly iced, the upper side also attains large values: extension 40 cm, roughness 6 mm. This occurred when the total water was between 0.05 and 0.13 g/m(exp 3), the temperature between -2.1 and 3.4 C, and the median volume diameter between 115 and 236 micrometers. ESA

N92-27682# Wright Lab., Wright-Patterson AFB, OH.
FOREIGN OBJECT DAMAGE TO TIRES OPERATING IN A WARTIME ENVIRONMENT Final Report, Jan. 1987 - Dec. 1990
KENNETH P. SCHWARTZ Nov. 1991 68 p
(AD-A247195; WL-TR-91-3014) Avail: CASI HC A04/MF A01

Over the past 5 years, various efforts addressed the problems associated with Foreign Object Damage (FOD) to aircraft operating in a debris strewn environment following an airbase attack. These efforts include engine object ingestion probability, engine (FOD) damage, aircraft damage from tire lofted foreign objects, external stores FOD, tire cutting FOD, and the operability of tires subjected to FOD. This report was written to provide a summary and preliminary assessment to the tire cutting FOD portion of the overall post-attack FOD program. The report summarizes the approach and results of tests on over 126 aircraft tires which were tested in a simulated post-attack environment under full scale test conditions. Test tires included F-16 main and nose, and an F-4 nose tire setup. Test variables included speed, load, size, pressure, tire type, turning, water effects, debris type, debris size, debris distribution, braking, and combined variable effects. Analysis consideration involved cut types, cut depths, number of cuts, cut/hit probabilities, tire failures, and aircraft operational impacts. GRA

N92-27750# Army Aviation Test Board, Fort Rucker, AL.
INGRESS, EMERGENCY EGRESS, AND EMERGENCY EVACUATION TESTING OF ARMY AIRCRAFT Final Report
30 Sep. 1991 23 p
(AD-A246398) Avail: CASI HC A03/MF A01

This test operation procedure (TOP) specifies procedures for testing ingress, emergency egress, and emergency evacuation of Army aircraft. Components installed on the interior and exterior of the aircraft as well as personnel equipment may adversely affect ingress and egress from an aircraft. The inherent design of a particular aircraft may also contribute to the time required to egress safely depending on the number of crew doors and exits designated as emergency evacuation routes. The criteria in appendix B provide guidelines for maximum times allowed for emergency egress and emergency evacuation. GRA

N92-27914# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
HUMAN FACTORS EVALUATION OF THE WORK ENVIRONMENT OF OPERATORS ENGAGED IN THE INSPECTION AND REPAIR OF AGING AIRCRAFT
RICHARD I. THACKRAY Jan. 1992 16 p
(AD-A246445; DOT/FAA/AM-92/3) Avail: CASI HC A03/MF A01

Site evaluations of air carriers and repair stations conducting inspections and heavy maintenance on PART 121 aging aircraft were conducted during 1989-90 under the Federal Aviation Administration's (FAA's) Office of Flight Standards Aging Fleet Evaluation Program. This report presents the findings of the human factors portion of this program in which aspects of the work environment of selected operators were evaluated with respect to illumination levels, noise, temperature/ventilation, work support equipment/workspace adequacy, occupational safety, and extent of worker overtime. Data are reported for 19 site evaluations. While 89 percent of the operators were given global ratings of acceptable or better in the area of human factors, the deficiencies noted were quite consistent across carriers and repair stations. Illumination levels, in particular, were found to be considerably below levels recommended by the Illuminating Engineering Society. There were also deficiencies in work support equipment and in compliance with the operator's stated safety program. Recommendations are given for improvements in each of these areas. GRA

N92-28052# Systems Control Technology, Inc., Arlington, VA.
COMPOSITE PROFILES OF HELICOPTER MISHAPS AT HELIPORTS AND AIRPORTS Final Report
L. D. DZAMBA, W. T. SAMPSON, III, and R. J. ADAMS Jan. 1992 92 p
(Contract DTFA01-87-C-0014)
(AD-A248887; SCT-91RR-31; DOT/FAA/RD-91/1) Avail: CASI HC A05/MF A01

In a companion report entitled Analysis of Helicopter Mishaps at Heliports, Airports, and Unimproved Sites, DOT/FAA/RD-90/8, National Transportation Safety Board and U.S. Army mishap reports were reviewed in order to determine the types of mishaps that have occurred at helicopter landing sites. Based upon these mishap records, helicopter composite mishap profiles were developed and are presented here in order to demonstrate the types of mishaps that have occurred at or near heliports and airports. Each composite profile includes a description of the mishap, facility design factors which contributed to the mishap, nondesign-related contributing factors, and operational safety enhancements where appropriate. This document is intended to be a learning and teaching aid. The intended audience includes helicopter landing area designers, managers, and operators, as well as pilots. The goal of the report is to broaden awareness in the helicopter community in order to promote safety. This report is one in a series of three dealing with helicopter mishaps at landing sites. The other reports are: Analysis of Helicopter Mishaps at Heliports, Airports and Unimproved Sites, DOT/FAA/RD-90/8, and Analysis of Helicopter Accident Risk Exposure near Heliports, Airports, and Unimproved Sites, DOT/FAA/RD-90/9. GRA

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A92-41208
THE AUTOMATIC DEPENDENT SURVEILLANCE (ADS) SYSTEM [LA SURVEILLANCE DEPENDANTE AUTOMATIQUE (ADS)]
BERNARD MIAILLIER (Eurocontrol, Direction Operations, Brussels, Belgium) Navigation (Paris) (ISSN 0028-1530), vol. 40, no. 158, April 1992, p. 182-191. In French. refs
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A review is presented of the ADS system used for the transmission, via a data link, of aircraft position data derived from airborne navigation systems. This system provides a method for monitoring air traffic with accurate and frequent position data in airspaces where radar surveillance is unavailable. It is anticipated

that ATC systems using ADS will consist of a tracking function, flight data processing, and an automatic detection of potential conflicts/deviations from intended track. R.E.P.

A92-41220* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MICROWAVE LANDING SYSTEM MODELING WITH APPLICATION TO AIR TRAFFIC CONTROL AUTOMATION
M. M. POULOSE (Institut Teknologi Brunei, Bandar Seri Begawan; NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 348-354. Previously announced in STAR as N91-23099. refs
Copyright

Compared to the current instrument landing system, the microwave landing system (MLS), which is in the advanced stage of implementation, can potentially provide significant fuel and time savings as well as more flexibility in approach and landing functions. However, the expanded coverage and increased accuracy requirements of the MLS make it more susceptible to the features of the site in which it is located. An analytical approach is presented for evaluating the multipath effects of scatterers that are commonly found in airport environments. The approach combines a multiplane model with a ray-tracing technique and a formulation for estimating the electromagnetic fields caused by the antenna array in the presence of scatterers. The model is applied to several airport scenarios. The reduced computational burden enables the scattering effects on MLS position information to be evaluated in near real time. Evaluation in near real time would permit the incorporation of the modeling scheme into air traffic control automation; it would adaptively delineate zones of reduced accuracy within the MLS coverage volume, and help establish safe approach and takeoff trajectories in the presence of uneven terrain and other scatterers. Author

A92-41472
INTRA-FLIGHT LASER DATA LINKS - TECHNOLOGY FOCUS
ROBERT J. FELDMANN and GREGORY J. TOUSSAINT (USAF, Wright Laboratory, Wright-Patterson AFB, OH) IN: Lasers '90; Proceedings of the 13th International Conference on Lasers and Applications, San Diego, CA, Dec. 10-14, 1990. McLean, VA, STS Press, 1991, p. 187-193. refs
Copyright

Attention is given to the current state of technology and some of the development issues that need resolution before air-to-air laser data links can be successfully applied to airborne communications problems. A step toward providing the support needed to begin a system development program is to perform risk reduction experimentation in critical technology areas and prototyping of both component and system concepts which can be demonstrated to the user. The way in which laser technology will fit into future avionics architectures and how the Avionics Directorate of the Wright Laboratory is advancing the state of the art in laser data link systems are discussed. P.D.

A92-42313
RFI EFFECTS ANALYSIS OF AN AIRPORT-INSTALLED HF TRANSMITTER ON AIRCRAFT COMM/NAV RECEIVERS
ELYA B. JOFFE (K.T.M. Project Engineering, Ltd., Kfar-Sava, Israel) and J. GAVAN (Holon Center for Technological Education, Israel) IN: 1991 IEEE International Symposium on Electromagnetic Compatibility, Cherry Hill, NJ, Aug. 12-16, 1991, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 212, 213. refs
Copyright

A medium power transmitter installed at Tel Aviv International Airport was a source of concern due to the possible radio-frequency interference (RFI) effects to essential airborne COMM/NAV systems, when most needed. An analysis based on a realistic scenario indicated that, although the receiver performance may be somewhat degraded, it will operate satisfactorily and provide a reliable COMM/NAV performance in flight and landing. These results have been substantiated by actual measurements of COMM/NAV airborne receivers. Author

A92-42486
USING SATELLITE COMMUNICATION FOR AIRCRAFT AUTOMATIC DEPENDENT SURVEILLANCE
M. A. ABDELRAZIK and J. F. HODAPP (E-Systems, Inc., Greenville, TX) IN: 1991 IEEE Aerospace Applications Conference, Crested Butte, CO, Feb. 3-8, 1991, Digest. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, 10 p. Research supported by INMARSAT, COMSAT, USAF, U.S. Navy, et al. refs
Copyright

This paper provides a technical description and summarizes the theory of operation of a prototype aircraft Automatic Dependent Surveillance (ADS) System. The system operates between 1.5 to 1.7 GHz and uses the International Maritime Satellite Organization (Inmarsat) satellite network to periodically transmit the precise location of the aircraft, its altitude, and heading to a ground air traffic controller. This system is also used to transmit and receive data messages between the aircraft and ground locations. The paper also summarizes the results of a series of test flights which included the first around-the-world ADS demonstration, and several flights between New Zealand and Antarctica. The test flights used three Inmarsat satellites located over the Atlantic, Pacific, and Indian Ocean. The prototype ADS system has been designed and developed by E-Systems, Inc. Author

A92-42604
CODE DIVISION MULTIPLE ACCESS (CDMA) SYSTEM CANDIDATE FOR INTEGRATED MODULAR AVIONICS
ANTONIO J. MENDEZ and ROBERT M. GAGLIARDI (Southern California, University, Los Angeles, CA) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 67-71. refs
Copyright

There are government and industry trends toward avionics modularity and integrated avionics. Key requirements implicit in these trends are suitable data communication concepts compatible with the integration concept. In this paper, the use of Code Division Multiple Access techniques is explored as an alternative to collision detection and collision avoidance multiple access techniques. Author

A92-42634
DECOUPLING OF ANTENNAS USING PERIODIC STRUCTURES [RAZVIAZKA ANTENN PRI POMOSHCHI PERIODICHESKIKH STRUKTUR]
L. S. BENENSON, A. G. KIURKCHAN, and A. I. SUKOV Radiotekhnika i Elektronika (ISSN 0033-8494), vol. 37, no. 1, Jan. 1992, p. 77-89. In Russian. refs
Copyright

The use of structures with capacitive surface impedance for the decoupling of onboard antennas is considered, taking into account the physical arrangement of the antennas. A review is given of the main calculation methods that can be used to investigate the properties of periodic structures. Numerical results are given for periodic metallic ribbed and strip structures, and decoupling coefficients are determined for antennas isolated by these types of structures. L.M.

A92-42789
DATA PROCESSING IN NAVIGATION COMPLEXES [OBRABOTKA INFORMATSII V NAVIGATSIONNYKH KOMPLEKSAKH]
OLEG A. BABICH Moscow, Izdatel'stvo Mashinostroenie, 1991, 512 p. In Russian. refs
(ISBN 5-217-01060-6) Copyright

Algorithms are presented for computing the coordinates of a flight vehicle from radio data obtained by short-range, long-range, and satellite navigation systems, airborne monitors of ground references, and Doppler and inertial systems. Stochastic models and methods for the statistical filtering of the measurement errors are also presented. The principles of the design and operation algorithm of navigation complexes including several measurement systems are discussed. V.L.

A92-43122
NAVIGATION EXPERIMENT ON AN AIRCRAFT USING THE GPS-INS NAVIGATION SYSTEM. I - INTRODUCTION TO THE SYSTEM
HIROKIMI SHINGU, HIROICHI MATSUSHIMA, TADAO UCHIDA (National Aerospace Laboratory, Chofu, Japan), MASARU OKA, MASAYUKI IKEUCHI, and SHOWA HARIGAE (Toshiba Corp., Kawasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 136-139. In Japanese. refs

The system structures of the Global Positioning System (GPS) and the inertial navigation system (INS) are presented. The gyro drift stability is evaluated. The structural element performance and characteristic tests are outlined. Y.P.Q.

A92-43123
NAVIGATION EXPERIMENT ON AIRCRAFT FLIGHT USING THE GPS-INS NAVIGATION SYSTEM. II - TEST RESULTS
SHOWA HARIGAE, Y. MAEDA (Toshiba Corp., Kawasaki, Japan), KOJI ONO, W. ISHIGAWA, and HIROKIMI SHINKU (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 140-143. In Japanese.

Fixed point calculation is given and test results are evaluated for a GPS/INS navigation experiment. The position, velocity, and altitude errors of the GPS-INS navigation system are analyzed. Y.P.Q.

A92-43881
A COMPUTERIZED FLIGHT INSPECTION SYSTEM
PEKKA ESKELINEN (Kotka Institute of Technology, Finland) IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985), vol. 7, no. 3, March 1992, p. 5-11.
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This paper describes the key elements of a noncommercial computerized flight inspection system designed for testing of basic air navigation ground facilities. Choice of proper power supply, connection of different receivers, their characteristics, antenna installations and data processing algorithms are discussed in detail. Aircraft ground tracking techniques are considered together with achievable positioning uncertainty. It is shown that a simple BASIC-programmed controller together with IEEE-488-bus equipment and a theodolite tracker can provide a basis for measurements according to ICAO Annex 10 requirements. A new technique for measuring two frequency ILS-installations with a combination of communication test receivers is illustrated. Author

A92-43937
AN INVESTIGATION OF THE DESENSITIZING EFFECTS BY HIGH POWER HF BROADCAST TRANSMITTERS ON HF AIRBORNE RECEIVERS
JACQUES GAVAN and ELYA B. JOFFE (Center for Technical Education, Holon, Israel) IEEE Transactions on Electromagnetic Compatibility (ISSN 0018-9375), vol. 34, no. 2, May 1992, p. 65-77. refs
Copyright

An investigation is conducted of the primary interference effects from a high power, HF broadcasting station on HF-communications radio systems; of these, airborne receivers are the most vulnerable to interference, with strong desensitization and blocking even when aircraft are flying 3 km above the 500-kW tower of an HF broadcasting station. Additional mutual-interference effects from such a station that can influence the radio system's performance are intermodulation (IM) between transmission station, IM in the airborne radio's front-end stages, IM generated in the propagation media, cross-modulation, harmonics of the transmitter station frequencies, and AM-to-either-AM-or-PM conversion. O.C.

A92-44428
SINGLE SLOTTED ARRAY ACHIEVES MULTIMODE PERFORMANCE
JOHN CROSS, DON COLLIER, and LEN GOLDSTONE (Norden Systems, Norwalk, CT) Microwaves & RF (ISSN 0745-2993), vol. 30, no. 4, April 1991, p. 118, 120, 122-126. refs
Copyright

Modern military aircraft must perform a variety of missions, often simultaneously, and the antennas for these aircraft must be versatile. For this reason, slotted flat-plate arrays, with their unique ability to divide available aperture space among several antenna requirements, have become increasingly popular. With recent design innovations, a single multimode antenna can now perform air-to-air pulse-Doppler monopulse, ground mapping, terrain following, terrain clearance, terrain avoidance, weapons transponder tracking, and ground-target tracking. Author

A92-44850
SCATTERING MECHANISM AND RCS REDUCTION OF ANTENNAS
YINGZHENG RUAN (University of Electronic Science and Technology of China, Chengdu, People's Republic of China) Chinese Society of Astronautics, Journal (ISSN 1000-1328), no. 4, 1990, p. 94-100. In Chinese. refs

Antennas in aircrafts give large contributions to the radar cross section (RCS) of target at particular aspects, which include both the common structural and antenna-mode components, the latter is a special character of loaded scatterers due to the re-radiation. In this investigation, the scattering mechanism and analytical computation methods for the two RCS components of antennas are discussed, and some technical ways as well as their effects for antenna RCS reduction are proposed. Author

N92-26291# Defence Research Establishment, Ottawa (Ontario).
AN EVALUATION OF SUPERRESOLUTION METHODS FOR TACTICAL RADIO DIRECTION FINDING
WILLIAM J. READ Oct. 1991 123 p
(AD-A246316; DREO-1091) Avail: CASI HC A06/MF A02

This report evaluates superresolution direction finding methods for land tactical narrowband very high frequency/ultrahigh frequency purposes. The DF methods are described and evaluated in depth using a common theoretical framework beginning with classical methods and ending with modern day eigenanalysis based methods. Based on this analysis, superresolution methods can be described in terms of a five step procedure where each step has a unique purpose in the estimation process. Different methods vary according to the operations performed at each step. This is useful in analyzing and comparing the theoretical performance of various DF methods under the same conditions. The results from simulations are also included to support the theoretical evaluations. GRA

N92-26623 Stanford Univ., CA.
AN ADAPTIVE CORRECTION TECHNIQUE FOR DIFFERENTIAL GLOBAL POSITIONING SYSTEM Ph.D. Thesis
HSING-TUNG CHOU 1991 155 p
Avail: Univ. Microfilms Order No. DA9205614

Accuracy and reliability are of the most important issues regarding the potential of the Global Positioning System (GPS) to become a sole means air navigation system. The purpose of this dissertation is to propose solutions to these problems. The Differential GPS (DGPS) is the most effective technique to improve the accuracy of the GPS. Many experiment results prove that the DGPS can make significant improvements. However, the current DGPS accuracy still cannot meet the ICAO category 2 approach/landing precision requirements. Thus, there is a need to explore the filtering technique to make further improvements. Low pass filters, the Hatch/Eschenbach filter, and the Kalman filter are investigated as candidate filters to improve the quality of the correction signals; the Hatch/Eschenbach filter and the Kalman filter are implemented as the user filter to smooth navigation solutions. Better accuracy can be achieved by the optimization of the DGPS filter configuration. Through static and dynamic tests, it is found that the most accurate and robust choice for DGPS is the Hatch/Eschenbach filter. It was used as both reference station

correction signal filter and user's navigation filter. Using this Hatch/Eschenbach filter configuration, the accuracy under the elevation mask of 7.5 degrees is lateral-0.98 m (2 sigma); vertical-1.81 m (2 sigma); absolute positioning-2.50 m (2 sigma). One serious problem of DGPS is the latency effect, which is the accuracy degradation caused by the delay of the correction signals. It greatly reduces the DGPS system reliability. To alleviate the latency effect, an adaptive correction technique (ACT) is developed. This technique adaptively identifies the autoregressive model parameters and order of the correction signals by using a Recursive Least Squares Lattice Filter (RLSLF). Using these parameters, the delta-step predictor of the RLSLF can generate better correction signals than the existing RTCM SC-104 correction algorithm. The static test results prove that ACT is better than RTCM SC-104 when the latency is longer than 180 seconds. In addition, it is very effective to suppress the growth of positioning error for very long latency. Based on results of the current research and the GPS 21 primary satellite constellation, a DGPS-aided landing precision database is constructed. This database provides the landing precision information of various combinations of latitudes and mask angles. It is a projection of the landing precision of the DGPS implementation in this research under full operational GPS. Dissert. Abstr.

N92-26756# Naval Postgraduate School, Monterey, CA.
THE NAVIGATION DATA LOGGER FOR A SUITCASE NAVIGATION SYSTEM M.S. Thesis
YU-CHI CHIN Jun. 1991 66 p
(AD-A245997) Avail: CASI HC A04/MF A01

This thesis presents the design, implementation, and description of a Data Logger for the Suitcase Navigation System. All the programs and examples presented in this thesis were implemented in the Ada programming language, which has successfully incorporated the low level I/O ports communication with high level abstraction. The software is portable as desired and can be reused by LCCDS when needed. GRA

N92-26795# Naval Postgraduate School, Monterey, CA.
PRECISION OF THE LONG BASELINE ACOUSTIC NAVIGATION SYSTEM USED BY PEGASUS M.S. Thesis
MARGARET F. HASKELL Jun. 1991 109 p
(AD-A246598) Avail: CASI HC A06/MF A02

A least squares algorithm is developed to solve for the trajectory and transponder array coordinates of the current velocity profiler, Pegasus. Measurement residuals and parameter precision are computed for data quality analysis. Travel times from a maximum of four seafloor transponders, pressure sensor depths, and transponder positions are input with their respective accuracy estimates. The algorithm is used to analyze a 2250 m profile from the Monterey Canyon with four transponders, one of which had not been positioned. This transponder's unknown position is found and problems in the other array coordinated identified. Transponder coordinate precision improves by factors of ten in the horizontal and five in depth, to about 13 m (DRMS) and 2 m (1 sigma) respectively. Trajectory precision is about 7 m (Drms) horizontal, with high correlation between points. Thus, the precision of horizontal velocity components, determined by time differencing points, is better than 11 cm/s (1 sigma). Depth precision is better than 3 m (1 sigma), except in the deeper portions where anomalous pressure residuals near the depth of the transponder array suggest systematic pressure errors needing further study. GRA

N92-26948# Surveillance Research Lab., Salisbury (Australia).
BUFFERED SERIAL DATA CARD
G. FIELKE May 1991 35 p
(AD-A246435; SRL-0058-TM; DODA-AR-006-440) Avail: CASI HC A03/MF A01

NAVSTAR Global Positioning System (GPS) User Equipments (UEs) send out navigation information in the form of blocks of serial data. The format and transmitting rate of the data varies between UEs. Several agencies within the Australian Department of Defense require the collection of GPS UE data. As a personal computer general purpose data logging card was not available commercially, it was decided to design and develop such a card to enable collection of data from any GPS UE. This card may be used to collect data from any source which transmits data at either RS232 or RS422 levels. This manual describes the operation of the Buffered Serial Data Card and the process of writing user software. GRA

N92-27217# Naval Postgraduate School, Monterey, CA.
NATIONAL AIRSPACE DATA INTERCHANGE NETWORK ANALYSIS M.S. Thesis
GUY M. ESTEN Mar. 1992 96 p
(AD-A247345) Avail: CASI HC A05/MF A01

This thesis is a description and analysis of the Federal Aviation Administration's National Airspace Data Interchange Network (NADIN). The Objective is to define, for telecommunications students, this data interchange network and examine the effect which current network upgrades will have on network performance. Descriptions of the current Data Interchange Network (NADIN IA) and the next generation Data Interchange Network (NADIN II) are included as well as information on related FAA programs, most notably the Radio Communications Link (RCL). Analysis is presented of NADIN II's impact on the Federal Aviation Administration's Data Interchange capabilities. Implementation problems with NADIN II are addressed. Conclusions include the economic soundness of NADIN II due to leased line savings and a strong recommendation to the NADIN II program manager to aggressively pursue full project funding. GRA

N92-27894*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STATUS OF AUTOMATIC GUIDANCE SYSTEMS FOR ROTORCRAFT IN LOW ALTITUDE FLIGHT
BANAVAR SRIDHAR, VICTOR H. L. CHENG, and HARRY N. SWENSON *In* AGARD, Air Vehicle Mission Control and Management 12 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

Rotorcraft operating in high-threat environments fly close to the earth's surface to utilize surrounding terrain, vegetation, or man-made objects to minimize the risk of being detected by an enemy. The piloting of the rotorcraft is at best a very demanding task and the pilots need help from on-board automation tools in order to devote more time to mission-related activities. The Automated Nap-of-the-Earth (NOE) Flight Program is a cooperative NASA/Army program aimed at the development of technologies for enhancing piloted low-altitude/NOE flight path management and control through computer and sensor aiding. The long-term objective is to work towards achieving automation for aiding the pilot in NOE flight with a flight demonstration of resulting computer/sensor aiding concepts at an established course. The technology for pilot-centered NOE automation is not currently available. Success in automating NOE functions will depend on major breakthroughs in real-time flight path planning algorithms, effective methods for the pilot to interface to the automatic modes, understanding of visual images, sensor data processing/fusion, and sensor development. Our approach to developing the technologies required to solve this problem consist of the following phases: (1) algorithm development, (2) laboratory evaluation, (3) piloted ground simulation, and (4) evaluation in flight. An overview of the research in this area at NASA Ames Research Center is given. Author

N92-27895# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Systemdynamik und Flugmechanik.
KNOWLEDGE-BASED PLANNING FOR CONTROLLED AIRSPACE FLIGHT OPERATION AS PART OF A COCKPIT ASSISTANT
T. PREVOT, R. ONKEN, and H.-L. DUDEK (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* AGARD, Air Vehicle Mission Control and Management 8 p Mar. 1992
Copyright Avail: CASI HC A02/MF A03

A knowledge based computer aid for flight planning tasks as part of a Cockpit Assistant for IFR (Instrument Flight Rules) operation is presented in detail after a brief overview of the modular

structure of the Cockpit Assistant has been given. Based upon the requirements of air traffic management, the system is aimed at supporting the pilot in complex planning and decision situations. By assessing the situation, flight goal conflicts are detected and avoided by offering sensible flight plan modifications to the pilot. The main features of the situation assessment and planning module are discussed with regard to knowledge representation and applied solution model. Thus, conflict detection, selection of an alternate destination and rerouting algorithms are described in detail. The present state of implementation, as tested in a flight simulation facility at the University of the German Armed Forces in Munich, is presented as well as some results of the test phase with professional pilots. The possibilities of integrating the system into the avionics of modern aircraft are discussed and an outlook is given of expanding it towards 4-D and RNAV capability and/or optimal 3-D aircraft trajectory planning under constraints from terrain, traffic and weather. Author

N92-27897# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. of Flight Guidance.
ON BOARD PLANNING OF 4D-TRAJECTORIES
V. ADAM and R. KOHRS *In* AGARD, Air Vehicle Mission Control and Management 12 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

The evolution of present day Air Traffic Management (ATM) towards an integrated Air Traffic Management will lead to the introduction of computer based planning systems on the ground side, which communicate with advanced Flight Management Systems onboard the aircraft via automatic data link. An experimental Flight Management System (EFMS) is under development in the frame of the PHARE program for research into future ATM concepts. This EFMS will have the capability to predict a 4-dimensional trajectory according to a set of constraints given by an ATC planning computer on the ground. It will negotiate this trajectory with ATC via data link and will generate appropriate guidance commands for the autopilot/autothrottle system to steer the aircraft along this trajectory. The functionality of the EFMS is described as well as the planning strategy for the generation of a trajectory from the departure to the destination airport which meets the defined constraint attributes. Author

N92-27898# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.
TRAJECTORY OPTIMIZATION FOR HYPERSONIC AIRCRAFT GUIDANCE
R. L. SCHULTZ, M. J. HOFFMAN, A. M. CASE, and S. I. SHEIKH *In* AGARD, Air Vehicle Mission Control and Management 16 p Mar. 1992 Sponsored by AFWAL
Copyright Avail: CASI HC A03/MF A03

A computationally efficient, real-time trajectory optimization and guidance approach for hypersonic aircraft is described. The optimization approach is based on Euler-Lagrange energy state approximations. A three-dimensional, spherical-earth, aircraft-motion model with constraints on temperature, dynamic pressure, acceleration, and angle of attack is employed. Climb-to-orbit, return-from-orbit, flight-to-designated-landing-site, unpowered-abort, and powered-abort flight conditions are considered. Different performance criterion are used for different problems. Solution methods of varying computational complexity and performance capability are developed. An exact solution to the optimization problem using iteration on adjoint variables is developed. This method is the most exact but is not suitable for on-board processing. However, it serves as the basis of performance comparison for the approximate methods. Approximate solution methods suitable for onboard guidance are developed for the climb-to-orbit problem and the flight-to-a-landing site problem. A computationally efficient method for generating footprints is described. Footprints are used to determine when to start final descent and to identify candidate landing sites under an air-breathing-engine or rocket-engine abort or other emergency conditions. A hypersonic-vehicle guidance, navigation, and control configuration of the complete optimal guidance scheme is described. Sensitivity analysis results are included for climb-to-orbit trajectories. The probability of achieving orbit using the optimal guidance scheme and a stored nominal approach are compared. Author

N92-27901# Electronic System G.m.b.H., Munich (Germany, F.R.).
AN EFFICIENT METHOD FOR THREE-DIMENSIONAL ROUTE PLANNING WITH DIFFERENT STRATEGIES AND CONSTRAINTS
U. LEUTHAEUSSER and F. RAUPP *In* AGARD, Air Vehicle Mission Control and Management 5 p Mar. 1992
Copyright Avail: CASI HC A01/MF A03

A method for planning paths through a digital map is presented. The task consists of planning 3-dimensional paths for autonomous air vehicles over a terrain represented by a digital map with different strategies and constraints. Possible strategies minimize time, danger, or fuel consumption. Constraints are lateral, and vertical maximum accelerations as well as time and fuel constraints. The path planning problem can be viewed as a shortest path problem (geodesic problem) in a space with a non-Euclidean metric depending on the applied strategy. One has to minimize a cost functional giving rise to the Hamilton-Jacobi equation which is solved by Dynamic Programming techniques. Because of the digitization bias, a second optimization step consisting of direct optimization methods is sometimes necessary. The result is a fast, non-heuristic and flexible technique for strategic route planning. Author

N92-27904# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
PARALLEL KNOWLEDGE BASED SYSTEMS ARCHITECTURES FOR IN-FLIGHT MISSION MANAGEMENT
M. R. BOWYER and S. A. CROSS *In* AGARD, Air Vehicle Mission Control and Management 12 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

The focus here is on the architectural approach, both in hardware and software, taken for the parallel DMuse project, and its applications to in-flight mission management. This includes a description of the Muse Real Time Intelligent Knowledge Based System (IKBS) toolkit as it now stands and the alterations necessary to provide this system on a multi-processor platform to produce the Distributed Muse (DMuse) toolkit. Author

N92-27905# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. of Flight Guidance.
IMPLEMENTATION AND OPERATIONAL EXPERIENCE WITH A NEW ARRIVAL TRAFFIC MANAGEMENT SYSTEM AT THE FRANKFURT ATC-CENTER
M. SCHUBERT and U. VOELCKERS *In* AGARD, Air Vehicle Mission Control and Management 17 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

The DLR-Institute for Flight Guidance had developed a new Arrival Traffic Management System called COMPAS (Computer Oriented Metering Planning Advisory System). The system has been implemented at the Frankfurt Regional Air Traffic Control Center in mid 1989 and is in continuous operation since then. A comprehensive implementation plan was developed in order to guarantee a smooth introduction, in particular with respect to both technical issues and controller acceptance. The experience gained and the lessons learned during the implementation process as well as the operational results are reported. Author

N92-27916# Krug Life Sciences, Inc., San Antonio, TX.
REFERENCE MODE EFFECT ON THE AUDITORY DISPLAY OF AIRCRAFT BANK ANGLE Final Report, 31 Aug. 1990 - 31 Aug. 1991
JAY C. NEUBAUER, DON C. TEAS, KENT K. GILLINGHAM, and PEG MURPHY Feb. 1992 31 p
(Contract F33615-89-C-0603)
(AD-A247825; AL-TR-1991-0121) Avail: CASI HC A03/MF A01

This report describes a study which examined flight performance of instrument rated pilots using only an auditory bank angle display with outside in and inside out display reference

modes. Spatial orientation is based on the evaluation of data from visual, vestibular, and other sensory mechanisms which provide information about motion and position relative to a stationary reference derived from walking upright on hard ground. Auditory and visual events are located by an observer within the orientational space. In an aircraft, the reference is no longer stationary and the evaluation of data from orientation mechanisms may be in error. These errors can lead to responses which, although intended to be corrective, actually are not. Visual information, for example, may be processed foveally, for recognition and identification of elements, or extrafoveally, for orientation in space. The two visual modes, recognition and guidance, can present conflicting, confusing orientation cues in aircraft. False horizons perceived while flying over water at night or over a sloping cloud bank are errors attributable to the guidance mode. Pilots sometimes accept these false cues as veridical and are unaware of the error until the true relation is recognized, perhaps too late. GRA

N92-27964# RDP, Inc., Waltham, MA.
VISUAL PHOTOMETRIC EXPERIMENT DATA PROCESSING SYSTEM Final Report, 23 Jan. 1987 - 31 Dec. 1991
KEVIN P. LARSON and ANDREW J. MAZZELLA, JR. 31 Dec. 1991 56 p
(Contract F19628-87-C-0065)
(AD-A248657; PL-TR-91-2248; SBI-AD-E200944) Avail: CASI HC A04/MF A01

Data processing and analysis developments for the Visual Photometric Experiment (VIPER) are described in detail, including descriptions of data files and program execution. GRA

N92-28079# New Brunswick Univ., Fredericton.
DREDGING RESEARCH PROGRAM: GLOBAL POSITIONING SYSTEM BIBLIOGRAPHY Final Report
WENDLYNN WELLS, DAVID E. WELLS, and ALFRED KLEUSBERG Mar. 1992 69 p
(Contract DAAL03-86-D-0001)
(AD-A248954; WES/TR/D-92-2) Avail: CASI HC A04/MF A01

This bibliography was prepared to supplement Technical Report DRP-92-1, Kinematic Differential Global Positioning System. The bibliography represents a current (as of March 1989) and comprehensive listing of publications and papers dealing with the Global Positioning System. GRA

N92-28132# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A FORMAL DEFINITION OF THE OBJECT-ORIENTED PARADIGM FOR REQUIREMENTS ANALYSIS M.S. Thesis
ANDREW D. BOYD Dec. 1991 90 p
(AD-A246814; AFIT/GSS/ENG/91D-3) Avail: CASI HC A05/MF A01

This paper develops a formal definition of the Object Oriented paradigm for requirements analysis. The literature was surveyed for both formal and informal methods for conducting an Object-Oriented Requirements Analysis (OORA). None of the methods were found to be adequate for doing an OORA. A formal definition of an OORA, based on the concept of classes, is developed. The definition itself is presented as set and relation theory. A supporting graphical representation is also developed and presented. The graphical method allows a system to be successfully leveled. The formalism is validated by applying it to the Air Traffic Control (ATC) simulation. GRA

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A92-41176
SOME ASPECTS OF ADVANCED AIRCRAFT DEVELOPMENT
ROSTISLAV A. BELIAKOV (Mikoian Design Bureau, Moscow, Russia) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 55-62.

The procedures used in the development of advanced military Soviet aircraft are discussed. Special attention is given to the basics of the main conceptual approaches used in the development of new aircraft, the work sequence, and the structure of the Integrated Purpose-Oriented Program of Scientific Research and Prototype Development program organized for the development of advanced fighters. A list of main systems and complex manufacturers is presented along with data on the world-class records of the MIG aircraft. I.S.

A92-41218* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EFFECTS OF HIGHER HARMONIC CONTROL ON ROTOR PERFORMANCE AND CONTROL LOADS
KHANH NGUYEN (NASA, Ames Research Center, Moffett Field, CA) and INDERJIT CHOPRA (Maryland, University, College Park) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 336-342. Previously cited in issue 11, p. 1614, Accession no. A90-29467. refs
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A92-41222
CONTROL STRATEGY FOR MAXIMIZING RECONNAISSANCE RANGE OF HYPERSONIC CRUISE VEHICLES
H. G. KAUFFMAN, R. V. GRANDHI, W. L. HANKEY, and P. J. BELCHER (Wright State University, Dayton, OH) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 360-365. Previously cited in issue 22, p. 3494, Accession no. A90-48876. refs
(Contract F33615-87-C-1550)
Copyright

A92-41233
APPLICATION OF ACTIVE FLEXIBLE WING TECHNOLOGY TO THE AGILE FALCON
EDMUND PENDLETON, MARK LEE (USAF, Wright Laboratory, Wright-Patterson AFB, OH), and LEE WASSERMAN (Delta Dynamics, Inc., Dayton, OH) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 444-451. Previously cited in issue 12, p. 1921, Accession no. A91-32018. refs

A92-41239* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL STRUCTURES - FOUR DECADES OF PROGRESS
EARL A. THORNTON (Virginia, University, Charlottesville) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 485-498. Research supported by NASA. Previously cited in issue 11, p. 1613, Accession no. A90-29305. refs
Copyright

A92-41243
EFFECT OF THRUST VECTORING ON LEVEL-TURN PERFORMANCE
PAI-HUNG LEE (Aeronautical Research Laboratory, Taichung, Republic of China) and C. E. LAN (Kansas, University, Lawrence) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 509-511. refs
Copyright

An analytical method is presented to determine the effect of thrust-vectoring on level-turn performance, with reference to

well-understood F-5E fighter aerodynamic performance. It is shown that different optimal thrust-deflection angles exist for the sustained maximum load factor, turn rate, and minimum turn radius. While thrust vectoring-based gains in load factor and turn rate were, respectively, 2 and 3 percent, at thrust/weight of 0.77 and 5000-ft altitude, the corresponding gains rose to 6 and 5 percent, respectively, at a thrust/weight value of 1.0. O.C.

A92-41263* *National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.*
ADEQUACY OF MODELING TURBULENCE AND RELATED EFFECTS ON HELICOPTER RESPONSE
V. V. GEORGE, G. H. GAONKAR (Florida Atlantic University, Boca Raton), J. V. R. PRASAD, and D. P. SCHRAGE (Georgia Institute of Technology, Atlanta) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1468-1479. refs
(Contract NCA2-512)
Copyright

'Blade-fixed' atmospheric turbulence encountered by a helicopter substantially differs from body-fixed (i.e., fuselage) turbulence, because the rotational velocity moves the blade station fore and aft through the turbulence. The present closed-form solution of a frequency-time spectrum for the dominant vertical turbulence velocity at arbitrary blade station defines in what way and in what degree the rotational velocity affects rotor-disk turbulence frequency and temporal characteristics. Blade-flapping response to blade- and body-fixed turbulence is also presented over a range of turbulence-scale length and advance ratio. O.C.

A92-43046
CHAOTIC STALL RESPONSE OF HELICOPTER ROTOR IN FORWARD FLIGHT
D. M. TANG and E. H. DOWELL (Duke University, Durham, NC) Journal of Fluids and Structures (ISSN 0889-9746), vol. 6, no. 3, May 1992, p. 311-335. refs
(Contract DAAL03-87-K-0023)
Copyright

A typical evolution process for rotor blade stall response from periodic to aperiodic or chaotic motion and a necessary condition for the onset of chaotic response are discussed. This is the first such study of chaotic motion due to aerodynamic stall of a helicopter blade in the literature. For this study, the ONERA nonlinear aerodynamic stall model is applied to the analysis of helicopter blade stall response. Nonlinear state variable equations and linear state variable perturbation equations are derived and solved. Also, a comparison between the results from the ONERA stall and a simpler nonlinear aerodynamic model is made.
Author

A92-43100* *National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.*
HELICOPTER AEROELASTIC STABILITY AND RESPONSE - CURRENT TOPICS AND FUTURE TRENDS
PERETZ P. FRIEDMANN (California, University, Los Angeles) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 18-46. refs
(Contract NAG2-209; NAG2-477)

This paper presents several current topics in rotary wing aeroelasticity and concludes by attempting to anticipate future trends and developments. These topics are: (1) the role of geometric nonlinearities; (2) structural modeling, and aeroelastic analysis of composite rotor blades; (3) aeroelastic stability and response in forward flight; (4) modeling of coupled rotor/fuselage aeromechanical problems and their active control; and (5) the coupled rotor-fuselage vibration problem and its alleviation by higher harmonic control. Selected results illustrating the fundamental aspects of these topics are presented. Future developments are briefly discussed. Author

A92-43118
OPTIMIZATION OF BLADE STRUCTURE TO REDUCE ROTOR VIBRATION
MASATO TOKI, K. NAGAI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and HIROSHI SUGIMOTO (Muroran Institute of Technology, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 120-123. In Japanese. refs

Helicoptor blade structural optimization is presented. Rotor vibration is calculated taking aeroelasticity into account. The optimization flow chart is presented and the optimal distribution of blade spanwise location is discussed. Y.P.Q.

A92-43138
OPERATIONAL PROGRESS OF THE STOL RESEARCH AIRCRAFT ASUKA
MAKOTO SASAKI, SHIZUO SEKINE (National Aerospace Laboratory, Chofu, Japan), HIROKAZU MIYATAKE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and H. MATSUOKA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 200-203. In Japanese. refs

The operational progress and FJR710/600S engine of the STOL research aircraft Asuka are presented. Flight tests of the STOL aircraft for engine operation including payload operation and engine overhaul are discussed. The improved design of the FJR710/600S engine is emphasized. Y.P.Q.

A92-43140
STOL RESEARCH AIRCRAFT ASUKA FLIGHT ANALYSIS IN CONNECTION WITH THE OPERATION OF THE MONITORING SYSTEM
K. YAZAWA and T. SHIMOMURA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 208-211. In Japanese. refs

The real-time monitor system for the flight test of the STOL research aircraft Asuka is presented. The data process analysis system for STOL is addressed. The operational process of the flight test center is illustrated. Y.P.Q.

A92-43142
FLIGHT TEST RESULTS AND UPPER SURFACE BLOWING (USB) TECHNOLOGY OF THE STOL RESEARCH AIRCRAFT ASUKA
TOSHIO BANDO, NORIAKI OKADA, SUKEYUKI TERUI (National Aerospace Laboratory, Chofu, Japan), H. OWA (Tokyo, University, Japan), MASAMICHI KURIYAMA, YOSHINARI TOBINAGA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 220-227. In Japanese.

The vertical aerodynamic characteristics of the STOL research aircraft Asuka have been evaluated. A comparison between flight test result and wind tunnel test results is presented. The effectiveness of boundary layer control is described. Y.P.Q.

A92-43143
FLIGHT TESTS ON THE STRUCTURES OF THE STOL RESEARCH AIRCRAFT ASUKA
MASAAKI SANO, MASATAKA HAKUI (National Aerospace Laboratory, Chofu, Japan), TOYO SHIMOMURA, and H. AONO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 228-231. In Japanese. refs

Data on the structural strength of the STOL research aircraft Asuka are presented. Data on the flight performance are analyzed. Measurements of flight payload, local stress, and vibration are presented. Y.P.Q.

A92-43149
THE LANDING EQUIPMENT OF A HIGH-TECH AIRCRAFT
TAKEO KIKUCHI (All Nippon Airways Co., Ltd., Tokyo, Japan)

IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 256-259. In Japanese.

The landing system for a large jet aircraft is presented. The thermal resistance of the brake is discussed, and the tire characteristics are examined. Y.P.Q.

A92-43189
THE RELATIONSHIP BETWEEN THE WEIGHT AND FLIGHT CHARACTERISTICS OF A TRANSONIC AIRCRAFT
KENJI KARASAWA and KANICHIRO KATO (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 420-423. In Japanese. refs

The blast wind response of a transonic aircraft is evaluated. The structures of the simulated flight equipment are discussed. The relation between the weight and flight characteristics is examined. Y.P.Q.

A92-43242
THE CONCEPT OF AN UNMANNED FLYING VEHICLE AT HIGH ALTITUDE
M. ONDA, YASUSHI MORIKAWA, and K. MATSUDA (Mechanical Engineering Laboratory, Tsukuba, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 632-635. In Japanese. refs

Characteristics of various kinds of air platforms are examined. The configurations and structure of the unmanned flying vehicle at high altitude are presented. Problems such as airframe structure, wind drag reduction, energy supply, and vehicle recovery are discussed. Y.P.Q.

A92-43243
REEVALUATION OF THE MOTION OF AN AIRSHIP
UYAKO NITTA and S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 636-639. In Japanese. refs

The aerodynamic characteristics and configurations of an airship are presented. Results are presented on the Skyship 500. Y.P.Q.

A92-43244
SMALL AND COST-EFFECTIVE AIRSHIP FOR TRANSPORTATION
S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 640-643. In Japanese. refs

Such characteristics as the number of ground support personnel, airport size, and advertising revenue are discussed for a small airship. A calculation method for direct operating cost (DOC) is discussed, and the configurations of various kinds of airships are discussed. Y.P.Q.

A92-43546
747-400 UPPER RUDDER CONTROL SYSTEM
Aerospace Engineering (ISSN 0736-2536), vol. 12, no. 6, June 1992, p. 11-14.
Copyright

A thorough development program and system evaluation were conducted to significantly reduce the risk associated with modifying the 747-400 airliner's upper rudder, in order to furnish the enhanced control authority required in the one-engine-out condition upon incorporation of more powerful engines. The triple-tandem valve developed furnishes excellent synchronization of all actuators. Attention is given to ground-testing of the device configuration. O.C.

A92-44547# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
THE F/A-18 EXTERNAL BURNING FLIGHT TEST
C. YUNGKURTH (Johns Hopkins University, Laurel, MD), F. DAWSON, S. HOUCK (U.S. Navy, Naval Air Test Center, Patuxent River, MD), S. CORDA (NASA, Flight Research Center, Edwards, CA), and C. TREFNY (NASA, Lewis Research Center, Cleveland, OH) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 16 p. refs
(AIAA PAPER 91-5050) Copyright

A flight test program was undertaken to demonstrate the feasibility of obtaining external burning (EB) data in a flight environment, and to address the question of facility interference in ground test external burning data. Results showed that external burning was effective at reducing transonic base drag in a flight environment having dynamically changing conditions. The flight test program demonstrated that external burning is not just a laboratory phenomenon but is a viable technology for aerospace vehicles. Author

N92-26435*# Notre Dame Univ., IN.
GAMMA GROUP-THE PALE HORSE: A PROPOSAL IN RESPONSE TO A COMMERCIAL AIR TRANSPORTATION STUDY ORT STUDY Final Design Proposal
T. EHLER, J. HAWKINS, J. NEWELL, M. OHARA, KARL SCHUDT, G. SOHA, and S. VANDENBERG May 1991 80 p Sponsored in part by Boeing Commercial Airplane Co.
(Contract NASW-4435)
(NASA-CR-190019; NAS 1.26:190019) Avail: CASI HC A05/MF A01

A conventional remotely piloted vehicle (RPV) was designed to operate in a fictional 'Aeroworld' as a 30 passenger aircraft. The topics addressed include: economic/cost analysis, aerodynamics, weight and structures, propulsion, stability and control, and performance. Author

N92-26655*# Massachusetts Inst. of Tech., Cambridge. Technology Lab. for Advanced Composites.
COMPOSITE FUSELAGE TECHNOLOGY (SUMMARY OF YEAR 2) Annual Report, 7 Apr. 1990 - 6 Apr. 1991
MICHAEL J. GRAVES and PAUL A. LAGACE Dec. 1991 38 p
(Contract NAG1-991)
(NASA-CR-190434; NAS 1.26:190434; TELAC-91-17) Avail: CASI HC A03/MF A01

The overall objective of this work is to identify and understand, via directed experimentation and analysis, the mechanisms which control the structural behavior of fuselages in their response to damage (resistance, tolerance, and arrest). A further objective is to develop straightforward design methodologies which can be employed by structural designers in preliminary design stages to make intelligent choices concerning the material, layup, and structural configuration so that a more efficient structure with structural integrity can be designed and built. Author

N92-26673# Rand Graduate Inst. for Policies Study, Santa Monica, CA.
THE LOCKHEED F-117A
CLAYTON K. S. CHUN 1991 15 p
(RAND-P-7746-RGS) Avail: CASI HC A03/MF A01

How the U.S. Air Force's F-117A tactical fighter embodies stealth technology is explored. First, a background on the aircraft is provided. Second, the F-117A's ability to avoid visual, radar, sound, and heat detection is examined. Finally, some possible policy implications for the Air Force's use of the F-117A today and in the future are investigated. Author

N92-26896# Naval Postgraduate School, Monterey, CA.
COMPUTER PROGRAM FOR CALCULATING IN-FLIGHT AIRCRAFT-STORE INTERFACE REACTION LOADS M.S. Thesis
STEPHEN A. MODZELEWSKI Dec. 1991 112 p
(AD-A245782) Avail: CASI HC A06/MF A02

This thesis utilizes Military Specification, Mil-A-8591H, to provide and document a new computer program for calculating store reaction forces, due to inertial loads and airloads, at the aircraft-store interface. Due to the fact that the store is a statically indeterminate structure with unknown flexibility characteristics, the

analysis to calculate the reaction forces is a relatively complex problem. The program was written to incorporate new requirements and techniques for calculating reaction loads at the aircraft-store interface, in accordance with Mil-A-8591 revision H. This computer program was developed to be used on the VAX/MS Computer System. A detailed User's Manual which is included in Appendix A of this thesis was written to accompany the computer program. The computer program will enable graduate students in the Aircraft, Helicopter, and Missile Design courses to utilize current military specifications for preliminary design and weapon system integration. GRA

N92-26944# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abt. Aerodynamik und Flugmechanik.
SEPARATION OF EXTERNAL STORES: COMPARISON OF RESULTS
H. AFFOLTER 12 Feb. 1991 53 p In GERMAN; ENGLISH summary
(F+W-TF-2058; ETN-92-90820) Avail: CASI HC A04/MF A01

Different methods allowing prediction of the separation behavior of external stores from an aircraft are presented. The separation of two different external fuel tanks from a Mirage 3 aircraft is shown, and the results of the different methods are compared. The separation behavior predicted by wind tunnel tests and computer calculations is confirmed with good accuracy in flight tests. ESA

N92-27185# Department of the Navy, Washington, DC.
HIGH LIFT AIRCRAFT Patent
EDWARD E. BETTS, inventor (to Navy) 10 Dec. 1991 16 p Filed 29 Nov. 1989
(AD-D015215; US-PATENT-5,071,088;
US-PATENT-APPL-SN-453658; US-PATENT-CLASS-244-12.1)
Avail: US Patent and Trademark Office

A high lift vertical takeoff and landing aircraft has first and second fuselages connected by a central airfoil. Jet engines at the leading edge of the airfoil expel propulsive stream simultaneously over top and bottom surfaces of the foil. Extendable flaps are utilized at a trailing edge of the airfoil with a horizontal control blade being attached to the leading edge of the foil. The control blade is within the jet's propulsive stream to permit proportioning of the stream above and below the airfoil. An extendable augmenter wing is attached between the fuselages aft and above the main airfoil to permit airflow in this region to be directed downwardly, accelerating the flow and providing additional lift. The main airfoil is positioned so that the fuselage walls extend above and below the foil. Lateral flow of the main engine exhaust is restrained by these walls. Above the wing walls and airfoil create a venturi to speed airflow and decrease pressure. Below the wing the walls and extended flaps dam exhaust and ambient flow to create a high pressure region. Outboard wings provide secondary lift and reduce main wing loading. A canard is attached between the fuselages to provide pitch control. Both top and bottom canard surfaces are blown by forward mounted engines or exhaust ducts to add lift to the aircraft and to permit upward tilting of the aircraft during takeoff and landing. GRA

N92-27188 Department of the Navy, Washington, DC.
PNEUMATICALLY ACTUATED MULTIPLE STORE LAUNCHER Patent
FRANK P. MARSHALL, inventor (to Navy) and BRUCE W. TRAVOR, inventor (to Navy) 10 Dec. 1991 6 p Filed 30 Oct. 1990
(AD-D015237; US-PATENT-5,070,760;
US-PATENT-APPL-SN-605902; US-PATENT-CLASS-89-1.51)
Avail: US Patent and Trademark Office

The present invention discloses a pneumatically actuated, multi-store dispenser wherein a discharge of gas causes sequential launching of stores from their tandem position inside a launch container. In some environments, it is desirable to dispense multiple store, for instances sonobuoys, in dense patterns from a launch vehicle that carries an abundant supply of pneumatic gas. Due to physical limitations of space in the dispensing vehicle, an effort was made to miniaturize the active components inside the store and therefore reduce the overall outer dimensions thereof. Once the size of the store was reduced, in order to meet the demands of the denser patterns, the inside of the individual launch containers were modified to allow each to hold and dispense more than one store. This new type of launch container, in addition to maintaining the size requirement dictated by the transporting vehicle's pneumatic system. GRA

N92-27335# Naval Postgraduate School, Monterey, CA.
A WIND TUNNEL STUDY OF THE PIONEER REMOTELY PILOTED VEHICLE M.S. Thesis
ROBERT M. BRAY Jun. 1991 144 p
(AD-A247028) Avail: CASI HC A07/MF A02

Remotely Piloted Vehicles (RPVs) performed impressively well in the recent Gulf War. The Pioneer RPV has been fielded as the ground launched, short-range RPV for the Marine Corps and as a RATO-launched, short-range RPV operating off of the Navy's battleships. A realistic flight simulation of the Pioneer RPV for training system operators was desired. A 0.4 scale model of the Pioneer RPV was tested in the Wichita State University 7 by 10 foot wind tunnel to acquire its aerodynamic coefficients. A collateral benefit was the calculation of the Pioneer RPV's flight performance. Graphs and tables of the stability and control derivatives necessary for a 'six degree of freedom' simulation are included in this thesis. Additionally, performance predictions were calculated using these newly acquired aerodynamic data and engine test data from the Naval Air Propulsion Center. Preliminary comparisons indicate good correlation between the wind tunnel based performance predictions and actual flight data. GRA

N92-27429# National Aerospace Lab., Tokyo (Japan). Flight Research Div.
NAL DORNIER 228-200 FLIGHT RESEARCH AIRPLANE: PRESENT STATUS AND OUTLINE OF THE INSTALLED EQUIPMENT
TAKATSUGU ONO Jul. 1991 56 p In JAPANESE; ENGLISH summary Original contains color illustrations
(ISSN 0452-2982)
(NAL-TM-637; JTN-92-80375) Avail: CASI HC A04/MF A01

An outline is presented concerning the present status of the Dornier 228-200, a NAL flight research airplane introduced in 1988. A description is given of the plane's introduction process, modifications, currently installed equipment and ground support system, and typical flight data. Technical information is provided which will be useful for planning various kinds of future flight experiments. Author (NASDA)

N92-27719# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
AN ANALYSIS OF FIXED WING TACTICAL AIRLIFTER CHARACTERISTICS USING AN INTRA-THEATER AIRLIFT COMPUTER MODEL M.S. Thesis
PAUL PAPPAS Sep. 1991 186 p
(AD-A246908; AFIT/GLM/ENS/91S-50) Avail: CASI HC A09/MF A02

This study used computer simulation to identify which tactical airlifter characteristics most significantly affected tactical airlift capability in a given scenario. The Generalized Air Mobility model was used to simulate a tactical airlift system. Aircraft characteristics within the model were grouped into six variables. A 2(exp 6) two level full factorial experimental design was used to assess the effect of changes in aircraft characteristics on the effectiveness of the tactical airlift system. The Yates algorithm was used to identify significant terms based upon the results of the factorial experiment. These significant terms were used to develop a parsimonious regression model that represented the response function of the experimental variables. The variables remaining in the regression model represented the tactical airlifter characteristics that most significantly affected the capability of the tactical airlift system. Only one scenario was used in the experiment: Central America. This scenario was characterized by a tropical mountainous environment, poor infrastructure, a limited number of major airfields,

and many short unprepared airfields. Two groups of tactical airlifter characteristics were found to significantly affect capability of the tactical airlift system in this scenario: The size of the aircraft's cargo bay, and the aircraft's ability to operate on unprepared surfaces. GRA

N92-27870# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON FLYING QUALITIES
HAROLD ANDREWS (Aviation Systems and Research, Arlington, VA.) Apr. 1992 22 p
(AGARD-AR-311; ISBN-92-835-0665-0) Copyright Avail: CASI HC A03/MF A01

The validity of constraining the responses of today's control dominant aircraft to conform to the classic flying qualities criteria derived from stability dominant aircraft experience has been an issue for many years. The introduction of full time visual scene enhancement with sensor fusion, and computer generated/interpreted night scenes, and the use of integrated flight and propulsion control schemes and direct force controllers have expanded flight envelopes, reduced drag, increased maneuverability, provided the framework for practical gust alleviation and active flutter suppression, and provided flexibility for fault-tolerant, damage-adaptive flight controls. However, the updating of flying qualities criteria has in general not kept pace with these technological changes. The Flight Mechanics Panel of AGARD therefore decided to organize a Symposium to review flying qualities issues today, and to report progress towards their resolution. The topic areas included: Flying Qualities Experiences on Contemporary Aircraft; Application of Flying Qualities Specifications; Flying Qualities Research and Flying Qualities at High Incidence. This Technical Evaluation Report evaluates the presentations and discussions in each Session, draws relevant conclusions and makes recommendations for future activities in this area. The papers presented at this Symposium are published as AGARD Conference Proceedings 508. Author

N92-28118# Aeronautical Research Labs., Melbourne (Australia).
A PRELIMINARY STUDY ON DAMAGE DETECTION USING PIEZOELECTRIC FILM
J. BENNETT, J. PAUL, R. JONES, and A. GOLDMAN Nov. 1991 29 p
(AD-A246350; ARL-STRUC-TM-538; DODA-AR-006-620) Avail: CASI HC A03/MF A01

Damage detection in metallic and composite structural components is of particular importance in the damage tolerant assessment and the maintenance of aircraft structures. This report describes the use of piezoelectric film for sensing damage in a number of structural components. Three specimens were evaluated, viz.: (1) a rivetted lap joint; (2) a surface crack in an aluminum alloy; (3) an impact damaged composite laminate. The lap joint was chosen to be representative of a fuselage lap joint in modern, wide bodied aircraft. The joint contained multi-site damage repaired with a bonded doubler. Piezoelectric film was applied to the doubler and the underlying damage was detected. The second specimen was a conventional aluminum alloy with surface flaws emanating from a fastener hole. The last specimen was a graphite epoxy composite laminate with impact damage at two locations, i.e., multiple damages sites. GRA

N92-28123# Naval Postgraduate School, Monterey, CA.
FLIGHT TESTING OF A HALF-SCALE REMOTELY PILOTED VEHICLE M.S. Thesis
PAUL A. KOCH Mar. 1992 62 p
(AD-A248568) Avail: CASI HC A04/MF A01

Flight testing of a half-scale Pioneer remotely piloted vehicle was conducted to determine the longitudinal static stability flying qualities. A pulsewidth modulated telemetry system was used to provide data on control surface deflections, angle of attack, sideslip angle, and airspeed. From the testing, the neutral point was determined to be 41.2 percent of mean aerodynamic chord, which was within 13 percent of theoretical predictions. On a subsequent flight, the Pioneer experienced electromagnetic interference which caused the disruption of the flight control uplink signal, causing it to fly uncontrolled into the ground. Simultaneous playback of video and time histories of downlink data was instructional in analyzing the interference leading to the accident. GRA

N92-28153# National Aerospace Lab., Tokyo (Japan). Flight Test Team.
EVALUATION OF HIGH LIFT DEVICES OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA
TOSHIO BANDOU Apr. 1991 33 p In JAPANESE; ENGLISH summary
(ISSN 0389-4010)
(NAL-TR-1102; JTN-92-80379) Avail: CASI HC A03/MF A01

The powered high lift device of the ASKA, the NAL Short Take Off and Landing (STOL) experimental aircraft, is an Upper Surface Blowing (USB) device that forces the jet exhaust flow downward, thus producing higher lift due to the Coanda effect. Three pieces of equipment were incorporated that enhanced the USB high lift generation: Boundary Layer Control (BLC), drooped ailerons, and vortex generations. The aerodynamic effects of these equipment are described based on flight test data. In early flight test stages, a shallow ASKA USB flap configuration encountered buffeting, beginning at a lower angle of attack than expected, thereby limiting the flight envelope. Based on the wind tunnel test surveys, a nacelle fence and drooped leading edge were subsequently installed to delay the buffet onset. The effect of these devices is also discussed based on flight test results.
Author (NASDA)

N92-28191# National Aerospace Lab., Tokyo (Japan). Flight Test Team.
EVALUATION OF LANDING CONFIGURATION BY FLIGHT TEST OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA
TOSHIO BANDOU May 1991 58 p In JAPANESE; ENGLISH summary
(ISSN 0389-4010)
(NAL-TR-1113; JTN-92-80382) Avail: CASI HC A04/MF A01

During the design phase of NAL Short Take Off and Landing (STOL) experimental aircraft, ASKA, the landing configuration was determined to be a 40 degree Upper Surface Blowing (USB) flap angle and a 65 degree outboard flap angle, whereas the design phase go around configuration was specified as a 20 degree USB flap angle, a 65 degree outboard flap angle, and leading edge Boundary Layer Control (BLC) off. Based on the results of alpha sweep tests and landing evaluations, it was determined that the design landing configuration had a small alpha-margin and high pitch attitude which produced poor downward viewing during approach and landing. The alpha-margin of the design go around configuration was also respectively small. Subsequently, flight tests were conducted to determine new configurations for landing and go around, and using these test results, a 60 degree USB flap angle was selected for the landing configuration and a 30 degree USB flap angle was for the go around one. A 65 degree outboard flap angle with all BLC on was also decided for both configurations. The process of determining these final configurations using flight tests and evaluations is discussed. Author (NASDA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A92-41431
MODULATION TRANSFER FUNCTION DEGRADATION IN SEGMENTED WINDOWS
JAMES I. GIMLETT (McDonnell Douglas Electronic Systems Co.,

Santa Ana, CA) Applied Optics (ISSN 0003-6935), vol. 31, no. 16, June 1, 1992, p. 2981, 2982. refs
Copyright

The drop in MTF in segmented windows that CODE V predicted is verified. Segmented windows are found to degrade the modulation MTF of high-acuity sensors unless the optical thicknesses of the individual panes are carefully matched. If the panes are tilted with respect to each other, then the loss must be accepted, as there is no way to match optical thicknesses for all angles of incidence. P.D.

A92-41928
EXPERIMENTAL TECHNIQUE OF MEASURING FUEL CONCENTRATION IN NON-UNIFORM FLOWFIELD

YEPING FAN (Nanjing Aeronautical Institute, People's Republic of China), WENJIE SHI, and JUNYUAN WANG (Shenyang Liming Co., People's Republic of China) Nanjing Aeronautical Institute, Journal (ISSN 1000-1956), vol. 24, no. 2, April 1992, p. 208-215. In Chinese.

The design of a sampling probe which can simultaneously measure the distribution of the velocity, fuel concentration, and temperature in a nonuniform flowfield and corresponding test system is presented. The measuring error and other system features are discussed. The fuel concentration distribution, velocity distribution, and temperature distribution are measured in the nonuniform flowfield of low and high temperatures. The fuel concentration measuring errors are +/- 10 percent at low temperature and +/- 6 percent at high temperature. C.D.

A92-42602* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
WAVELENGTH-MULTIPLEXED FIBER-OPTIC POSITION ENCODER FOR AIRCRAFT CONTROL SYSTEMS

GLENN BEHEIM, MICHAEL J. KRASOWSKI, JORGE L. SOTOMAYOR (NASA, Lewis Research Center, Cleveland, OH), KLAUS FRITSCH, JOSEPH M. FLATICO, RICHARD L. BATHURST, JOHN G. EUSTACE (John Carroll University, Cleveland, OH), and DONALD J. ANTHAN (Cleveland State University, OH) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 50-59. refs
Copyright

NASA-Lewis has developed wavelength-multiplexed digital position fiber-optics transducers for use in aircraft control systems. A prototype LED-powered rotary encoder for a commercial aircraft turbofan engine is under construction which will have 8-bit resolution and an operational temperature in the 90 C range. A compact electrooptics module is also under development which will be able to withstand gas turbine environments. A second-generation device will incorporate integrated photonics technologies to increase optical power margin. O.C.

A92-42603
EFFICIENCY OF A 5V/5MW POWER BY LIGHT POWER SUPPLY FOR AVIONICS APPLICATIONS

BRADLEY D. SHERMAN (Douglas Aircraft Co., Long Beach, CA), ANTONIO J. MENDEZ, and JOHN-MICHAEL MOROOKIAN (Southern California, University, Los Angeles, CA) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 60-66. refs
Copyright

A 5V/5mW power by light (PbL) power supply has been designed and developed. The design is based on a 50mw, 800nm laser diode, a segmented GaAs photocell, and a dc/dc converter which acts as a voltage regulator. This paper discusses the system concept and elements as well as the measured efficiencies of the components and the system configuration. The paper also discusses the scalability of the design concept. Author

A92-43139
OPERATION OF THE ON-BOARD MEASURING SYSTEM OF THE STOL RESEARCH AIRCRAFT ASUKA

T. OKA, YOSHIO SAKURAI (National Aerospace Laboratory, Chofu, Japan), T. YUTO, and H. OKADA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 204-207. In Japanese. refs

The structure of the measuring sensor and the on-board measuring system for the Asuka aircraft are described. Fault control and maintenance procedures are reported. Y.P.Q.

A92-43150
INTRODUCTION TO THE TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) III

M. SHIRAKAWA, K. OSE, and TOYO FUKUDA (Ministry of Transport, Electronic Navigation Research Institute, Mitaka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 260-263. In Japanese. refs

The signal system, azimuth derivation accuracy, and azimuth error monitoring of the traffic alert and collision avoidance system (TCAS) III is introduced. The collision avoidance algorithm and avoidance modeling are discussed. Y.P.Q.

A92-43151
THE TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) FOR AIR NAVIGATION

YUKIO OYANAGI (All Nippon Airways Co., Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 264-267. In Japanese.

Features of the traffic alert and collision avoidance system (TCAS) are presented. The improvement plan for the TCAS is given and the TCAS data acquisition system and crewmember training are described. Y.P.Q.

A92-43208
DEVELOPMENT OF THE D-SIZE LIQUID CRYSTAL FLAT PANEL DISPLAY FOR AIRCRAFT

TATSUO SHIMIZU, KENJI MATSUMURA, and O. OYAMA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 496-499. In Japanese. refs

The functions and performance of the D-size liquid crystal flat panel display (FPD) are presented. The brightness distribution of the pixel pattern of a high-resolution CRT discussed. Evaluations using the primary flight display and the digital map display are described. Y.P.Q.

A92-43209
EVALUATION TEST ON THE SIMULATOR OF THE LIQUID CRYSTAL FLAT DISPLAY. II

HIROYASU KAWAHARA, AKIRA WATANABE, KAORU WAKAIRO (National Aerospace Laboratory, Chofu, Japan), TATSUO SHIMIZU, KENJI MATSUMURA, and O. OYAMA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 500-503. In Japanese. refs

The characteristics and performance of the liquid crystal display (LCD) panel are presented. The flight simulation test signal system and primary flight display (PFD) and map display system are illustrated. The flight simulator motion model is discussed. Y.P.Q.

A92-43217
DISPLAY TRENDS IN AIRCRAFT COCKPITS

M. SHIBATA (Japan Defense Agency, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 532-535. In Japanese.

The cockpit display and man-machine interface of aircraft are presented. The performances of various display devices are analyzed, such as the flat panel display (FPD), the liquid crystal

display (LCD), HUD, and CRT. Projected future cockpit systems are also considered. Y.P.Q.

A92-43220
RESEARCH ON A HELICOPTER INFORMATION CONTROL SYSTEM
SHUICHI YOKOKURA (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 544-547. In Japanese. refs

An analytical method for a helicopter information control system is presented. The structure of the system is illustrated, and model-evaluation results of the system are described. Y.P.Q.

A92-43221
ADVANCED DISPLAY SYSTEM FOR AN AIRCRAFT PAYLOAD
TOSHIJI OHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 548-551. In Japanese. refs

A man-machine interface system for aircraft control is presented. The effectiveness of the advanced display system is described and the flat panel display (FPD) and HUD system are addressed. A comparison between liquid crystal display (LCD) and CRT is made. Y.P.Q.

A92-43222
CURRENT STATUS AND FUTURE TASKS OF A COCKPIT LIQUID CRYSTAL DISPLAY
RYOJI YAMADA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 552-555. In Japanese. refs

The development of a cockpit LCD is discussed. The display qualities of the LCD are examined, considering the characteristics of the man-machine interface. Computer processing is applied to achieve the required brightness and color of the LCD. Y.P.Q.

A92-43224
DEMONSTRATION PERFORMANCE OF AN AIRCRAFT LIQUID CRYSTAL DISPLAY
K. IKEDA, E. AWAMURA, and S. YAMAMOTO (Tokyo Aircraft Instrument Co., Ltd., Komae, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 560-563. In Japanese. refs

The performance of an on-board liquid crystal display (LCD) is discussed. The LCD is compared with the CRT in terms of brightness, color, contrast, and visual field is discussed. The brightness distribution is examined. Y.P.Q.

A92-43225
DIGITAL MAPPING DISPLAY TECHNOLOGY
ICHIZO KOBAYASHI (Toshiba Corp., Kawasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 564-567. In Japanese.

An aircraft digital mapping display system (DMS) is discussed, with particular attention given to the man-machine interface. The characteristics of the DMS are described, and the topographic display method is discussed. Y.P.Q.

N92-27424*# Massachusetts Inst. of Tech., Cambridge. Aeronautical Systems Lab.
EXPERIMENTAL EVALUATION OF CANDIDATE GRAPHICAL MICROBURST ALERT DISPLAYS Interim Annual Report
CRAIG R. WANKE and R. JOHN HANSMAN Jun. 1992 29 p
Previously announced in IAA as A92-25745
(Contract NASA ORDER L-91172-C; F19628-90-C-0002; RTOP 505-64-12-01)
(NASA-CR-189633; NAS 1.26:189633; ASL-91-2) Avail: CASI HC A03/MF A01

A piloted flight simulator experiment was conducted to evaluate issues related to the display of microburst alerts on electronic cockpit instrumentation. Issues addressed include display clarity, usefulness of multilevel microburst intensity information, and whether information from multiple sensors should be presented separately or 'fused' into combined alerts. Nine active airline pilots of 'glass cockpit' aircraft participated in the study. Microburst alerts presented on a moving map display were found to be visually clear and useful to pilots. Also, multilevel intensity information coded by colors or patterns was found to be important for decision making purposes. Pilot opinion was mixed on whether to 'fuse' data from multiple sensors, and some resulting design tradeoffs were identified. The positional information included in the graphical alert presentation was found useful by the pilots for planning lateral missed approach maneuvers, but may result in deviations which could interfere with normal airport operations. A number of flight crew training issues were also identified. Author

N92-27906# McDonnell Aircraft Co., Saint Louis, MO.
ICAAS PILOTED SIMULATION EVALUATION
R. P. MEYER, R. J. LANDY, and D. J. HALSKI *In* AGARD, Air Vehicle Mission Control and Management 16 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

Described here are the Integrated Control and Avionics for Air Superiority (ICAAS) piloted simulation evaluations, along with the system development leading up to the simulations and the data analysis plan for evaluating simulation results. The ICAAS advanced development program is sponsored by the United States Air Force Wright Laboratory at Wright Patterson Air Force Base, Ohio. A research and development contract was awarded to the McDonnell Aircraft Company, St. Louis, Missouri, in September 1987. The program objective is to develop, integrate and demonstrate critical technologies which will enable United States Air Force tactical fighter 'blue' aircraft to kill and survive when outnumbered as much as four to one by enemy 'red' aircraft during air combat engagements. Primary emphasis is placed on beyond visual range (BVR) combat with provisions for effective transition to close-in combat. An overview is given of the ICAAS system and its functions. The hardware elements needed to implement the ICAAS system are described and require high throughput parallel processing Reduced Instruction Set Computer (RISC) computers and an advanced 'glass' cockpit. The development of the ICAAS system is discussed as it moved from rapid prototyping to unit testing of attack management and flight Management software and finally into hardware software integration testing prior to manned simulation. The Data Analysis plan for reducing piloted simulation results to assess system performance is described. The evaluation of the ICAAS system performance encompasses not only integrated system performance but also performance of individual ICAAS subsystems as they are reflected by measures of situation awareness, flight management utilization, weapon utilization and sensor effectiveness. This includes use of multiple measures of performance as well as univariate and multivariate analyses to assess ICAAS system performance. Author

N92-27925# General Dynamics Corp., Fort Worth, TX.
CORE AVIONICS AND STANDARDIZATION Final Report, 23 Sep. 1991 - 31 Mar. 1992
DAVID L. KELLOG, J. K. HENDERSON, MIKE J. HARRIS, and ANTHONY J. SCHIAVONE 31 Mar. 1992 47 p
(Contract N00014-91-C-0233)
(AD-A248326) Avail: CASI HC A03/MF A01

The standardization of avionics is based on modularity and commonality across an instruction set architecture. When budgetary cutbacks are considered, the ability to use standardization to cut costs assumes greater importance. Methodology to examine benefits of standardization is presented. Objectives associated with standards adopted by the Joint Integrated Avionics Working Group (JIAWG) and the Next Generation Computer Resources (NGCR) program are examined. Comparisons and recommendations are made. GRA

N92-27973# Computer Resource Management, Inc., Pleasantville, NJ.
AVIONIC DATA BUS INTEGRATION TECHNOLOGY Final Report
D. ELWELL, L. HARRISON, J. HENSYL, and N. VANSUETENDAEL Dec. 1991 233 p
(Contract DTFA03-86-C-00042)
(DOT/FAA/CT-91/19; AD-A252406) Avail: CASI HC A11/MF A03

As multiple digital avionic systems were introduced into aircraft, there arose a need for digital communications between systems. In the early 1970s, many different digital data bus designs were used to provide this communication. Because these digital systems proved to be reliable and cost effective, their popularity increased. Proliferation led to standardization, particularly in the air transport category of aircraft, which allowed communications between line replaceable units (LRUs) to become more complex. The LRUs began to rely more heavily on each other to reduce the amount of equipment required. Sensor data and systems data could be shared among multiple systems, rather than each system requiring its own private source. Integrated digital avionics are increasingly being used to implement essential and critical functions that cannot be sufficiently reproduced by conventional means. The safety of such aircraft is highly dependent upon the computer software, hardware, and data buses connecting the systems. The newest concerns relate to the problems that are unique to highly integrated systems. There is no standard with which to assess the possible impact of these bus-based systems on aircraft safety. These and other advanced avionic systems will result in specific safety assessment problems when the appropriate data packages are submitted to the Federal Aviation Administration during the certification process. Author

N92-28004# Amptek, Inc., Bedford, MA.
PROTOTYPE INSTRUMENTATION AND DESIGN STUDIES
ALAN C. HUBER, A. W. EVEREST, JOHN O. MCGARITY, DAVID J. SPERRY, and ERNEST G. HOLEMAN 24 Sep. 1991 34 p
(Contract F19628-87-C-0094)
(AD-A248378; PL-TR-91-2236; AD-E200941; SR-3) Avail: CASI HC A03/MF A01

Flight prototype sensor systems using spherical sections and electrostatic deflection have been developed, fabricated, tested, and calibrated. The detectors measure the flux of ions and electrons over a 100 x 10 deg angular fan and in 32 discrete energy levels from 10 eV to 10 KeV. This study describes the sensor system design for an instrument package for shuttle flight as well as a correlator to look for wave-particle interactions. Operating procedures for a 2.4 Gigabyte Flight Data Recorder are included. GRA

N92-28093# Litton Industries, Blacksburg, VA. Poly-Scientific Div.
FIBER OPTIC DATA BUSSES FOR AIRCRAFT
NORRIS E. LEWIS *In* AGARD, Advances in Fibre-Optic Technology in Communications and for Guidance and Control 15 p May 1992
Copyright Avail: CASI HC A03/MF A02

A variety of fiber optic data busses are being developed for aircraft applications. This paper addresses five different data busses under consideration for both military and commercial aircraft. The impact of data bus protocol on component design, the effect of data bus topology on power budget and installation issues, and overall data bus performance are discussed. Author

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.

A92-41225* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL MANAGEMENT FOR A MACH 5 CRUISE AIRCRAFT USING ENDOTHERMIC FUEL
DENNIS H. PETLEY (NASA, Langley Research Center, Hampton, VA) and STUART C. JONES (Lockheed Engineering and Sciences Co., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 384-389. Research sponsored by USAF. Previously cited in issue 22, p. 3499, Accession no. A90-48871. refs
Copyright

A92-41819
GENERALITIES ON THE RAMJET [GENERALITES SUR LE STATOREACTEUR]
ROGER MARGUET (ONERA, Chatillon, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 101-104. In French.
Copyright

The general features of the ramjet are briefly reviewed, with emphasis on its basic elements, its propulsion performance, and its utilization characteristics. The evolution of ramjet missions in France since the Second World War is then traced. L.M.

A92-41822
NEW RAMJET CONFIGURATIONS [LES NOUVELLES CONFIGURATIONS DU STATOREACTEUR]
JEAN GUILLOT (Aerospatiale, Division Engins Tactiques, Chatillon, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 111-114. In French.
Copyright

A review is presented of recent ramjet developments for missile propulsion. Attention is given to the application of new materials and accessories for the extreme internal and external temperatures encountered. Consideration is given to the systematic studies and modifications to the vibration areas that are critical for temperature control. R.E.P.

A92-42400
AIRLINES COULD REAP BIG SAVING WITH NEW PRATT COMMON CORE
STANLEY W. KANDEBO Aviation Week & Space Technology (ISSN 0005-2175), vol. 136, no. 23, June 8, 1992, p. 43, 45.
Copyright

An account is given of the design features and projected performance and economic benefits anticipated from the effort to boost PW4000 high bypass turbofan engine output from the 60,000 lb thrust range to 84,000 lb and beyond. This modification program was conducted to ensure turbofan core components' commonality throughout the range of the PW4000 family of engines manufactured after early 1994. It is also anticipated that all existing, lower-thrust PW4000s will be modified to conform to the common-core standard. The largest engine of the family, the PW4084, will have an eventual output of the order of 90,000 lbs of thrust. O.C.

A92-42800
A QUICK AUTOMATIC METHOD FOR COMPUTING PERFORMANCE OF DUCTED-PROPELLER
SHIGENORI ANDO and MICHIYO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 302-308. In Japanese. refs

A quick automatic method for computing aerodynamic performance of ducted propellers is presented. The thrust- and

power-coefficients and propulsive efficiency are calculated and plotted against the advance ratio. The representative blade section is investigated. It is found that the most suitable section is one at 75-percent radius as the same as nonducted cases. Thrust coefficient is predicted satisfactorily. But propulsive efficiency is overestimated; the difference seems to be 'blower efficiency' defined in a previous paper. Author

A92-43195
WIND TUNNEL TEST FOR A HIGH SPEED PROPELLER WITH COAXIAL CONTRAROTATION
SHIGERU SAITO, M. HASHITADE (Institute of Space and Astronautical Science, Sagamihara, Japan), M. NAKAMURA (National Aerospace Laboratory, Tokyo, Japan), KANICHI AMONO, M. SAITO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 444-447. In Japanese.

The configurations of the wind tunnel test equipment are presented. The test method is given and the measurement of the contrarotating propeller is discussed. Test data are analyzed and the thrust characteristics of the propeller are illustrated. Y.P.Q.

A92-43196
AERODYNAMIC DESIGN OF AN ADVANCED TURBOPROP USING EULER CODES
R. TAKAKI and MAKOTO KOBAYASHI (Kyoto University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 448-451. In Japanese. refs

The usefulness of Euler equations for aerodynamic design of an advanced turboprop is presented. The TVD scheme and boundary conditions are given and computational grids are analyzed. The pressure distribution on a blade is illustrated. Y.P.Q.

A92-43233
EXPERIMENTAL OPERATION OF AIRCRAFT-ENGINE TURBINE BLADE MATERIALS
SEIWA WATANABE (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 596-599. In Japanese.

The structure of the JT9D-7A engine is introduced. Its first stage turbine blade (PWA-1455) life control program countermeasure for thermal fatigue rupture is analyzed. Y.P.Q.

A92-43239
RESEARCH ON A LOW-NOISE ENGINE FOR A HIGH-SPEED VTOL AIRCRAFT
MASANORI ENDOH, K. SAITO, and YUKIO MATSUDA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 620-623. In Japanese.

The system structure and design configurations of a low-noise engine for a high speed VTOL aircraft are presented. The relationship among thrust, fuel consumption rate, and Mach number is analyzed. The main characteristics and configurations of the VTOL aircraft are given. Y.P.Q.

A92-43545
AUXILIARY POWER UNITS FOR ADVANCED FIGHTERS
Aerospace Engineering (ISSN 0736-2536), vol. 12, no. 6, June 1992, p. 7-10.
Copyright

A development status evaluation is presented for the USAF's Advanced Components APU (ACAPU) exploratory research program for the establishment of a technology base for advanced-fighter secondary power requirements formulation. The ACAPU requirements encompass 400-HP output generation by 1 cu ft of powerhead hardward, 0.5 lb/HP-hour specific fuel consumption, 5000-hour MTBF, and production of 200 HO within any altitude, up to 50,000 ft without inlet-ram assist. Attention is given to gas turbine component design details. O.C.

A92-44511
APPLICATION OF COMPUTATIONAL FLUID DYNAMICS TO PITCH/YAW THRUST VECTORING SPHERICAL CONVERGENT FLAP NOZZLES
S. A. SYED, J. J. ERHART, and E. W. KING (Pratt & Whitney Group, West Palm Beach, FL) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 799-805. Previously cited in issue 17, p. 2651, Accession no. A90-40597. refs
Copyright

A92-44514* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ROW-BY-ROW OFF-DESIGN PERFORMANCE CALCULATION METHOD FOR TURBINES
T. SCHOBIERI and M. ABOUELKHEIR (Texas A & M University, College Station) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 823-828. Research supported by NASA. Previously cited in issue 17, p. 2864, Accession no. A91-41705. refs
Copyright

A92-44517
VISCOUS FLOW ANALYSIS OF ADVANCED PARTICLE SEPARATORS
M. ZEDAN, A. MOSTAFA, P. HARTMAN, and A. SEHRA (Textron Lycoming, Stratford, CT) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 843-848. Previously cited in issue 18, p. 2829, Accession no. A90-42038. refs
Copyright

A92-44524
EFFECTIVENESS OF PLASMA TORCHES FOR IGNITION AND FLAMEHOLDING IN SCRAMJET
YUKINORI SATO, MASAMI SAYAMA, KATSURA OHWAKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), GORO MASUYA, TOMOYUKI KOMURO, KENJI KUDOU, ATSUO MURAKAMI, KOUICHIRO TANI, YOSHIO WAKAMATSU, TAKESHI KANDA (National Aerospace Laboratory, Miyagi, Japan) et al. Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 883-889. Previously cited in issue 20, p. 3092, Accession no. A89-46927. refs
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A92-44525* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLOW ESTABLISHMENT IN A GENERIC SCRAMJET COMBUSTOR
P. A. JACOBS (ICASE; NASA, Langley Research Center, Hampton, VA), R. C. ROGERS, E. H. WEIDNER (NASA, Langley Research Center, Hampton, VA), and R. D. BITTNER (Analytical Services and Materials, Inc.; NASA, Langley Research Center, Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 890-899. Previously cited in issue 19, p. 2984, Accession no. A90-42729. refs
(Contract NAS1-18605)
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A92-44526* National Aeronautics and Space Administration, Washington, DC.
HYPERSONIC MIXING AND COMBUSTION STUDIES IN THE HYPULSE FACILITY
R. J. BAKOS, J. TAMAGNO, O. RIZKALLA, M. V. PULSONETTI, W. CHINITZ, and J. I. ERDOS (General Applied Science Laboratories, Ronkonkoma, NY) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 900-906. Research sponsored by National Aero-Space Plane Joint Program Office. Previously cited in issue 18, p. 2829, Accession no. A90-42015. refs
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A92-44545
COUPLED VIBRATIONS OF TURBOMACHINE BLADES
V. P. SINGH (CR State College of Engineering, Harayana, India) Institution of Engineers (India), Journal, Mechanical Engineering Division (ISSN 0020-3408), vol. 72, pt. MC 2, July 1991, p. 35-38. refs
Copyright

In this paper a dynamic variational principle, proposed by Dean and Plass, is used to determine the natural frequencies of turbomachine blades executing coupled bending-bending-torsion vibrations including the effects of shear deflection and rotary inertia. Five-term solution is used and the method provides a rapid convergence pattern of frequencies. The results obtained are checked with theoretical and experimental results available in the literature and are found in good agreement. Author

A92-44734
NUMERICAL SIMULATION OF IMPACT RESISTANCE ON COMPOSITE BLADE
TOSHIHIRO KAWASHIMA, YASUYUKI TANAKA, and TADASHI NATSUMURA Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 2, March 1992, p. 117-122. In Japanese. refs

In the field of advanced aeroengine development, composite material holds an important position due to its high specific strength. In particular, weight reduction due to the use of FRP (Fiber Reinforced Plastics) in fan blades permit the use of larger scale fans, thus leading to more efficient engines. Fan blades are required to have prescribed impact resistance to foreign object ingestion. Numerical simulations and experimental tests have been conducted to investigate the impact failure modes and mechanisms in FRP plate and blade models. The results suggest that flexural wave propagation causes lamination failure. Furthermore, numerical simulation shows the presence of the 'edge wave', a wave which causes damage in leading and trailing edges of FRP blade. A damage prevention method which suppresses the edge wave response was examined. An analytical approach to impact resistance design is recommended. Author

N92-26405*# Georgia Tech Research Inst., Atlanta.
ACOUSTIC INTERACTIONS BETWEEN AN ALTITUDE TEST FACILITY AND JET ENGINE PLUMES: THEORY AND EXPERIMENTS Final Report, May 1990 - Oct. 1991
K. K. AHUJA, R. R. JONES, III, C. K. TAM (Florida State Univ., Tallahassee.), K. C. MASSEY, and A. J. FLEMING Jan. 1992 162 p
(Contract NAS1-19061)
(NASA-CR-190423; NAS 1.26:190423; AD-A245463; GTRI-A8612-001; AEDC-TR-91-20) Avail: CASI HC A08/MF A02

The overall objective of the described effort was to develop an understanding of the physical mechanisms involved in the flow/acoustic interactions experienced in full-scale altitude engine test facilities. This is done by conducting subscale experiments and through development of a theoretical model. Model cold jet experiments with an axisymmetric convergent nozzle are performed in a test setup that stimulates a supersonic jet exhausting into a cylindrical diffuser. The measured data consist of detailed flow visualization data and acoustic spectra for a free and a ducted plume. It is shown that duct resonance is most likely responsible by theoretical calculations. Theoretical calculations also indicate that the higher discrete tones observed in the measurements are related to the screech phenomena. Limited experiments on the sensitivity of a free 2-D, C-D nozzle to externally imposed sound are also presented. It is shown that a 2-D, C-D nozzle with a cutback is less excitable than a 2-D C-D nozzle with no cutback. At a pressure ratio of 1.5 unsteady separation from the diverging walls of the nozzle is noticed. This separation switches from one wall to the opposite wall thus providing an unsteady deflection of the plume. It is shown that this phenomenon is related to the venting provided by the cutback section. GRA

N92-26480 Purdue Univ., West Lafayette, IN.
PERFORMANCE PREDICTION AND DESIGN OF MAXIMUM THRUST PLANAR SUPERSONIC NOZZLES USING A FLUX-DIFFERENCE-SPLITTING TECHNIQUE Ph.D. Thesis
JOHN HOWARD DOTY 1991 292 p
Avail: Univ. Microfilms Order No. DA9201318

An analysis and computer program have been developed for the design of maximum thrust nozzles for hypersonic vehicles and applied to planar, inviscid, supersonic rotational flow of a thermally and calorically perfect gas. The flowfield analysis is accomplished by a flux-difference-splitting (FDS) technique. The nozzle wall thrust is maximized for parabolic nozzle contours using a direct search optimization procedure. Three different Riemann solvers were investigated as the basis for the FDS method. The exact Riemann solver is superior to either the approximate or the linearized-approximate Riemann solver when applied to a local Riemann problem. However, when used in the FDS method to solve an entire flowfield, numerical results with all three are comparable. The major advantage of the linearized-approximate Riemann solver is the savings in computational time. First order accurate FDS solutions agree well with exact solutions. For the cases studied, the second order accurate FDS method was more accurate than the first order method. However, this should be weighed against the increased computation time and coding complexity. Dissert. Abstr.

N92-26553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A PARAMETRIC NUMERICAL STUDY OF MIXING IN A CYLINDRICAL DUCT
V. L. OECHSLE, H. C. MONGIA (General Motors Corp., Indianapolis, IN.), and J. D. HOLDEMAN Jul. 1992 22 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Original contains color illustrations
(Contract RTOP 537-02-02)
(NASA-TM-105695; E-7083; NAS 1.15:105695) Copyright

The interaction is described of some of the important parameters affecting the mixing process in a quick mixing region of a rich burn/quick mix/lean burn (RQL) combustor. The performance of the quick mixing region is significantly affected by the geometric designs of both the mixing domain and the jet inlet orifices. Several of the important geometric parameters and operating conditions affecting the mixing process were analytically studied. Parameters such as jet-to-mainstream momentum flux ratio (J), mass flow ratio (MR), orifice geometry, orifice orientation, and number of orifices/row (equally spaced) around the circumferential direction were analyzed. Three different sets of orifice shapes were studied: (1) square, (2) elongated slots, and (3) equilateral triangles. Based on the analytical results, the best mixing configuration depends significantly on the penetration depth of the jet to prevent the hot mainstream flow from being entrained behind the orifice. The structure in a circular mixing section is highly weighted toward the outer wall and any mixing structure affecting this area significantly affects the overall results. The increase in the number of orifices per row increases the mixing at higher J conditions. Higher slot slant angles and aspect ratios are generally the best mixing configurations at higher momentum flux ratio (J) conditions. However, the square and triangular shaped orifices were more effective mixing configurations at lower J conditions. Author

N92-26561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CFD MIXING ANALYSIS OF JETS INJECTED FROM STRAIGHT AND SLANTED SLOTS INTO CONFINED CROSSFLOW IN RECTANGULAR DUCTS
D. B. BAIN, C. E. SMITH (CFD Research Corp., Huntsville, AL.), and J. D. HOLDEMAN Jul. 1992 24 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Original contains color illustrations

(Contract RTOP 537-02-20)
(NASA-TM-105699; E-7087; NAS 1.15:105699; AIAA PAPER 92-3087) Copyright

A CFD study was performed to analyze the mixing potential of opposed rows of staggered jets injected into confined crossflow in a rectangular duct. Three jet configurations were numerically tested: (1) straight (0 deg) slots; (2) perpendicular slanted (45 deg) slots angled in opposite directions on top and bottom walls; and (3) parallel slanted (45 deg) slots angled in the same direction on top and bottom walls. All three configurations were tested at slot spacing-to-duct height ratios (S/H) of 0.5, 0.75, and 1.0; a jet-to-mainstream momentum flux ratio (J) of 100; and a jet-to-mainstream mass flow ratio of 0.383. Each configuration had its best mixing performance at S/H of 0.75. Asymmetric flow patterns were expected and predicted for all slanted slot configurations. The parallel slanted slot configuration was the best overall configuration at x/H of 1.0 for S/H of 0.75. Author

N92-26586 Rensselaer Polytechnic Inst., Troy, NY.
AN EXPERIMENTAL INVESTIGATION OF A 2-D SCRAMJET INLET AT FLOW MACH NUMBERS OF 8 TO 25 AND STAGNATION TEMPERATURES OF 800 TO 4,100 K Ph.D. Thesis
MARCO ANTONIO SALAMINUCCI 1991 354 p
Avail: Univ. Microfilms Order No. DA9209274

The development of air-breathing hypersonic vehicles, such as the National Aerospace Plane (NASP) and NASP Derived Vehicles (NDV), requires the detail understanding of the physics of the hypersonic internal and external flowfields. The internal flow through the Supersonic Combustion Ramjet (scramjet) is particularly important for these vehicles since hypersonic velocities up to Mach 25 must be achieved by the use of this type of propulsion system. The limited available experimental data for the internal air flow in a scramjet inlet at high Mach numbers and stagnation temperatures motivated this study. A 0.25 m span variable geometry 2-D scramjet inlet was designed, constructed, and tested in the Rensselaer Polytechnic Institute 0.61 m diameter Hypersonic Shock Tunnel. For these tests, the flow Mach number in the test section was varied from 8 to 25 and the reservoir temperatures investigated were in the 800 - 4,100 K range. The free stream until Reynolds number varied from 1.3 x 10 exp 4 to 2.3 x 10 exp 6/m and the leading edge free stream Knudsen number was in the 0.1 - 31 range. The lower end of the reservoir temperature, 800 - 1,100 K, was generated by operating the shock tunnel in the reflected mode. On the other hand, the equilibrium interface mode of operation, with helium in the driver section, was required to produce the upper end of the stagnation temperature range of 4,100 K, with real gas effects.
Dissert. Abstr.

N92-26613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
USE OF AN APPROXIMATE SIMILARITY PRINCIPLE FOR THE THERMAL SCALING OF A FULL-SCALE THRUST AUGMENTING EJECTOR
WENDY S. BARANKIEWICZ, GAIL P. PERUSEK, and MOUNIR B. IBRAHIM (Cleveland State Univ., OH.) Jul. 1992 14 p Proposed for presentation at the 28th Joint Propulsion Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, ASME, SAE, and ASEE
(Contract RTOP 505-62-71)
(NASA-TM-105724; E-7124; NAS 1.15:105724; AIAA PAPER 92-3792) Avail: CASI HC A03/MF A01

Full temperature ejector model simulations are expensive, and difficult to implement experimentally. If an approximate similarity principle could be established, properly chosen performance parameters should be similar for both hot and cold flow tests if the initial Mach number and total pressures of the flow field are held constant. Existing ejector data is used to explore the utility of one particular similarity principle; the Munk and Prim similarity principle for isentropic flows. Static performance test data for a full-scale thrust augmenting ejector are analyzed for primary flow temperatures up to 1560 R. At different primary temperatures, exit pressure contours are compared for similarity. A nondimensional flow parameter is then used to eliminate primary nozzle temperature dependence and verify similarity between the hot and cold flow experiments. Author

N92-26697# Oak Ridge National Lab., TN.
SIMULATION OF 3D NON-PLANAR FATIGUE CRACK GROWTH IN A TURBINE BLADE ROOT
D. O. POTYONDY, A. R. INGRAFFEA (Cornell Univ., Ithaca, NY.), and L. J. GRAY 1992 31 p Presented at the American Society of Mechanical Engineers Pressure Vessel and Piping Conference, New Orleans, LA, 21-25 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE92-006859; CONF-920631-7) Avail: CASI HC A03/MF A01

A case study of fatigue life predictions for the root of a turbine blade containing an initial flaw is presented. A fracture simulation system is utilized to perform simulations of low cycle (startup/shutdown) fatigue crack growth in the root. The turbine blade has a complex structural geometry, and the cracks have been observed to grow in a highly non-planar fashion. Simulation of these cracks requires the capability to model three dimensional geometry and to allow for arbitrary non-planar crack growth. A geometric model of the portion of the root near the crack is created. Boundary conditions for this substructure are obtained from a finite element model of the entire blade (without a crack), loaded by centrifugal forces. One approach of transferring these boundary conditions to the geometric model is described. A small initial crack is added to the geometric model, and a linear elastic boundary element analysis is performed in order to compute the stress intensity factor variation (modes 1, 2, and 3) along the crack front. The crack growth rate curve for the blade material is used along with the mode-1 stress intensity factor variation to predict the number of cycles, and new crack shape, for a user-specified increment of growth. The model is then locally remeshed for the next boundary element analysis. Comparisons with experimental fatigue tests of this same configuration are presented. DOE

N92-27037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERFACE OF AN UNCOUPLED BOUNDARY LAYER ALGORITHM WITH AN INVISCID CORE FLOW ALGORITHM FOR UNSTEADY SUPERSONIC ENGINE INLETS
DOUGLAS DARLING and BARBARA SAKOWSKI Jul. 1992 12 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE
(Contract RTOP 505-62-20)
(NASA-TM-105684; E-7063; NAS 1.15:105684; AIAA PAPER 92-3083) Avail: CASI HC A03/MF A01

An uncoupled boundary layer algorithm was combined with an inviscid core flow algorithm to model flows within supersonic engine inlets. The inviscid flow algorithm that was used was the LArge Perturbation INlet Code (LAPIN). The boundary layer and inviscid core flow algorithms were formulated in different manners. The boundary layer algorithm was two dimensional and solved in nonconservation form, while the core flow algorithm was one dimensional and solved in conservation form. In order to interface the two codes, the following modifications were important. The coordinate system was set up to maintain the parabolic nature of the boundary layer algorithm while approaching the one dimensional core flow solution far from a wall. The pressure gradient used in the boundary layer equation was calculated using the core flow values and the boundary layer equations, so the boundary layer solution smoothly approached the core flow values far from the wall. Flaring was used for the advection terms perpendicular to the core flow to maintain the stability of the algorithm. With these modifications, the combined viscous/inviscid algorithm matched well with experimental observations of pressure distributions with a supersonic inlet. Author

N92-27039# Rolls-Royce Ltd., Bristol (England).
VSTOL ENGINE DESIGN EVOLUTION: GROWTH OF THE PEGASUS ENGINE FOR HARRIER

A. B. STREET 1 Nov. 1990 12 p
(PNR-90805; ETN-92-90775) Copyright Avail: CASI HC A03/MF A01

The Pegasus engine entered service in 1969 powering the Harrier aircraft and has been progressively developed. The operational background of the Harrier/AV8 family of aircraft was used to define a demonstrator program primarily aimed at improving performance. The XG15 demonstrator program for the Pegasus 11-61 was successfully completed in 1987 followed by durability demonstration in early 1988. The results formed the basis of the improved F402-RR-408 engine offering reduced life cycle costs at higher thrust according to prevailing operational requirements. The production engine validation test program commenced with an engine roll out in Jun. 1988, flight testing commencing at Bristol (United Kingdom) one year later with completion due in May 1990 at the same time as commencement of production engine delivery. A summary of the program and technical arisings is given. ESA

N92-27040# Rolls-Royce Ltd., Bristol (England).
ASTOVL ENGINE CONTROL
B. J. QUINN 1 Nov. 1990 7 p
(PNR-90808; ETN-92-90777) Copyright Avail: CASI HC A02/MF A01

The future Advanced Short Take Off and Vertical Landing (ASTOVL) aircraft will probably require good supersonic capability and combine the attributes of the F16 aircraft with those of the Harrier, and the engine will undoubtedly be placed at the back of the aircraft. Thus the front lift nozzles mounted forward of the aircraft center of gravity, will require long ducts from the engine. To minimize hot gas injection effects and the weight of the ducting to the front lift nozzles, it is proposed that fan delivery air should be used directly. This introduces the need for a dual cycle engine configuration, unmixed for lift, mixed for propulsion, and thus for movable blocker doors to ensure that only lift or propulsive nozzles are selected. However, during mode change it is probable that fan running line control will be necessary to minimize potential surge or flutter problems. Further, the much larger separation between the front and back lift nozzles will generate potentially large pitching moments during engine modulation at various landing weights for which back lift nozzle area variation is a possible solution. Clearly control is thus becoming more sophisticated than on Harrier/Pegasus, and has certainly generated the need for extensive aircraft/engine integration studies. A possible control architecture is identified, and it is concluded that this approach is reasonable. ESA

N92-27041# Rolls-Royce Ltd., Derby (England).
ASTOVL PROPULSION SYSTEMS: CONFIGURATION AND CONCEPT CHOICE
N. A. MITCHELL 1 Nov. 1990 11 p Sponsored in part by Ministry of Defence
(PNR-90809; ETN-92-90778) Copyright Avail: CASI HC A03/MF A01

A wide variety of Advanced Short Takeoff and Vertical Landing (aircraft) (ASTOVL) propulsion concepts were studied against a number of different customer requirements including NST6464. These studies are reviewed with particular reference to those aspects which affect concept choice and the quality of the overall system. Once these studies were complete, a reexamination of the principal attributes of a STOVL aircraft was carried out by visiting Harrier operations on deployment both on land and at sea. This together with the results of the full scale landing simulations of an ASTOVL aircraft led to the evolution of a propulsion system for supersonic STOVL aircraft. The key elements of this propulsion system are that in the STOVL regime the propulsion system is unmixed and has the characteristics of the Pegasus (i.e., cool front jets and full nozzle vectoring) but is a mixed flow afterburning turbofan in the flight regime. The critical technologies for this propulsion system are identified and the programs required to underwrite them are outlined. The major characteristics of this propulsion system are compared with other systems and those elements which contribute to a low risk propulsion system are identified. ESA

N92-27042# Rolls-Royce Ltd., Bristol (England).
HOT-GAS REINGESTION ENGINE RESPONSE CONSIDERATIONS
D. D. WILLIAMS 1 Nov. 1990 14 p Sponsored by Ministry of Defence
(PNR-90810; ETN-92-90779) Copyright Avail: CASI HC A03/MF A01

Some of the fundamentals of hot gas reingestion in the context of engine stability are reviewed. Generic time variant total temperature distortion descriptors are discussed against a background of external work and of small and full scale experience from simulated vertical landings of an augmented Pegasus/Harrier vectored thrust installation. Results are presented of compression system component and overall engine simulations intended to provide guidelines to engine total temperature distortion sensitivity and stability margin assessment. ESA

N92-27043# Rolls-Royce Ltd., Derby (England).
SIMULTANEOUS ENGINEERING IN AERO-GAS TURBINE DESIGN AND MANUFACTURE
T. BROUGHTON 15 Nov. 1990 13 p
(PNR-90811; ETN-92-90780) Copyright Avail: CASI HC A03/MF A01

The increasingly competitive world in which manufacturing companies now operate imposes rigorous requirements in bringing the right product at the right price to the market place. Aerogas turbines are an example of a product which is extremely complex in terms of design, manufacture and development and, hence, they provide an enormous challenge to the management of their engineering and manufacturing processes. Simultaneous engineering is seen as a means of managing engineering activities to achieve a competitive advantage. The manner in which simultaneous engineering has been implemented within the company is highlighted. ESA

N92-27062# Royal Aircraft Establishment, Farnborough (England).
THE CHANGING ROLE OF EXPERIMENTATION IN AEROENGINE R AND D: THE POINT OF VIEW OF THE RESEARCH WORKER
J. DUNHAM Nov. 1991 19 p
(AD-A246372; RAE-TM-P1216; DRIC-BR-307984) Avail: CASI HC A03/MF A01

The pioneers of the gas turbine based their components designs on simple mathematical models which employed many empirical factors. They conducted two types of experiment: Trials of engines and components, to develop their mechanical integrity and endurance, and to improve their performance and stability (development tests), and Parametric experiments on simplified components or simulated component geometries, to evolve better models and to generate empirical correlations of component behavior (research tests). Fifty years later, the same need for development tests remains, but as design methods have evolved from simple empirical models to complex computational fluid dynamics (CFD) models, the nature of research tests has changed. There is still a need for experiments aimed at evolving better mathematical models, but the empiricism is at a more detailed level (such as transition prediction) and so are the experiments. But component testing has moved away from a parameter variation to tests aimed at the development and verification of better CFD models. Meanwhile, instrumentation techniques have also improved a great deal, enabling more accurate and detailed measurements. GRA

N92-27379*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
INTEGRATED FLIGHT PROPULSION CONTROL RESEARCH RESULTS USING THE NASA F-15 HIDEC FLIGHT RESEARCH FACILITY
JAMES F. STEWART Jun. 1992 22 p Proposed for presentation at the 6th Biannual Flight Test Conference, Hilton Head, SC, 24-26 Aug. 1992

(Contract RTOP 533-02-36)
(NASA-TM-4394; H-1817; NAS 1.15:4394; AIAA PAPER 92-4106)
Copyright Avail: CASI HC A03/MF A01

Over the last two decades, NASA has conducted several flight research experiments in integrated flight propulsion control. Benefits have included increased thrust, range, and survivability; reduced fuel consumption; and reduced maintenance. These flight programs were flown at NASA Dryden Flight Research Facility. This paper presents the basic concepts for control integration, examples of implementation, and benefits of integrated flight propulsion control systems. The F-15 research involved integration of the engine, flight, and inlet control systems. Further extension of the integration included real time, onboard optimization of engine, inlet, and flight control variables; a self repairing flight control system; and an engines only control concept for emergency control. The flight research programs and the resulting benefits are described for the F-15 research. Author

N92-27422# Rolls-Royce Ltd., Bristol (England).
THERMALLY SPRAYED COATING SYSTEMS FOR SURFACE PROTECTION AND CLEARANCE CONTROL APPLICATIONS IN AERO ENGINES
T. N. RHYS-JONES 1 Apr. 1990 15 p Repr. from Surface and Coatings Technology, v. 43/44, 1990 p 402-415
(PNR-90802; ETN-92-90845) Copyright Avail: CASI HC A03/MF A01

The principal current and new thermal spray coating processes used for compressor, combustion chamber and turbine applications in aircraft engines are described with particular reference to high velocity combustion and plasma spraying techniques. The uses of coatings for wear and erosion resistance, oxidation and corrosion control, thermal barrier applications and gas path sealing (clearance) are discussed. ESA

N92-27461# Textron Lycoming, Stratford, CT.
APPLICATION OF CFD IN THE DESIGN OF GAS TURBINE ENGINE COMPONENTS
ARUN K. SEHRA, MOHAMED A. ABOLFADL, and MOHAMED G. ZEDAN *In* AGARD, CFD Techniques for Propulsion Applications 26 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

The application is illustrated of three dimensional viscous procedures for optimizing the turbomachinery component geometry. Specific cases presented include the application of 3-D viscous analyses to a transonic axial compressor rotor, a splittered axial compressor rotor, a turbine rotor, and an exhaust mixer nozzle. Application of an axisymmetric Navier-Stokes solver to the inlet particle separator, and a two dimensional inverse design procedure for customizing compressor airfoil geometry are also briefly included. Author

N92-27462# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VALIDATION OF A CANARI CODE BY THE COMPUTATION OF THREE DIMENSIONAL TURBULENT FLOW IN TURBINE VALVE [VALIDATION DU CODE CANARI PAR LE CALCUL DE L'ECOULEMENT TRIDIMENSIONNEL TURBULENT DANS UN DISTRIBUTEUR DE TURBINE]
BEATRICE ESCANDE and LAURENT CAMBIER *In* AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992 In FRENCH; ENGLISH summary
Copyright Avail: CASI HC A02/MF A06

The preliminary results are presented which were obtained in order to validate the CANARI code in a turbomachinery case. This code solves the Reynolds averaged compressible three dimensional Navier-Stokes equations. It is applied to the flow computation through a high pressure turbine annular cascade. This computation is characterized by the use of a highly stretched O mesh around the blades and of H meshes for the upstream and downstream regions, in order to allow an accurate description of the leading edge and trailing edge phenomena. The configuration studied is an experimental set-up which has been recently realized at ONERA for the validation of computational codes. Author

N92-27463# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
COMPUTATION AND VISUALIZATION OF SPECIFIC FLOW PHENOMENA IN TURBOMACHINERY APPLICATION
J. HAARMEYER and B. STUBERT *In* AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992
Copyright Avail: CASI HC A02/MF A06

Capacity and speeds in industrial computer hardware allows the complete numerical evaluation of the three dimensional flow field through turbomachinery blading. Detailed consideration of specific flow phenomena like horseshoe vortex or tip clearance effects is of increasing importance in the engine design process. The large amount of data produced by a 3-D calculation requires separate development of algorithms for visualization of the computational results. Numerical techniques for the integration of both streamlines and vortex lines through 3-D vector fields are needed to identify fluid flow features based on values at discrete grid points. Such an integrated technique is covered and also includes a search algorithm for places of local rotations. Some evaluations of Euler calculations in a turbomachinery application are shown. Author

N92-27464# Vrije Univ., Brussels (Belgium). Computational Fluid Dynamics Group.
AN INTEGRATED CFD SYSTEM FOR 3D TURBOMACHINERY APPLICATIONS
C. HIRSCH, C. LACOR, C. DENER, and D. VUCINIC *In* AGARD, CFD Techniques for Propulsion Applications 15 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

A complete CFD system, composed of an interactive mesh generator, an efficient flow solver and an advanced, portable, flow visualization system is presented for turbomachinery applications. The mesh generator (IGG) and the visualization system (CFView) have the same user interface and call on Object Oriented Programming on top of X Windows. The flow solver is developed within a multigrid method, where the time integration schemes are considered as 'smoothers'. Both explicit or implicit time integration methods can be chosen. The explicit integration is based on the Runge-Kutta method and the implicit solver uses relaxation methods with Gauss-Seidel point or line strategies. The space discretization allows for central as well as upwind schemes and algebraic or two equation turbulence models are available. The application to an annular turbine blade row is shown. Author

N92-27466# Royal Aerospace Establishment, Farnborough (England).
PREDICTIONS AND MEASUREMENTS OF 3D VISCOUS FLOW IN A TRANSONIC TURBINE NOZZLE GUIDE VANE ROW
G. C. HORTON, S. P. HARASGAMA, and K. S. CHANA *In* AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Previously announced as N92-14319
Copyright Avail: CASI HC A03/MF A06

A transonic turbine nozzle guide vane was tested in an annular cascade with two different endwall geometries. The measurements were taken at engine representative flow conditions and include surface static pressures and a downstream area traverse of total pressure. The flow through these geometries was modeled at the test conditions using a three dimensional viscous flow program. The effects of different mesh densities and two turbulence models were studied. Predictions of secondary flow and loss were obtained and are compared with the experimental measurements. The different turbulence models were found to have little effect in the predicted overall loss though there were differences in the distribution and the shape of the vane wakes. The one equation turbulence model produced wakes which had similar levels of total pressure deficit to the experiment and had a more similar shape than those with the Baldwin-Lomax algebraic model. Author

N92-27469# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STEADY AND UNSTEADY 3D FLOW COMPUTATION THROUGH A TRANSONIC TURBINE STAGE [CALCULS 3D STATIONNAIRE ET INSTATIONNAIRE DANS UN ETAGE DE TURBINE TRANSSONIQUE]
ALAIN LEMEUR *In* AGARD, CFD Techniques for Propulsion Applications 24 p Feb. 1992 In FRENCH; ENGLISH summary
Copyright Avail: CASI HC A03/MF A06

The following problems are discussed. The best approach in order to obtain the average characteristics of the flow field by directly using a three dimensional computation on a complete turbomachinery stage. The real flow is absolutely 3-D and unsteady. This implies that numerical simulation of the flow must be unsteady. Therefore, it is necessary to make more or less rigorous unsteady computation or averaged steady computation can be directly performed. Two different ways to carry out computation on a highly loaded turbine stage are given and analyzed. The steady approach in which the average flow is redistributed at each iteration between both rows, in order to obtain the average steady solution. And the unsteady approach by taking into account several channels on both rows. The computation is purely unsteady with a time periodicity; i.e., if a result is obtained at time t, the same results must be found at time t + T, T being the time period. In these cases, a time average must be made over a period in order to obtain the 3-D flow field average. Author

N92-27484# Rolls-Royce Ltd., Bristol (England). Combustion Technology Dept.
MODELLING THE VAPORISER AND PRIMARY ZONE FLOWS FOR A MODERN GAS TURBINE COMBUSTION CHAMBER
N. R. BOND, J. M. LEVALLOIS, and K. R. MENZIES *In* AGARD, CFD Techniques for Propulsion Applications 18 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

A three dimensional curvilinear finite volume computational fluid dynamics (CFD) code has been applied to aid understanding of the mechanisms leading to observed baseline temperature patterns on a modern vaporizer combustion chamber. This code calculates recirculating, turbulent, combusting flows with a k-epsilon turbulence model and a conserved scalar/local chemical equilibrium combustion model. Predictions were obtained for both the vaporizer internal flows and for the complete flametube; the latter used the predicted vaporizer exit flow patterns as boundary conditions. The vaporizer flow models displayed a sensitivity to the fuel injector location which was subsequently confirmed by water analogy experiments. In conjunction with the flametube calculations, the effect of injector geometry and location on the primary zone flow patterns and temperatures were assessed, explaining the experimental results. The computational studies suggested a modified fuel injector geometry to reduce sensitivity and improve fuel distribution, which was validated by subsequent experiments in the full combustor. Author

N92-27519*# Iowa State Univ. of Science and Technology, Ames. Dept. of Mechanical Engineering.
VISUALIZATION OF BOUNDARY-LAYER DEVELOPMENT ON TURBOMACHINE BLADES WITH LIQUID CRYSTALS Final Technical Report
DALE E. VANZANTE and THEODORE H. OKIISHI Dec. 1991 65 p Original contains color illustrations
(Contract NAG3-917; ERI PROJ. 3067)
(NASA-CR-190433; NAS 1.26:190433; ISU-ERI-AMES-92114; TCRL-36)

This report documents a study of the use of liquid crystals to visualize boundary layer development on a turbomachine blade. A turbine blade model in a linear cascade of blades was used for the tests involved. Details of the boundary layer development on the suction surface of the turbine blade model were known from previous research. Temperature sensitive and shear sensitive liquid crystals were tried as visual agents. The temperature sensitive crystals were very effective in their ability to display the location of boundary layer flow separation and reattachment. Visualization of natural transition from laminar to turbulent boundary layer flow with the temperature sensitive crystals was possible but subtle. The visualization of separated flow reattachment with the shear sensitive crystals was easily accomplished when the crystals were allowed to make a transition from the focal-conic to a Grandjean texture. Visualization of flow reattachment based on the selective reflection properties of shear sensitive crystals was achieved only marginally because of the larger surface shear stress and shear stress gradient levels required for more dramatic color differences. Author

N92-27587*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
FLIGHT-DETERMINED BENEFITS OF INTEGRATED FLIGHT-PROPULSION CONTROL SYSTEMS
JAMES F. STEWART, FRANK W. BURCHAM, JR., and DONALD H. GATLIN Jun. 1992 25 p *Proposed for presentation at the* 18th ICAS Congress, Beijing, China, 20-25 Sep. 1992
(Contract RTOP 533-02-36)
(NASA-TM-4393; H-1811; NAS 1.15:4393; PAPER-92-2.9.1)
Avail: CASI HC A03/MF A01

Over the last two decades, NASA has conducted several experiments in integrated flight-propulsion control. Benefits have included improved maneuverability; increased thrust, range, and survivability; reduced fuel consumption; and reduced maintenance. This paper presents the basic concepts for control integration, examples of implementation, and benefits. The F-111E experiment integrated the engine and inlet control systems. The YF-12C incorporated an integral control system involving the inlet, autopilot, autothrottle, airdata, navigation, and stability augmentation systems. The F-15 research involved integration of the engine, flight, and inlet control systems. Further extension of the integration included real-time, onboard optimization of engine, inlet, and flight control variables; a self-repairing flight control system; and an engines-only control concept for emergency control. The F-18A aircraft incorporated thrust vectoring integrated with the flight control system to provide enhanced maneuvering at high angles of attack. The flight research programs and the resulting benefits of each program are described. Author

N92-27652*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL STUDY OF CROSS-STREAM MIXING IN A RECTANGULAR DUCT
D. S. LISCINSKY, B. TRUE, A. VRANOS (AB Research Associates, South Windsor, CT.), and J. D. HOLDEMAN 1992 13 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Original contains color illustrations
(Contract RTOP 537-02-20)
(NASA-TM-105694; E-7082; NAS 1.15:105694; AIAA PAPER 92-3090) Copyright

An experimental investigation of non-reacting cross-stream jet injection and mixing in a rectangular duct was conducted for application in a low emissions combustor. Planar digital imaging was used to measure concentration distributions in planes perpendicular to the duct axis. Mixing rate was measured for 45 deg slanted slot and round orifice injectors. Five areas of inquiry are discussed: (1) mixing improves continuously with increasing momentum-flux ratio; (2) given a momentum-flux ratio, there is an optimum, orifice spacing; (3) mixing is more dependent on injector geometry than mass flow ratio; (4) mixing is influenced by relative slot orientation; and (5) jet structure is different for round holes and slanted slots injectors. The utility of acquiring multipoint fluctuating properties of the flow field is also demonstrated. Author

N92-27669*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL PERFORMANCE OF THREE DESIGN FACTORS FOR VENTRAL NOZZLES FOR SSTOVL AIRCRAFT
BARBARA S. ESKER and GAIL P. PERUSEK Jul. 1992 16 p Presented at the 28th Joint Propulsion Conference and Exhibit; sponsored by AIAA, SAE, ASME, and ASEE

(Contract RTOP 505-68-32)
(NASA-TM-105697; E-7085; NAS 1.15:105697; AIAA PAPER 92-3789) Avail: CASI HC A03/MF A01

An experimental study of three variations of a ventral nozzle system for supersonic short-takeoff and vertical-landing (SSTOVL) aircraft was performed at the NASA LeRC Powered Lift Facility. These test results include the effects of an annular duct flow into the ventral duct, a blocked tailpipe, and a short ventral duct length. An analytical study was also performed on the short ventral duct configuration using the PARC3D computational dynamics code. Data presented include pressure losses, thrust and flow performance, internal flow visualization, and pressure distributions at the exit plane of the ventral nozzle. Author

N92-27817# Massachusetts Inst. of Tech., Cambridge.
SELF-ADAPTIVE AEROPROPULSION COMPONENTS-ENHANCING AXIAL COMPRESSOR PERFORMANCE Annual Letter Report, FY 1991
A. H. EPSTEIN 1992 3 p
(Contract N00014-87-K-0352; N00014-91-J-1575)
(AD-A246123) Avail: CASI HC A01/MF A01

The principal technical objective of this work is to explore the use of active feedback stabilization to suppress the performance limiting instabilities endemic to jet engine compression systems known as rotating stall and surge. Previous work under ONR sponsorship has shown that these disturbances are the mature form of small amplitude travelling waves characteristic of turbomachinery, and that damping of the small amplitude waves prevents rotating stall. A major theoretical conclusion of this work, backed by experimental data, is that the compressor acts as a fluid oscillator with the rotating stall regimes representing the eigenmodes of the system. Thus, it is important to understand both the details of the oscillator (the compressor) and its forcing functions (distortion and turbulent fluctuations). Almost nothing is currently known about the nature of turbulent fluctuations in a jet engine and their relationship to compressor stability since, prior to the concept of active compressor stabilization, there was little motivation to pursue these questions. The work to date has been on low speed research compressors with uniform inflow and low turbulence levels. The main aim of the new work is to extend both theory and experiment to include wave detection and active compressor control in the presence of inlet distortion and high turbulence levels characteristic of actual aircraft installations. GRA

N92-28073# Cranfield Inst. of Tech., Bedford (England). Dept. of Turbomachinery and Engineering Mechanics.
RADIAL INFLOW TURBINE STUDY Interim Report No. 6, 1 Jun. - 31 Dec. 1991
S. HAMI and R. L. ELDER Dec. 1991 12 p
(Contract DAJA45-89-C-0006)
(AD-A246938; R/D-5824-AN-01) Avail: CASI HC A03/MF A01

The radial inflow turbine is a primary component used both in small gas turbines and turbochargers. Better understanding of the flow processes occurring within the small passages of the machine could result in the improved design of units. As most of the detailed aerodynamics is still ill-defined, a joint research project with the objective of improving our understanding was carried out. This document gives the sixth report on the project. It describes progress and measurements taken downstream of the rotor. GRA

N92-28076# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
AFRAPT PROGRAM AT TEXAS A AND M UNIVERSITY RESEARCH FOR ADVANCED AIRCRAFT ENGINE STRUCTURES Final Report, Sep. 1986 - Aug. 1991
JOHN M. VANCE 23 Oct. 1991 9 p
(Contract AF-AFOSR-0297-86)
(AD-A247040; AFOSR-92-0163TR) Avail: CASI HC A02/MF A01

Sixteen graduate students in mechanical and aerospace engineering were supported on this grant, producing four M.S. graduates and three Ph.D. graduates during the grant period. Eight students are still pursuing research and studies toward their degree. Two students failed the Ph.D. qualifying examination and left Texas A and M. Six of the program participants are now employed by companies in the aircraft or aerospace propulsion field. GRA

N92-28162# Naval Postgraduate School, Monterey, CA.
AN APPRAISAL OF COST-EFFECTIVENESS MODELS USED IN THE AIR FORCE AND NAVY AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAMS M.S. Thesis
JAMES D. DAVIS Dec. 1991 94 p
(AD-A245910) Avail: CASI HC A05/MF A01

This thesis examines the cost-effectiveness models used by the Air Force and Navy to assist with the decision-making process of their Component Improvement Programs (CIP). The focus is on the elements of the two models and the reasonableness of each model's results. A sensitivity analysis was performed on significant input parameters to determine what effect errors in these parameters would have on the predicted return-on-investment (ROI) results. The author concluded that, although the models provide insight into life cycle costs (LCC) of aircraft engines, they are extremely sensitive to errors in certain input variables and should not be relied upon for CIP budget justification. GRA

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AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A92-41212
ANALYSIS OF AIRSHIP LATERAL MANEUVERABILITY
B. L. NAGABHUSHAN and RAMIN P. K. PASHA (Saint Louis University, Cahokia, IL) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 299, 300. Abridged. refs
(AIAA PAPER 91-1274) Copyright

Equations of motion have been derived and used to investigate analytically lateral and directional maneuverability characteristics of an advanced airship configuration consisting of auxiliary aerodynamic and powered yaw control augmentation. Theoretical expressions for turning radius, sideslip angle, roll angle, and the corresponding rudder reflection or auxiliary control needed in a steady turn have been obtained in terms of vehicle geometry, stability, control, and flight parameters. These theoretical results are also analyzed and shown to agree with experimental observations of the past. Potential for improving vehicle maneuverability either by relaxing its inherent static stability or by use of auxiliary yaw controls, is discussed and illustrated with an example 2.8-million cu ft airship. Author

A92-41226
IDENTIFICATION OF THE TRANSFER FUNCTION BETWEEN TURBULENCE AND AIRCRAFT
QING CHEN and GUNTHER SCHAENZER (Braunschweig, Technische Universitaet, Federal Republic of Germany) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 390-395. Research sponsored by DFG. refs
Copyright

An aircraft is considered as a 'two-point' model to describe more physically the dynamic response due to turbulence and the complex interaction among its different parts. The relevant effects, as far as possible, have been taken into account for simulating the complete aircraft model, which includes a model for the rigid aircraft motion and a model corresponding to the effect of turbulence. The latter unknown model is established on the analysis of its physical background. An example is demonstrated by flight test data of the research aircraft Dornier DO 128 of the Technical University of Braunschweig. This aircraft has an additional time lag of 0.1 s that will include primarily the effects of unsteady aerodynamics. Author

A92-41528
A MODEL OF A DEFORMABLE AEROPLANE WITH A WING OF LOW ASPECT RATIO AND MOVABLE CONTROL SURFACES FOR STUDYING NATURAL VIBRATIONS
A. OLEJNIK and P. ZALEWSKI (Military Technical Academy, Warsaw, Poland) Journal of Technical Physics (ISSN 0324-8313), vol. 32, no. 3-4, 1991, p. 447-466. refs
Copyright

Attention is given to a model of a deformable aeroplane whose assemblies are divided into box elements with variable geometrical and mass parameters, situated in an arbitrary manner in space. The remaining assemblies are approximated by elements composed of beams and solid bodies. Such a model enables vibration analysis of an aeroplane of any aspect ratio, any sweepback and dihedral angle, and carrying external suspension elements. The method of 2D discretizion was used to analyze the natural vibrations of the wings of a turbojet trainer. This semimonocoque wing structure of small aspect ratio (5.2) was modeled by 37 box elements, longerons, and spars. The results of the computation natural vibration frequencies of a wing with a rigidly and elastically attached aileron and the relevant modes are illustrated. P.D.

A92-42605
DEVELOPMENT OF FLY-BY-LIGHT SYSTEMS FOR COMMERCIAL AIRCRAFT
JOHN R. TODD (Douglas Aircraft Co., Long Beach, CA) and LARRY J. YOUNT (Honeywell, Inc., Sperry Commercial Flight Systems Group, Phoenix, AZ) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 72-78.
Copyright

Fly-by-wire/Fly-by-light (FBW/FBL) controls are in the process of supplanting traditional mechanical control technology for commercial transport aircraft. Douglas Aircraft Company in cooperation with its suppliers is actively pursuing a comprehensive program to develop and validate advanced flight control concepts and technologies. This paper details the various perceived technical barriers associated with fly-by-light as well as the work in progress to overcome them. The advantages of fly-by-light technology are discussed with particular attention to its potential to help prevent and/or tolerate electromagnetic effects. Author

A92-43112
STUDY ON A FLIGHT SIMULATOR OF TIME DELAYS
K. OCHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 96-99. In Japanese. refs

Digital computer technology for the improvement of a flight simulator is discussed. The time delay effectiveness of the flight simulator is presented. The pilot induced oscillation and time delay response are addressed. Y.P.Q.

A92-43115
FLIGHT EVALUATIONS ON IN-FLIGHT SIMULATION OF UNSTABLE AIRCRAFT
YUKIICHI TSUKANO and S. INAGAKI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 108-111. In Japanese. refs

In-flight simulation tests for aircraft control and stable systems are evaluated. The variable stability and response aircraft (VSRA) is used for flight test in order to identify the stability and control derivatives. Stable evaluation for visual observation is analyzed. Y.P.Q.

A92-43120
MULTIHARMONIC CONTROL RESPONSE OF A ROTOR BLADE DURING FORWARD FLIGHT (TEST)
GIZO HASEGAWA and TOMOARI NAGASHIMA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 128-131. In Japanese. refs

The vibration reduction of the rotors is presented. The configuration of the test facility is described, and control pitch angles and payload changes are defined. Fast Fourier transform (FFT) analysis for obtained spectral analytic results is presented. Y.P.Q.

A92-43121
MULTIHARMONIC CONTROL RESPONSE OF A ROTOR BLADE DURING FORWARD FLIGHT (ANALYSIS)
GIZO HASEGAWA, TOMOARI NAGASHIMA, and TOSHIFUMI NEKOHASHI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 132-135. In Japanese. refs

A rotor rear flow model is used to study vibration reduction. The Loewy and Miller method is given for the analysis of multiharmonic control response. Rotor shapes are analyzed, and analytic results are presented. Y.P.Q.

A92-43127
STUDY ON AN INDUCTION METHOD FOR A FLYING OBJECT, TAKING ACCELERATING TARGETS INTO ACCOUNT
YORIAKI BABA, MAKOTO YAMAGUCHI, and KICHIRO TAGAO (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 156-159. In Japanese. refs

An induction method for the proportional navigation is outlined. The mutual position of the target and the flying object is analyzed. The development of the simple tracking navigation method is described. Y.P.Q.

A92-43128
AIRCRAFT EVASIVE MANEUVERS AGAINST FLYING OBJECTS
TAKESHI KURODA and FUMIAKI IMADO (Mitsubishi Electric Corp., Amagasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 160-163. In Japanese. refs

The equations of motion for the calculation of aircraft evasive maneuvers is presented. The positional relationship between an aircraft and a flying object is analyzed. Computational results show the optimum evasive maneuver in the case of one aircraft with a flying object or two aircraft with a flying object. Y.P.Q.

A92-43129
THREE-DIMENSIONAL GAME FOR TWO AIRCRAFT
FUMIAKI IMADO and T. ISHIHARA (Mitsubishi Electric Corp., Amagasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 164-167. In Japanese. refs

The application of nonlinear optimum control theory to the 3D game for two aircraft is discussed. The mathematical model is given, and the aircraft maneuvers are computed. The tactical control method is addressed. Y.P.Q.

A92-43131
STEP RESPONSE OF INCOMPRESSIBLE UNSTEADY AERODYNAMIC MODELING
SHINJI SUZUKI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 172-175. In Japanese.

Active flutter suppression (AFS) and gust load alleviation (GLA) control systems are presented. Normal aerodynamic step response and the transformation of the state equations are described. Computing results on the step response of incompressible unsteady aerodynamics are analyzed. Y.P.Q.

A92-43134
GUST LOAD ALLEVIATION CONTROL DESIGN FOR THE ACCURACY OF AN AEROELASTIC ACTIVE CONTROL MODEL
K. FUJII, YOSHIKAZU MIYAZAWA, and H. MATSUSHITA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 184-187. In Japanese. refs

Research on active control technology (ACT) for gust load alleviation (GLA) is discussed. Test equipment for the GLA is introduced and equations describing the GLA is considered. A mathematical model for the control design is analyzed. Y.P.Q.

A92-43135
ACT WIND TUNNEL EXPERIMENT ON GUST LOAD ALLEVIATION. II - WIND TUNNEL TEST WITH ACTIVE SUPPORT FACILITY
H. MATSUSHITA, K. FUJII, and S. SUZUKI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 188-191. In Japanese. refs

A dynamic model support facility for an ACT (active control technology) wind tunnel test is presented. The flutter margin characteristics of the gust load alleviation (GLA) control are discussed. The linear quadratic Gaussian (LQG) method is used for the design of the optimum control. Y.P.Q.

A92-43146
PATH ANGULAR CONTROL OF THE STOL RESEARCH AIRCRAFT ASUKA
NORIAKI OKADA, TOKIO KASAI (National Aerospace Laboratory, Chofu, Japan), and H. TSUJIMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 240-243. In Japanese.

The path angular control of the STOL research aircraft Asuka is described. The development of the path angular control model is described. Y.P.Q.

A92-43159
AN ADAPTIVE FLIGHT CONTROL FOR USE IN CONNECTION WITH HELICOPTER ENGINE FAILURE
YOSHINORI OKUNO (National Aerospace Laboratory, Tokyo, Japan) and KEIJI KAWACHI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 296-299. In Japanese. refs

A92-43180
ROBUST FLIGHT CONTROL SYSTEM DESIGN USING A MULTIMODEL APPROACH. II
Y. MIYAZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 384-387. In Japanese. refs

A theoretical evaluation of a flight control system is presented. The slow mode of aircraft longituinal dynamics is discussed. Computational results are given. Y.P.Q.

A92-43182
MODEL REFERENCE ADAPTIVE FLIGHT CONTROL SYSTEM (MRAFCS) DESIGN WITH CONSIDERATION OF THE BALANCE POINT
H. KATO, T. SAKAI, and YUZO SHIMADA (Nihon University, Funabashi, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 392-395. In Japanese. refs

A design methodology for a model reference adaptive flight control system (MRAFCS) is presented. The microdisturbance functions and aircraft motion equations are discussed. The pattern derivation of the adaptive control system is considered, and results of numerical simulation are presented. Y.P.Q.

A92-43183
STUDY OF THE FLIGHT CONTROL OF REMOTELY PILOTED HELICOPTERS
F. HANE and KISHI YAMAMOTO IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 396-399. In Japanese. refs

The aerodynamics of a remotely piloted helicopter is discussed. The characteristics of the control system are described. Y.P.Q.

A92-43184
A RESTRUCTURABLE FLIGHT CONTROL SYSTEM DESIGN USING NONLINEAR COMPENSATION
YOSHIMASA OCHI and KIMIO KANAI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 400-403. In Japanese. refs

The state and power equations of nonlinear compensation for a restructurable flight control system (RFCS) are presented. The thrust control and input vibration suppression are described. The time responses for thrust control and no-input/input compensation are analyzed. Y.P.Q.

A92-43185
THE ACCELERATION CONTROL SYSTEM DESIGN OF A FLIGHT VEHICLE USING A TWO-WING CONTROL METHOD
YOSHIMASA OCHI, KIMIO KANAI, T. SAKA (National Defense Academy, Yokosuka, Japan), F. IMADO, and KEN KURODA (Mitsubishi Corp., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 404-407. In Japanese. refs

A92-43218
A STUDY OF THE PILOT'S ASSOCIATE SYSTEM
K. TANAKA and K. MATSUMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 536-539. In Japanese. refs

The functions of the cockpit advisory system (CAS) for aircraft control is presented. The ground simulator testing model and pertinent computer programs are discussed. Y.P.Q.

A92-43884
EVALUATION AND COMPARISON OF TRIPLE AND QUADRUPLE FLIGHT CONTROL ARCHITECTURES
TOM SADEGHI (New York, State University, Binghamton) and FARZIN MOTAMED (General Electric Co., Aircraft Control Systems Dept., Binghamton, NY) IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985), vol. 7, no. 3, March 1992, p. 20-31. refs
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This paper defines and compares fault tolerances of a triple flight control architecture to a quadruple type, and investigates the impact of worst case failures on transient response of an aircraft. New insight in computing fault coverage is discussed. Two coverage models were used to compute the Probability of Loss of Control (PLOC) and the Probability of Mission Abort (PMA) for candidate architectures. Results indicate that both triple and quadruple architectures can meet the fault tolerant requirements with an acceptable level of transients upon first and second failures. Triple architectures will require a higher level of fault detection, isolation, and accommodation coverage than quadruple architectures and produce substantially larger transients upon second failure. Author

N92-27505# Naval Postgraduate School, Monterey, CA.
APPLICATION OF NEURAL NETWORK TO ADAPTIVE CONTROL THEORY FOR SUPER-AUGMENTED AIRCRAFT
M.S. Thesis
DENIS J. BERTRAND Dec. 1991 205 p
(AD-A246596) Avail: CASI HC A10/MF A03

The neural network structures developed in this thesis

demonstrate the ability of parallel distributed processing in solving adaptive control problems. Adaptive control theory implies a combination of a control method and a model estimation. The control method investigated is the Lyapunov Model Reference Adaptive Control (MRAC) and the model estimation investigated is the linear least square estimator. The neural network theory is introduced with emphasis on the back-propagation algorithm. The implementation of the neural network adaptive control structure is demonstrated on the longitudinal dynamics of the X-29 fighter aircraft. Three configurations are proposed to train the neural network adaptive control structures to provide the appropriate inputs to the unstable X-29 plant so that desired responses can be obtained. These configurations are presented in eight cases, which emulate stable systems like the X-29 closed-loop plant or the optimal and the limited X-29 controllers, and unstable systems like the X-29 plant or its inverse. GRA

N92-27577# *Wright Lab., Wright-Patterson AFB, OH.*
ADD-ON DAMPING TREATMENT FOR LIFE EXTENSION OF THE F-15 UPPER-OUTER WING SKIN Final Report, Jan. 1989 - Feb. 1991
VINCENT LEVRAEA, LYNN ROGERS, ARNEL PACIA, and MICHAEL PARIN 30 Sep. 1991 122 p
(AD-A246149; WL-TM-91-307-FIBG) Avail: CASI HC A06/MF A02

The purpose of this investigation was to design, fabricate, and verify candidate add-on damping treatments for the F-15 upper-outer wing skin. The F-15 upper-outer wing skin has experienced high cycle fatigue cracks caused by flow separation on the upper wing surface. The separated flow results during high load factor maneuvers, and in turn induced large vibratory loads on the upper wing skin and associated substructure. The capability of the F-15 to sustain these maneuvers allows the excitation to occur for sufficiently long periods of time to result in damage. Damage accumulates due to the resonant vibration of local skin/stiffener modes. The cracks initiate at the fastener holes adjacent to the integrally machined 'T' stiffeners and tend to propagate parallel to the stiffeners. Two damping treatments resulted from the investigation and were recommended for f-15 fleet retrofit. One was an external constrained-layer treatment and the other was an internal 'stand-off' treatment. Laboratory vibration, corrosion, and thermal aging tests were conducted as part of the development of the add-on damping treatments. Estimates of the life extension factors for the external and internal damping treatments were 5 and 34 respectively. GRA

N92-27956# National Aerospace Lab., Tokyo (Japan). Structural Mechanics Div.
NUMERICAL SIMULATION OF SHOCK-STALL FLUTTER OF AN AIRFOIL USING THE NAVIER-STOKES EQUATIONS
K. ISOGAI *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 12 p Mar. 1992
Copyright Avail: CASI HC A03/MF A04

In order to confirm, qualitatively, the unusual flutter phenomenon, which has been observed experimentally for the high aspect ratio (non-tailored) forward swept wing model, as a shock-stall flutter, the aeroelastic response calculation of a two dimensional airfoil whose vibration characteristics are similar to those of the typical section of a forward swept wing, was performed by using the compressible Navier-Stokes equations as a flow solver. By the examination of the flow pattern, pressure distribution and the behavior of the unsteady aerodynamic forces during the diverging oscillation of the airfoil, it is concluded that this is a shock-stall flutter, in which the large scale shock-induced flow separation is playing the dominant role and that there is a mechanism of putting energy into the elastic system of the airfoil, leading to nearly a single degree of freedom flutter. Author

N92-27958# National Aerospace Lab., Amsterdam (Netherlands).
DEVELOPMENT OF A METHOD TO PREDICT TRANSONIC LIMIT CYCLE OSCILLATION CHARACTERISTICS OF FIGHTER AIRCRAFT
J. J. MEIJER and A. M. CUNNINGHAM, JR. (General Dynamics Corp., Fort Worth, TX.) *In* AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 21 p Mar. 1992 Sponsored in part by AF and General Dynamics Corp.
(Contract NIVR-07801N)
Copyright Avail: CASI HC A03/MF A04

An analysis of steady wind tunnel data obtained for a fighter type aircraft indicated that shock-induced and trailing edge separation plays a dominant role in the development of Limit Cycle Oscillations (LCO) at transonic speeds. On this basis, a semi-empirical LCO prediction method is being developed which makes use of such steady wind tunnel data. The preliminary method was applied to several configurations and correctly identified those which have encountered LCO. The method has the potential for application early in the design process of new aircraft to determine and understand these nonlinear aeroelastic characteristics. The method is still being evaluated, and upgrading and refinements are expected from unsteady wind tunnel force and pressure measurements to be obtained from oscillating models as part of an extensive investigation into the aerodynamic nature of LCO. The method is described in its present form and the results of the latest predictions are compared with flight results and used to further assess various parametric effects. Author

N92-28154# National Aerospace Lab., Tokyo (Japan). Flight Test Team.
NOTE ON FLIGHT MEASURED CONTROL EFFECTIVENESS OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA
TOSHIO BANDOU Apr. 1991 32 p In JAPANESE; ENGLISH *summary*
(ISSN 0389-4010)
(NAL-TR-1103; JTN-92-80380) Avail: CASI HC A03/MF A01

An aircraft's control effectiveness can be evaluated in flight tests by applying an exactly known moment to the aircraft. In the NAL Short Take Off and Landing (STOL) aircraft (ASKA), a method was adopted during flight tests to measure control effectiveness of a variable incidence T-tailplane with elevators, ailerons, and spoilers. Known pitching moments were applied by using crew members loaded with ballasts to move from either a forward to rear position or vice versa, whereas known rolling moments were produced by asymmetric fuel loading. Longitudinal spoiler characteristics as a result of spoiler deflections, were investigated by performing alpha sweep tests with a spoiler up-rig. This easy flight test method was used in ASKA's flight tests to evaluate control effectiveness. The flight measured control effectiveness is subsequently compared with wind tunnel test results.
Author (NASDA)

N92-28209*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
ROBUST INTELLIGENT FLIGHT CONTROL FOR HYPERSONIC VEHICLES Ph.D. Thesis - Massachusetts Inst. of Technology
GREGORY ERROL CHAMITOFF 20 Feb. 1992 348 p
(Contract NAS9-18426)
(NASA-CR-185680; NAS 1.26:185680; CSDL-T-1106) Copyright Avail: CASI HC A15/MF A03

Intelligent optimization methods are applied to the problem of real-time flight control for a class of airbreathing hypersonic vehicles (AHSV). The extreme flight conditions that will be encountered by single-stage-to-orbit vehicles, such as the National Aerospace Plane, present a tremendous challenge to the entire spectrum of aerospace technologies. Flight control for these vehicles is particularly difficult due to the combination of nonlinear dynamics, complex constraints, and parametric uncertainty. An approach that utilizes all available a priori and in-flight information to perform robust, real time, short-term trajectory planning is presented.
Author

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.

A92-41209
SIMULATION IN THE AIR FORCE [LA SIMULATION DANS L'ARMEE DE L'AIR]
BLANC (Armee de l'Air, Paris, France) (Institut Francais de Navigation, Colloque sur la Simulation Aerienne et Maritime, Paris, France, Dec. 11, 1991) Navigation (Paris) (ISSN 0028-1530), vol. 40, no. 158, April 1992, p. 207-213. In French.
Copyright

An overview is presented of simulation training as applied in the French Air Force. Attention is given to various simulators and how they are employed to instruct, train, and enhance the operational level of aircrews. It is shown that simulation is an important aid for flight management and safety, and a valuable factor for the instruction of airborne and technical personnel. R.E.P.

A92-41210
SIMULATION AS APPLIED TO MISSION PLANNING [LA SIMULATION APPLIQUEE A LA PREPARATION DES MISSIONS]
CASAU (Marine Nationale, Paris, France) (Institut Francais de Navigation, Colloque sur la Simulation Aerienne et Maritime, Paris, France, Dec. 11, 1991) Navigation (Paris) (ISSN 0028-1530), vol. 40, no. 158, April 1992, p. 221-226. In French.
Copyright

An overview is presented of flight simulation equipment and utilization for the preparation of military operational flight plans. Attention is given to the use of digitized navigation maps and the utilization of data obtained from navigation satellites. Consideration is given to the planning of attack missions and to the use of SPOT imagery. R.E.P.

A92-41215* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DESIGN AND DEVELOPMENT OF A COMPRESSIBLE DYNAMIC STALL FACILITY
L. W. CARR (U.S. Army, Aviation Systems Command; NASA, Ames Research Center, Moffett Field, CA) and M. S. CHANDRASEKHARA (U.S. Naval Postgraduate School, Monterey, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 314-318. Research supported by USAF and U.S. Navy. Previously cited in issue 09, p. 1295, Accession no. A89-25511. refs
Copyright

A92-41221
SOFTWARE RELIABILITY FOR FLIGHT CREW TRAINING SIMULATORS
GEORGE E. STARK (Mitre Corp., Houston, TX) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 355-359. Previously cited in issue 04, p. 476, Accession no. A91-16679. refs
Copyright

A92-41230
ROBUST FLIGHT RECONSTRUCTION FOR HELICOPTER SIMULATION AND TRAINING
K. KRISHNAKUMAR, R. K. PRASANTH, and J. E. BAILEY (Alabama, University, Tuscaloosa) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 421-428. refs
Copyright

The concept of using flight-recorded data for training via real-time simulator playback of flight maneuvers is introduced, and the requirements and technical methodology for simulator-based flight reconstruction are discussed. A robust Kalman filter design, which includes parametric uncertainties modeled as multiplicative white noise processes, is utilized as a state estimator flight simulator driver. Actual robust Kalman filter implementation utilizes a UH-60 helicopter nonlinear simulation (piecewise linear aerodynamics) for state propagation to facilitate easy transition between flight reconstruction and manual simulation. This robust technique is compared to the traditional linearized extended Kalman filter approach. Resulting flight data reconstruction system simulation, using computer-generated data and flight test data, demonstrates the flight payback insensitivity to helicopter model parameter changes. The study results indicate superior performance of the robust Kalman filter approach for the flight reconstruction for flight simulation (FRFFS) problem. Author

A92-41336#
AERO-OPTICAL TESTING IN THE NSWC HYPERVELOCITY TUNNEL NO. 9
ERIC R. HEDLUND, ARNOLD S. COLLIER, and WILLIAM O. MURDAUGH (U.S. Navy, Naval Surface Warfare Center, Silver Spring, MD) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 12 p. Research sponsored by U.S. Army. refs
(AIAA PAPER 92-2797)

An optical system was developed and used to measure the pitch plane boresight error and image blur induced by a hypersonic flowfield over a sensor window of a conical forebody. These experiments were performed in the NSWC Hypervelocity Wind Tunnel No. 9 at Mach 10 with a nominal freestream Reynolds number of 9.5 million/ft. These data represent some of the first aero-optical measurements made in a hypersonic wind tunnel. The paper discusses the details of the optical system, measurement uncertainty, results, and recommendations for future tests. A complete data set with look angles of 10, 20, 30, 45, 65 degrees is presented for angles of attack of -15, -7.5, 0, +15 degrees for two cooling concepts. Author

A92-41929
SOME PROBLEMS ON THE SIDEWALL INTERFERENCE IN TWO-DIMENSIONAL SUBSONIC AND TRANSONIC WIND TUNNEL TESTING
KEMING CHENG and YIYI HUANG (Nanjing Aeronautical Institute, People's Republic of China) Nanjing Aeronautical Institute, Journal (ISSN 1000-1956), vol. 24, no. 2, April 1992, p. 216-219. In Chinese. refs

Some problems related to sidewall interference in 2D wind tunnel testing are discussed. The characteristics of sidewall interference are indicated, and a comparative analysis of various correction rules for the interference is made. Expansion of the sidewall to alleviate the interference is quantitatively analyzed. C.D.

A92-43096
HYPERSONIC TESTING TECHNOLOGY OF HOPE (H-II ORBITING PLANE)
NORIO SUZUKI and TETSUICHI ITO (NASDA, Tsukuba Space Center, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 2-5. In Japanese. refs

The requirements on heat-resistant materials in connection with HOPE reentry are presented. The hypersonic test is described and a model test for aerodynamic heating is discussed. The measuring results of the aerodynamic heating distribution are reported, and wind tunnel tests for aerodynamic characteristics are outlined. Y.P.Q.

A92-43097
TEST ON HIGH ENTHALPY HYPERSONIC FLOW USING A BALLISTIC RANGE
T. FUJIWARA, AKIHIRO SASO, and XINYU CHANG (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 6-9. In Japanese. refs

A numerical analysis of three-dimensional hypersonic flow is presented. The test equipment for studying high enthalphy hypersonic flow is introduced. The ballistic range measuring sector and the vacuum chamber are emphasized. The thrust velocity measurement is studied. Y.P.Q.

A92-43098
A TWO-STAGE-DIAPHRAGM FREE-PISTON SHOCK TUBE FOR A STRONG SHOCK WAVE
HIROKI HONMA and HIROYUKI IIZUKA (Chiba University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 10-13. In Japanese. refs

The performance and configurations of a free-piston two-stage-diaphragm shock tube are presented. Piston compression peak pressure and the initial pressure in the high pressure tube are compared. Y.P.Q.

A92-43099
STUDY ON SMALL STALKER TUBE PERFORMANCE AND NUMERICAL CALCULATION
S. TAKAYAMA, T. OTA, and R. CASEY (Tohoku University, Sendai, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 14-17. In Japanese. refs

The performance and schematic of a stalker tube are presented. The test results show the pressure variations at the compression tube and the pressure distribution in the shock tube. The TVD method is used for the numerical simulation. The maximum pressure of compression in terms of Pc and Wp and isopycnics in the free piston shock wave tube are illustrated. Y.P.Q.

A92-43104
THERMAL MEASUREMENT TEST IN A SHOCK WIND TUNNEL
Y. HAMADA, T. MATSUDA (Kawasaki Heavy Industries, Ltd., Kobe, Japan), TAKASHI YAMAZAKI, and K. SOGA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 60-63. In Japanese. refs

The National Aerospace Laboratory (NAL) wind tunnel is introduced. A thermal electric sensor is used for measurement of the cylinder model. Test results are given and the aerodynamic heating distribution around the cylinder is emphasized. Y.P.Q.

A92-43105
RESEARCH ON HYPERSONIC WIND TUNNEL METHODS IN THE 90'S
SEIICHI HASEGAWA and E. YOSHIOKA (Sumitomo Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 68-71. In Japanese. refs

The facility requirements of thermal wind tunnel tests are presented. The viscous interaction efficiency test is addressed. The thermal resistant structural system and structural materials for spacecraft surfaces are discussed. Y.P.Q.

A92-43110
STUDY ON THE LOWER ASPECT VIEW OF A HELICOPTER SIMULATOR
M. UEMURA and M. OI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 88-91. In Japanese.

The display instrument of the simulated visual field for a helicopter is presented. The simulation test of the NOE (nap of the earth) flight course using computer generated imagery is discussed. The display method and the effectiveness of the lower aspect view of a helicopter simulator are addressed. Y.P.Q.

A92-43113
STUDY ON THE EFFECTIVE UTILIZATION OF THE CURRENT FLIGHT SIMULATOR
H. OKU (All Japan Air Transportation, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 100-103. In Japanese.

Current flight simulator (B767-300) characteristics are introduced, and the simulated visual field instrument is discussed. The eight-channel sound generation system and the SELPAC/MULTISEL computer system are described. Y.P.Q.

A92-43124
DEVELOPMENT OF AN INSTRUMENT FOR MEASURING RUNWAY ROUGHNESS
TOKUO SOTOZAKI and KOSABURO YAMANE (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 144-147. In Japanese. refs

The structure and functions of a runway-roughness measuring instrument are presented. The theory of the optical sensor used and the relationship between the optical sensor and the grooved surface are described. Y.P.Q.

A92-43125
A PROPOSED METHOD FOR EVALUATING RUNWAY ROUGHNESS
TOKUO SOTOZAKI and KOSABURO YAMANE (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 148-151. In Japanese. refs

The evaluation of the roughness of a slippery runway and a method for measuring the average texture depth (ATD) are presented. The roughness of grooved and nongrooved runway surfaces is evaluated. A power spectral density (PSD) method is used to evaluate runway roughness from the standpoint of aircraft loads. Y.P.Q.

A92-43136
TRANSONIC WIND TUNNEL TESTS OF FLUTTER SUPPRESSION EQUIPMENT (WING RESPONSE DATA PROCESSING)
H. MATSUSHITA, K. FUJII, and S. SUZUKI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 192-195. In Japanese. refs

A wing model designed for vibration tests is described. A transonic wind tunnel test is presented and data analysis for the wing aeroelastic characteristics is considered. An FFT data analysis approach is addressed. Y.P.Q.

A92-43158
A STUDY OF A GROUND SUPPORT EQUIPMENT (GSE) NETWORK
H. INOKA (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 292-295. In Japanese.

The aircraft condition monitoring system (ACMS) and the central maintenance computer system (CMCS) are described. The structure of the ACMS and the ground support equipment (GSE) network are discussed. The computer software and hardware for the network system are addressed. Y.P.Q.

A92-43171
RECENT AIRFOIL TESTS IN NAL 2D HIGH REYNOLDS NUMBER WIND TUNNEL
I. KAWAMOTO, H. MIWA, S. BABA, M. SATO, H. KANDA, and N. SUDANI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 346-349. refs

Experimental results are presented for the NAL's 2D high

Reynolds number wind tunnel sidewall boundary layer suction feature. Boundary layer thickness, centerline Mach numbers, and representative airfoil pressure measurements are evaluated. The shock location on the NACA 0012 airfoil at Mach 0.8 and zero incidence is found to exhibit no improvement at full boundary layer suction conditions. Boundary layer thickness is intrinsically large relative to other facilities. O.C.

A92-43172
MEASUREMENT OF MAGNUS DERIVATIVES WITH AN ELASTICALLY FORCED OSCILLATION RIG
B. R. SRINIVASA RAO and G. N. V. RAO (Indian Institute of Science, Bangalore, India) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 350-352.

In this paper, measurement of magnus force and moment derivatives using an elastically forced oscillation rig is described. Measurements were made at low wind speeds on a finned body of revolution. The rig consists of a scotch-yoke driving a frame to which the model is fitted by means of two longitudinally spaced flexures. The rig is capable of exciting three-degree-of-freedom oscillations to the model. Measurement of excitation, displacement, and force were made, and the magnus derivatives were calculated at the dominant oscillations in roll and swerve modes whose magnitude agreed fairly well with that for a somewhat similar body, reported in the literature. It is therefore concluded that the rig which was initially developed to determine coupling derivatives can also be used to determine magnus derivatives. Author

A92-43199
WING TEST AT THE CRYOGENIC WIND TUNNEL OF THE NATIONAL DEFENSE ACADEMY
YUTAKA YAMAGUCHI, YOSHIHIRO MAN, and Y. NAKAUCHI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 460-463. In Japanese. refs

Wind test results and NASA 0.3 meter transonic cryogenic tunnel (TCT) data are compared. The test equipment and methodology are discussed. The temperature pattern and R4 airfoil pressure distribution are presented. Y.P.Q.

A92-43210
MOTION ESTIMATION FOR CABLE-MOUNT DYNAMIC WIND-TUNNEL TEST
SHUICHI SASA, MASAAKI YANAGIHARA, TAKASHI SHIMOMURA, MINORU TAKIZAWA, SEIZO SUZUKI, and MASAHIKO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 504-507. refs

Cable-mount dynamic wind-tunnel tests were made in the NAL low speed wind tunnel for estimating longitudinal aerodynamic derivatives of a 5-percent spaceplane model. The longitudinal motion trajectories were estimated by the Kalman filtering technique. The estimates were well consistent with sensor measurements. Stationary and nonstationary Kalman filters were applied, and the applicability of state estimation for real time control was also evaluated. The effectiveness of the system configuration for cable-mount dynamic wind-tunnel test is shown. Author

N92-26527# Aerospace Medical Research Labs., Brooks AFB, TX.
MICROCOMPUTER-BASED INSTRUMENT FLIGHT SIMULATION: UNDERGRADUATE PILOT TRAINING STUDENT ATTITUDE ASSESSMENT Final Report, Jan. - Feb. 1991
BRIAN K. ROGERS Dec. 1991 23 p
(Contract AF PROJ. 1123)
(AD-A245449; AL-TR-1991-0039) Avail: CASI HC A03/MF A01

The purpose of this investigation was to assess United States Air Force (USAF) Undergradate Pilot Training (UPT) student attitudes toward using a T-37 tailored personal computer (PC) or microcomputer-based simulation as an addition to the formal training syllabus. Eight student classes were surveyed in Phases 1 and 2 of the three phases of UPT. As hypothesized the UPT students were most receptive to using a microcomputer simulation for instrument training after having completed both instrument academics and the initial instrument simulator missions. Only 36 pct. of the students starting UPT were likely to use a microcomputer simulation to replace 75 pct. or more of their chair-flying, compared to 51.4 pct. of the students who had completed an instrument simulator sortie. On the average, UPT students having completed 12106 (two sorties prior to the instrument check ride) said they would use a microcomputer simulation on a daily basis to enhance their training. After attempting to learn the instrument procedures, students indicated they were eager to use a microcomputer simulation. It was demonstrated that, in general, UPT students are sensitive to their difficulties in learning instrument procedures and are willing to replace chair-flying with a microcomputer simulation. GRA

N92-26720# Los Alamos National Lab., NM.
AN EXPLOSIVELY DRIVEN, FAST SHOCK TUBE
T. H. TAN and S. MARSH 1992 9 p Presented at the 2nd International Symposium on Intense Dynamic Loading and Its Effects, Chengdu, China, 9-12 Jun. 1992
(Contract W-7405-ENG-36)
(DE92-008437; LA-UR-92-356; CONF-920688-7) Avail: CASI HC A02/MF A01

A simple, cylindrically configured fast shock tube (FST) has been employed as a tool to investigate the hydrodynamics of plate drive under a very high impulse loading condition. The shock tube has a high explosive outer shell and a low density foam core. The implosion produces a well defined Mach disk that is then subsequently used to drive a metallic plate. A thin stainless steel (SS) plate has been successfully launched to 9 km/s with this device. The experimental results from the study of material flow will be presented and compared with numerical calculation. Various interesting measurement techniques will also be discussed. DOE

N92-27428# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.
A PRESSURE MEASUREMENT METHOD USING ELECTRONICALLY SCANNER PRESSURE SENSORS (ESP) INSTALLED IN A GUST WIND TUNNEL
TOSHIMI FUJITA, AKIHITO IWASAKI, FUMIKO ITOU, and HIROTOSHI FUJIEDA Jul. 1991 27 p In JAPANESE; ENGLISH summary
(ISSN 0452-2982)
(NAL-TM-638; JTN-92-80364) Avail: CASI HC A03/MF A01

Electronically Scanner Pressure (ESP) sensors were installed at various data acquisition locations in a Gust Wind Tunnel in order to obtain pressure measurements at high speeds. However, changes in the environmental conditions, particularly flow temperature, resulted in the sensors displaying a span and zero shift, thus making them difficult to use in a long run wind tunnel tests. Experiments were subsequently performed to solve these problems, and a method was established which assured they maintain their required measurement accuracy. This method utilized the established ESP sensors system and efficiently reduced data acquisition requirements. In the case of a Short Take Off and Landing (STOL) aircraft semispan model, the time required for wake measurements was reduced by approximately equals 2 percent, i.e., the test took only one hour versus one and a half days using the previous method. Both the newly developed method and the currently used high speed pressure measuring system using ESP sensors are described. Author (NASDA)

N92-27645# Toronto Univ. (Ontario). Dept. of Aerospace Science and Engineering.
THE MODELLING OF TURBULENCE AND DOWNBURSTS FOR FLIGHT SIMULATORS Ph.D. Thesis
PAUL AARON ROBINSON Jun. 1990 394 p
(ISBN-0-315-59945-6; CTN-92-60468) Copyright Avail:

Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $45.00 CAN, MF $15.00 CAN

This study investigates the degree of complexity required in the simulation of turbulence and thunderstorm downburst wind shear for flight simulation. A turbulence model is presented which contains all the correlations found in homogeneous isotropic turbulence. As part of the development of this turbulence model, a method is introduced by which a time series may be modulated to alter its statistical properties while not affecting its spectral properties. Several simplifications and alternate models are considered. This report also presents further developments in the simulation of thunderstorm downbursts. A single ring vortex system, a triple ring vortex system, and Joint Airport Weather Studies (JAWS) data are implemented on the University of Toronto Institute for Aerospace Studies (UTIAS) B-747 Flight Simulator. By means of pilot evaluations on this simulator, it was found that the inclusion of the isotropic turbulence correlations did not seem to affect the pilots' performance or aircraft response. Overall, spectral methods were favored as a means of generating turbulence for flight simulation. Pilot evaluations of the downburst models showed that both single and triple ring vortex systems produced similar pilot reactions to the actual downbursts (JAWS data). It is suggested that the ring vortex models be expanded upon to include more than one downburst cell. Author (CISTI)

N92-27670*# *National Aeronautics and Space Administration.* Langley Research Center, Hampton, VA.

EFFECT OF COLLECTOR CONFIGURATION ON TEST SECTION TURBULENCE LEVELS IN AN OPEN-JET WIND TUNNEL

G. S. MANUEL, JOHN K. MOLLOY, and P. STEPHEN BARNA Jul. 1992 22 p

(Contract RTOP 505-61-41-02)

(NASA-TM-4333; L-16838; NAS 1.15:4333) Avail: CASI HC A03/MF A01

Flow quality studies in the Langley 14- by 22-Foot Subsonic Tunnel indicated periodic flow pulsation at discrete frequencies in the test section when the tunnel operated in an open-jet configuration. To alleviate this problem, experiments were conducted in a 1/24-scale model of the full-scale tunnel to evaluate the turbulence reduction potential of six collector configurations. As a result of these studies, the original bell-mouth collector of the 14- by 22-Foot Subsonic Tunnel was replaced by a collector with straight walls, and a slot was incorporated between the trailing edge of the collector and the entrance of the diffuser. Author

N92-27753# Pennsylvania State Univ., University Park. Applied Research Lab.

PARTICLE IMAGE VELOCIMETRY Semiannual Progress Report

S. DEUTSCH 12 Feb. 1992 1 p

(Contract N00014-91-J-1608)

(AD-A246638) Avail: CASI HC A01/MF A01

We will develop Particle Image Velocimetry (PIV) as a viable turbulence research tool at a near-wall flow facility (glycerin tunnel). The PIV technique is used to study the influence of controlled disturbances on the fluid structure in the very near wall region and compare these results with those from an ongoing LDA study. A PIV system may be conveniently separated into two parts: an image acquisition system and an image interrogation system. The image acquisition system is now operational, while the image acquisition system is still under development. The system consists of a small Helium-Neon laser and the associated optics needed for picture illumination and transformation, an x-y traversing system for accurate slide positioning during interrogation, a CCD camera, and an image monitor. The interrogation system optically transforms a laser illumination image and then uses a Young's fringe pattern based technique to analyze the image and reconstruct the velocity field. This interrogation system is tied to a Swan 386 microcomputer and established that all the hardware and software functions properly. GRA

N92-27792*# Academy of Sciences (USSR), Moscow. Central Aero-Hydrodynamic Inst.

CRYOGENIC TEST RIG WITH AN AERODYNAMIC MAGNETICALLY LEVITATED CARRIAGE

SERGEY YU. BORISOV, ANTON L. ISKRA, and ANATOLY P. PHILATOV *In* NASA. Langley Research Center, International *Symposium on Magnetic Suspension Technology, Part 2* p 547-558 May 1992

Avail: CASI HC A03/MF A04

The results are presented of the studies which concern the use of a magnetically levitated aerodynamic carriage with a model moving in a closed cryogenic channel. The facility dimensions are established, operating ranges are calculated, thermal isolation, cooling and measurement systems are described, comparison of this facility with wind tunnels is given and its advantages are shown. Author

N92-27801*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PROPULSION SIMULATOR FOR MAGNETICALLY SUSPENDED WIND TUNNEL MODELS

P. B. JOSHI, M. R. MALONSON, G. P. SACCO, C. L. GOLDEY, K. GARBUTT, M. GOODYER (Southampton Univ., England), and P. LAWING *In its* International Symposium on Magnetic Suspension Technology, Part 2 p 709-739 May 1992

(Contract NAS1-18845)

Avail: CASI HC A03/MF A04

Simulation of propulsion induced aerodynamic forces and moments, which arise as a result of interactions between propulsive jets and the free stream, is one of the most desired capabilities in magnetic suspension wind tunnels. The feasibility of generating exhaust jets of appropriate characteristics onboard magnetically suspended models was examined. Four concepts of remotely operated propulsion simulators was considered. Three conceptual designs involving conventional technologies such as compressed gas cylinders, liquid monopropellants, and solid propellants were developed. The fourth concept, a laser assisted thruster, which can potentially simulate both inlet and exhaust flows, was found to require very high power levels. The measurement of aerodynamic forces and/or moments were demonstrated, including the effects of exhaust jets, in MSBS wind tunnels. Two propulsion simulator models were developed, a small scale and a large scale unit, both using compressed, liquified CO2 as propellant. Results of the wind tunnel tests with the small scale simulator are discussed. Author

N92-27802*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PRESENT STATUS OF THE MIT/NASA LANGLEY 6-INCH MSBS

TIMOTHY SCHOTT, THOMAS JORDAN, TAUMI DANIELS, and CHARLES ALCORN (Old Dominion Univ., Norfolk, VA.) *In its* International Symposium on Magnetic Suspension Technology, Part 2 p 741-764 May 1992

Avail: CASI HC A03/MF A04

The latest improvements are described which were made to the MIT/NASA Langley 6 Inch Magnetic Suspension and Balance System and its operational capabilities. Since its relocation from MIT in 1984, the system has suffered from reliability problems with original equipment. System performance is ultimately limited by noise and antiquated power supplies. Although a limited amount of funding and man hours has been expended, some significant improvements were made to the system. The design and implementation of a new electro-magnetic position sensor has significantly reduced system noise and drift. The system was shown fully operational for the first time since its arrival at NASA Langley. An ogive cylinder test model was suspended while running the wind tunnel at its maximum of approx. Mach 0.5. Other aerodynamic models were suspended with wind on. Also, the simulation of low speed cavity store separation using an ogive cylinder test model is described. Methods used for flow visualization for this test are also discussed. The system is ideally suited for this type of low speed testing. Author

N92-27803*# Moscow Inst. of Aviation Technology (USSR).
PROGRESS OF MAGNETIC SUSPENSION AND BALANCE SYSTEMS FOR WIND TUNNELS IN THE USSR
A. V. KUZIN, Y. D. VYSHKOV, and G. K. SHAPOVALOV (Academy of Sciences, USSR, Moscow) *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 765-774 May 1992
Avail: CASI HC A02/MF A04

Magnetic Suspension and Balance Systems (MSBS) for wind tunnels are being developed in order to solve the principal problems of aerodynamics which cannot be solved by conventional means: (1) measurements of aerodynamic loads acting on the aircraft models without the effects of mechanical supporting devices; and (2) the study of base pressure. This paper traces the progress of MSBS for wind tunnels in the Commonwealth of Independent States (CIS). The paper describes electromagnetic configuration, position sensing, and control and calibration systems of two wind tunnel MSBS existing in the CIS. The features of high-angle-of-attack control and roll control are discussed. The results of preliminary experiments on high-angle-of-attack and roll controls, digital control, and aerodynamic testing are also presented. Author

N92-27804*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
WIND TUNNEL MAGNETIC SUSPENSION SYSTEMS AT THE UNIVERSITY OF SOUTHAMPTON, ENGLAND
MICHAEL J. GOODYER *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 775-788 May 1992
Avail: CASI HC A03/MF A04

The magnetic suspension system at Southampton University was used in two roles: as a device for producing useful aerodynamic data, and as a vehicle to develop and demonstrate new technology for application to a projected larger facility. Examples of both follow, beginning with an outline of the quest to develop methods for reaching high angles of attack because of current interest in researching the associated aerodynamics. Author

N92-27836# Technology Systems, Inc., North Edgecomb, ME.
DEVELOPMENT OF THE BASIC FLIGHT INSTRUCTION TUTORING SYSTEM (BFITS) Final Report, Sep. 1989 - Dec. 1991
CHARLES J. BENTON, PAUL CORRIVEAU, JEFFERSON M. KOONCE, and WILLIAM C. TIRRE Jan. 1992 28 p
(Contract F33615-89-C-0009)
(AD-A246458; AL-18) Avail: CASI HC A03/MF A01

The Basic Flight Instruction Tutoring System (BFITS) is a microcomputer-based flight trainer designed to teach both the declarative and procedural knowledge needed for basic flight maneuvers, while monitoring, tracking, and recording the student's behavior as he/she works with the tutor. BFITS provides a criterion task for (1) the validation of experimental psychological tests under consideration for pilot selection, and (2) the evaluation of the effects of drugs and environmental factors on pilot performance. BFITS consists of an instructional module, a flight simulator, and a performance evaluator, which work together to involve the student in tasks requiring both cognitive and psychometer skills. The instructional module teaches the declarative knowledge of basic flight using text, graphics, and animation. The flight simulator provides the student with practice in flying a simulated airplane. It is used in conjunction with a number of easily changed flight scenarios that direct the students current task and provide performance evaluation criteria and hint messages. The performance evaluator tracks student progress and allows the student to view a graphical display of his/her performance as measured against the evaluation criteria. Flights can be played back for review also. GRA

N92-27976*# MCAT Inst., San Jose, CA.
DEVELOPMENT OF A QUIET SUPERSONIC WIND TUNNEL WITH A CRYOGENIC ADAPTIVE NOZZLE Progress Report
STEPHEN W. D. WOLF May 1992 68 p
(Contract NCC2-604)
(NASA-CR-188055; NAS 1.26:188055; MCAT-92-012) Avail: CASI HC A04/MF A01

Aspects of the design and construction of the Laminar Flow Supersonic Wind Tunnel at the NASA-Ames Fluid Mechanics Laboratory are discussed. The wind tunnel is to be used as part of the NASA High Speed Research Program (HSRP).

N92-27977*# MCAT Inst., San Jose, CA.
DEVELOPMENT OF A QUIET SUPERSONIC WIND TUNNEL WITH A CRYOGENIC ADAPTIVE NOZZLE Annual Progress Report, Mar. 1991 - Apr. 1992
STEPHEN W. D. WOLF *In its* Development of a Quiet Supersonic Wind Tunnel with a Cryogenic Adaptive Nozzle 8 p May 1992
(Contract NCC2-604)
Avail: CASI HC A02/MF A01

The main objective of this work was the development of an interim quiet (low-disturbance) supersonic wind tunnel for the NASA-Ames Fluid Mechanics Laboratory (FML). This is a result of the need to bring the full-scale tunnel on-line as rapidly as possible to impact the NASA High Speed Research Program (HSRP). The development of a cryogenic adaptive nozzle and other sophisticated features of the tunnel will now happen later, after the full scale wind tunnel is in operation. Author

N92-27978*# MCAT Inst., San Jose, CA.
THE FML COMPRESSOR AS A DRIVE SYSTEM FOR THE LFSWT: A NARRATIVE
JAMES LAUB and STEPHEN WOLF *In its* Development of a Quiet Supersonic Wind Tunnel with a Cryogenic Adaptive Nozzle 10 p May 1992
Avail: CASI HC A02/MF A01

During 1988, a feasibility study was performed to decide how best to build a Laminar Flow Supersonic Wind Tunnel (LFSWT) at the NASA-Ames Fluid Mechanics Laboratory (FML) for boundary layer transition research. A full report was received in June 1988. The report was based on the following guidelines: continuous operation at Mach numbers within the range from 1.8-4.0 was required to impact the NASA 'HiStar' project; low disturbance flow is essential for transition research; minimum test section height is 8 inches; tunnel must fit in an FML test cell; tunnel design should be simple; and construction costs should be minimized. The study considered three drive system options: (1) use surplus JPL compressors and support equipment; (2) use of the FML compressor with ambient injectors; and (3) use of the FML compressor with injectors driven by the NASA-Ames 3000 psia air supply. Author

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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.

A92-41184
INTERNATIONAL CONFERENCE ON AEROSPACE TRENDS...2001 - FROM AEROPLANE TO AEROSPACE PLANE, THIRUVANANTHAPURAM, INDIA, JUNE 27, 28, 1991, PROCEEDINGS
Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, 116 p. For individual items see A92-41185 to A92-41197.
Copyright

Consideration is given to operational characteristics of future launch vehicles, trends in propulsion technology, technology challenges in the development of cryogenic propulsion systems

for future reusable space-launch vehicles, estimation of the overall drag coefficient of an aerospace plane, and self-reliance in aerospace structures. Attention is also given to basic design concepts for smart actuators for aerospace plane control, a software package for the preliminary design of a helicopter, and multiconstraint wing optimization. O.G.

A92-41193
BASIC DESIGN CONCEPTS FOR SMART ACTUATORS FOR AEROSPACE PLANE CONTROL
B. N. SURESH and THOMAS KURIAN (ISRO, Vikram Sarabhai Space Centre, Thiruvananthapuram, India) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 195-198. refs

Control requirements for an aerospace plane vehicle are briefly discussed, and the basic design concepts of a smart actuator are reviewed. It is concluded that a smart actuator with a triple modular redundant spare controller meets the reliability and safety requirements of space vehicles. The system will be based on autonomous redundant hardware and on-board software, and will directly interface with the control and guidance computers. O.G.

A92-41344#
MULTIPLE APERTURE WINDOW AND SEEKER CONCEPTS FOR ENDO KEW APPLICATIONS
V. H. SHUI, B. L. REEVES, N. A. THYSON (Textron Defense Systems, Wilmington, MA), W. H. MUEFFELMANN, J. S. WERNER (Loral Infrared and Imaging Systems, Lexington, MA), and G. JONES (U.S. Army, Strategic Defense Command, Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 15 p. refs
(AIAA PAPER 92-2806)

Hypersonic interceptors performing endoatmospheric hit-to-kill missions require very high seeker angle measurement accuracies in very severe aero-thermal environments. Wall jet window/aperture cooling usually leads to significant aero-optic degradation in seeker and hence interceptor performance. This paper describes window/aperture concepts that have the potential of eliminating or significantly reducing the need for coolant injection, together with a multiple aperture sensor concept that can provide a high angle measurement accuracy and a large field of regard, with a small aperture size. Author

A92-41535* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EARTH AEROBRAKING STRATEGIES FOR MANNED RETURN FROM MARS
ROBERT D. BRAUN, RICHARD W. POWELL (NASA, Langley Research Center, Hampton, VA), and J. E. LYNE (Eloret Institute, Palo Alto, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, no. 3, May-June 1992, p. 297-304. Previously cited in issue 21, p. 3607, Accession no. A91-49821. refs
Copyright

A92-43190
FLIGHT SIMULATION OF A SPACEPLANE
S. SUZUKI, T. KANDO, and S. TORINOUMI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 424-427. In Japanese. refs

A theoretical study of a spaceplane is presented, with emphasis on the aerodynamic characteristics. Simulation results are given and the effectiveness of airframe shapes is analyzed. Y.P.Q.

A92-43192
WIND TUNNEL TESTS ON THE MOTION OF A SPACEPLANE SIMULATION FOR CABLE MOUNT
MASAHIKO NAGAYASU, SEIZO SUZUKI, SHUICHI SASSA (National Aerospace Laboratory, Tokyo, Japan), and K. YONEMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 432-435. In Japanese. refs

The structures of the cable mount system (CMS) for a spaceplane is presented. The control measuring system and interactive parameter identification system are illustrated and wind tunnel dynamic test is discussed. Test results are given and aerodynamic microcoefficients are listed. Y.P.Q.

A92-43200
TRANSONIC VISUALIZATION TEST FOR THE AIRFRAME SHAPE IMPROVEMENT OF A SPACEPLANE
S. SAYA, MAMORU SATO, H. KANDA, and S. BABA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 464-467. In Japanese. refs

A visualization test for spaceplane shape improvement is presented. The wind tunnel test and its test method are introduced. The basic and improved configurations of the test model are described. Y.P.Q.

A92-43211
ESTIMATION OF SPACEPLANE LONGITUDINAL STABILITY AND CONTROL DERIVATIVES FROM DYNAMIC WIND TUNNEL TEST
MASAAKI YANAGIHARA, SHUICHI SASA, TAKASHI SHIMOMURA, MINORU TAKIZAWA, SEIZO SUZUKI, and MASAHIKO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 508-511. refs

Dynamic wind tunnel tests using a 5-percent cable-mounted model of the NAL spaceplane have been conducted in the NAL low-speed large scale wind tunnel. A parameter identification study of the recorded data was undertaken to extract longitudinal stability and control derivatives. The following three estimation methods were adopted: (1) estimate all the derivatives simultaneously; (2) estimate the stability and control derivatives separately; and (3) estimate the dynamic derivatives only while the static derivatives are fixed in results from static wind tunnel tests. The estimated derivatives were evaluated by comparing mathematically simulated time histories based on them with tunnel test data. As a result, all major derivatives were estimated well and the effectiveness of the dynamic test was shown. Author

A92-43212
ESTIMATION OF SPACEPLANE MODEL INERTIA CHARACTERISTICS
MASAAKI YANAGIHARA, SHUICHI SASA, TAKASHI SHIMOMURA, and MASAHIKO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 512-515. refs

The moments and product of inertia of a NAL spaceplane 5-percent model have been determined experimentally. The method was based on a bifilar pendulum system, and estimation errors were also evaluated. As a result, the moment of inertia Iy and Iz were estimated within the error of about 1 percent but Ix and the product of inertia Ixz had larger errors. The largest cause for these errors is that the moment of inertia of a suspension rig about the x axis is relatively large compared with that of the model. Author

A92-43269
COLLISION PROBABILITY ESTIMATE METHOD FOR IMPACT GENERATED LOW EARTH ORBIT SPACE DEBRIS CLOUDS
JOHN W. FRYE (TRW, Inc., Systems Engineering and Development Div., Carson, CA) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 1. San Diego, CA, Univelt, Inc., 1992, p. 287-310. refs
(AAS PAPER 91-369) Copyright

An approach is defined for quickly estimating the cumulative

probability of collision for high value resources with low earth orbit space debris clouds produced by hypervelocity impacts. Debris cloud geometry is tracked from the time of the impact event through various stages of cloud development. Cumulative probability of collision estimates during the early phases of debris cloud formation are treated differently than those of the later phases in order to efficiently account for both the short and long term debris hazards. Collision probabilities are based on the cross sectional areas of the high value resource and the midorbital plane of the debris cloud. Experiments with a FORTRAN coding of the approach on IRIS and SUN workstations indicated that practical interactive run times could be expected for cases with limited numbers of high value satellites and debris clouds. Author

A92-43356
AEROBANG - A NEW SYNERGETIC PLANE-CHANGE MANEUVER
I. M. ROSS (U.S. Naval Postgraduate School, Monterey, CA) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 3. San Diego, CA, Univelt, Inc., 1992, p. 1789-1808. Research supported by U.S. Navy. refs
(AAS PAPER 91-418) Copyright

'Aerobang' is a maximum-thrust synergetic plane-change maneuver that traverses the heating-rate constraint boundary. A preliminary analysis indicates that the proposed maneuver offers improved fuel efficiency over the steady-state aerocruise without a loss in simplicity of the control program. The maximum throttle setting concentrates the turn at the node and much of the lift generated can be used to perform the turn. For example, for supercircular speeds, the bank angle may be chosen to be 90 deg. An additional nicety of the maneuver is that its temporal integrated heating-rate is less than that of the aerocruise maneuver. Author

N92-26362# Naval Postgraduate School, Monterey, CA.
SOLID FUEL RAMJET INFRARED SIGNATURE M.S. Thesis
RUSSELL P. LUEHRSEN Dec. 1991 76 p
(AD-A246299) Avail: CASI HC A05/MF A01

The objective of the thesis was to determine the effects of equivalence ratio and fuel composition on the infrared signature of solid fueled ramjets (SFRJ). Solid fuels investigated were Plexiglas, HTPB, and HTPB with aluminum, silicon, boron carbide, and or magnesium. They were tested at chamber pressures of 80-170 psia and with equivalence ratios between 0.3 and 1.4. With the plume emissivity set to 1.0, plume irradiance was found to increase approximately with the second power of the actual combustor stagnation temperature. In addition to providing needed plume signature data for the SFRJ, this information can be used to validate numerical predictions from the SPF (Standardized Plume Flowfield) and SIRRM (Standardized Infrared Radiation Model) computer codes, which are used to predict the plume infrared signature. GRA

N92-27403*# Engineering Research and Consulting, Inc., Tullahoma, TN.
AUTOMATED SCREENING OF PROPULSION SYSTEM TEST DATA BY NEURAL NETWORKS, PHASE 1 Final Report, 4 Oct. 1991 - 3 Apr. 1992
W. ANDES HOYT and BRUCE A. WHITEHEAD (Tennessee Univ. Space Inst., Tullahoma.) 17 Apr. 1992 48 p
(Contract NAS8-39184; SBA-4-91-2-0357)
(NASA-CR-184329; NAS 1.26:184329; ERC-R-92-022) Avail: CASI HC A03/MF A01

The evaluation of propulsion system test and flight performance data involves reviewing an extremely large volume of sensor data generated by each test. An automated system that screens large volumes of data and identifies propulsion system parameters which appear unusual or anomalous will increase the productivity of data analysis. Data analysts may then focus on a smaller subset of anomalous data for further evaluation of propulsion system tests. Such an automated data screening system would give NASA the benefit of a reduction in the manpower and time required to complete a propulsion system data evaluation. A phase 1 effort to develop a prototype data screening system is reported. Neural networks will detect anomalies based on nominal propulsion system data only. It appears that a reasonable goal for an operational system would be to screen out 95 pct. of the nominal data, leaving less than 5 pct. needing further analysis by human experts. Author

N92-27613# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE STABILITY OF A DUAL SPIN SATELLITE WITH ASYMMETRIC ROTOR AND FLEXIBLE PLATFORM Ph.D. Thesis
ZVI VIDERMAN 7 Jun. 1989 223 p
(ISBN-0-315-54650-6; CTN-92-60472) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $45.00 CAN, MF $15.00 CAN

The stability problem of a force free dual spin satellite which comprises an asymmetric rigid rotor and a flexible platform is addressed. Two cases are investigated, the case where the rotor is free from axial torques, and the case where the spin rate of the rotor relative to the platform is maintained constant. A minimum number of the nonlinear equations of motion are derived directly by a hybrid method, which combines Euler and Lagrange equations, without the necessity to deal explicitly with internal forces and to consider forces of constraints. Conditions for the existence of pure spin motion are obtained, and the equations of motion are linearized about this motion. The linearized equations of motion of such a system are characterized by periodic coefficients which appear also in the mass matrix and by gyroscopic terms. A special type of satellite is found, in which the number of linearized equations may be reduced. It is shown that the relation between the stability of the linearized system and the local stability of the actual non-linear system differs from the relation of satellites with axisymmetric rotor in case the rotor is axially torque free. Two methods for stability analysis are developed, the first a modification of Hsu's numerical scheme and the second a perturbation method based on the multiple scales method. Three numerical examples are investigated. These examples are a rigid platform, a platform with rigid core and point mass damper, and a rigid core and beam-like antenna. Author (CISTI)

N92-27788*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INTERNATIONAL SYMPOSIUM ON MAGNETIC SUSPENSION TECHNOLOGY, PART 2
NELSON J. GROOM, ed. and COLIN P. BRITCHER, ed. (Old Dominion Univ., Norfolk, VA.) Washington May 1992 459 p Symposium held in Hampton, VA, 19-23 Aug. 1991
(Contract RTOP 590-14-11-02)
(NASA-CP-3152-PT-2; L-17092-PT-2; NAS 1.55:3152-PT-2)
Avail: CASI HC A20/MF A04

In order to examine the state of technology of all areas of magnetic suspension and to review related recent developments in sensors and controls approaches, superconducting magnet technology, and design/implementation practices, a symposium was held. The proceedings are presented. The sessions covered the areas of bearings, sensors and controls, microgravity and vibration isolation, superconductivity, manufacturing applications, wind tunnel magnetic suspension systems, magnetically levitated trains (MAGLEV), space applications, and large gap magnetic suspension systems.

N92-27994# Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF TELEMETRY FOR THE AGILITY FLIGHT TEST OF A RADIO CONTROLLED FIGHTER MODEL M.S. Thesis
MICHAEL J. GALLAGHER Mar. 1992 90 p
(AD-A248653) Avail: CASI HC A05/MF A01

Advanced design tools, control devices, and supermaneuverability concepts provide innovative solutions to traditional aircraft design trade-offs. Emerging technologies enable

improved agility throughout the performance envelope. Unmanned Air Vehicles provide an excellent platform for dynamic measurements and agility research. A 1/8-scaled F-16A ducted-fan radio-controlled aircraft was instrumented with a telemetry system to acquire angle of attack, sideslip angle, control surface deflection, throttle position, and airspeed data. A portable ground station was built to record and visually present real-time telemetry data. Flight tests will be conducted to acquire baseline high angle-of-attack performance measurements, and follow-on research will evaluate agility improvements with varied control configurations. GRA

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A92-41091
CYCLIC HOT CORROSION OF HAYNES 230 ALLOY
FEN-REN CHIEN and RICHARD BROWN (Rhode Island, University, Kingston) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 9, May 1, 1992, p. 2367-2376. refs
Copyright

Cyclic hot corrosion conducted on Haynes 230 at temperatures of 871 and 1093 C indicated that catastrophic corrosion occurred. The corrosion rate was related to the high content of tungsten and chromium in the alloy. The concept of basic and acid fluxing was applied to explain the dissolution of the protective film of Cr2O3 and volatile WO3 by an Na2SO4-rich liquid due to the formation of Na2CrO4 and Na2WO4. As the basic melts were acidified by continuously consuming oxygen ions, platelike crystals of Cr2O3 were precipitated on the free surface by conversion from Na2CrO4. Acid fluxing was achieved by the refractory oxide, WO3, consuming oxygen ions. The presence of sulphur suppressed the diffusion of chromium outward to form protective Cr2O3. Internal chromium-rich sulphide particles were observed. It was suggested that, at very low P(O2), sulphur reacted with chromium to form CrS initially. As oxygen penetrated through the porous layer, the CrS was oxidized internally to Cr2O3. Author

A92-41119
NEW TITANIUM APPLICATIONS ON THE BOEING 777 AIRPLANE
ROBERT R. BOYER (Boeing Commercial Airplane Group, Seattle, WA) JOM (ISSN 1047-4838), vol. 44, no. 5, May 1992, p. 23-25.
Copyright

This paper lists the advantages of using Ti in civilian aircraft and examines the Ti alloys that are available and useful for such applications. Ti alloys provide good characteristics for aircraft structural applications in terms of weight savings, volume constraints, operating temperatures, corrosion resistance, and compatibility with CFRP composites. The Ti alloys Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, and Beta-21S are described in terms of their characteristics and applications to one airplane. C.C.S.

A92-41874
DEVELOPMENT OF INTERMETALLIC MATERIALS FOR AEROSPACE SYSTEMS
D. M. DIMIDUK, D. B. MIRACLE, and C. H. WARD (USAF, Wright Laboratory, Wright-Patterson AFB, OH) (Institute of Metals, Conference on High Temperature Intermetallics, London, England, Apr. 30-May 1, 1991) Materials Science and Technology (ISSN 0267-0836), vol. 8, no. 4, April 1992, p. 367-375. refs
Copyright

The present development status evaluation for aerospace intermetallics surveys the progress made in the last four years towards the implementation of these materials in high-temperature structural applications and gives attention to current prospects for the use of intermetallics in gas turbine hot section components. Attention is given to the family of titanium and nickel aluminides and other intermetallics that can withstand service temperatures in excess of 1000 C, as well as to development-pacing considerations and problems thus far encountered. O.C.

A92-42040
CYCLIC FATIGUE BEHAVIOR OF SILICA FIBER
HARVEY N. ROGERS (Hughes Aircraft Co., Electro-Optical and Data Systems Group, El Segundo, CA) IN: Fiber optics reliability: Benign and adverse environments IV; Proceedings of the Meeting, San Jose, CA, Sept. 18-20, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 112-117. refs
Copyright

The mechanical reliability of optical fiber is critically important for many engine sensor applications where the fiber is subjected to cyclic loading, high temperature, and oily, acidic environments. The effect of buffer coatings on the cyclic fatigue behavior of fused silica fibers is investigated. Aluminum, polyimide, UV-curable epoxy acrylate, and Tefzel coated fibers were tested at room temperature and after exposure to heat and oil. Cyclic fatigue was measured using a test fixture that simulates the motion of a piston in an internal combustion engine. The results indicate that the selection of buffer coating is an important consideration in determining mechanical reliability of optical fibers in this application. Author

A92-42345
COMPOSITE MAKERS SENSE CHANGES
ALAN S. BROWN Aerospace America (ISSN 0740-722X), vol. 32, no. 6, June 1992, p. 42, 43.
Copyright

The use of process-monitoring sensors and other process controls in the manufacture of polymer composites is reviewed to improve efficiency and consistency in production. An ideal on-line process-control system is described which includes sensors, processing models, materials databases, and control technologies. The sensors should be developed to withstand very high temperatures in order to be applied to the curing of polyimides and resins for the aerospace sector. C.C.S.

A92-42501
MINIMUM SURFACE TREATMENTS FOR ADHESIVELY BONDED REPAIRS
A. A. BAKER and R. J. CHESTER (Defence Science and Technology Organisation, Aeronautical Research Laboratory, Melbourne, Australia) International Journal of Adhesion and Adhesives (ISSN 0143-7496), vol. 12, no. 2, April 1992, p. 73-78. refs
Copyright

The environmental durability of adhesive bonds for both epoxy and acrylic adhesives has been shown to be improved by the use of a silane solution together with a primer. Durability approaching that of acid anodization treatments can be obtained from silane plus primer treatments together with considerable savings in the speed of surface treatment - an important factor during aircraft repair. The compatibility of specific adhesives and primers should be experimentally determined, however, as this study has observed differences in the effectiveness of primers in improving bond toughness and durability. Author

A92-42655
THERMAL DEFORMATION OF A POLYMER HEAT SHIELD MATERIAL ON THE DESCENT TRAJECTORY [TERMICHESKOE DEFORMIROVANIE POLIMERNOGO TEPLOZASHCHITNOGO MATERIALA NA TRAEKTORII SPUSKA]
A. A. SEVEROV, L. I. GRACHEVA, V. N. KOLOSKOVA, and VAD. V. VENGZHEN (AN Ukrainy, Institut Problem Prochnosti, Kiev, Ukraine; NPO Energiia, Moscow, Russia) Problemy Prochnosti (ISSN 0556-171X), no. 4, 1992, p. 56-62. In Russian. refs
Copyright

Thermal deformation of a heat-shield coating of a polymer

composite material with a phenol formaldehyde matrix is considered under simulated conditions of flight vehicle descent from the orbit. It is shown that the maximum thermal deformation in the composite reinforcement plane occurs at 45 deg to the filler; the amplitude of the dilatometric values significantly decreases with the increasing heating rate. Test results obtained during the descent from the orbit indicate that the relative residual thermal deformation of the heat-shield material may reach 2 percent or more. O.G.

A92-42798
STUDIES ON THE MECHANISM OF IGNITION AND FLAMEHOLDING BY PLASMA JETS
HIDEYUKI HORISAWA, ITSURO KIMURA, and MASAMI SAYAMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 285-294. In Japanese. refs

Studies on the mechanism of ignition and flame-holding by upstream-injection plasma jets were conducted for H2 diffusion flames in high speed air streams. The plasma jets were operated with Ar gas involving active species such as O2, N2, and H2, in the range of relatively low power. It was observed that for ignition and flame holding, the concentration of active species in feedstock is more important than plasma jet power. This fact suggests the effectiveness of active species produced by plasma jets, rather than that of plasma jet power. This fact suggests the effectiveness of active species produced by plasma jets, rather than that of plasma-jet thermal energy, and also the importance of radical concentration supplied to the ignition-point of a fuel jet, compared to the total quantity of radicals produced. It was also found that the effectiveness of additives is in the order, O2 greater than or equal to N2 greater than H2, and the results of numerical simulation on combustion-reaction promotion by the radicals added agreed qualitatively with the experimental ones. Author

A92-43237
THERMAL FIBER-REINFORCED-PLASTIC COMPOSITE TECHNOLOGY FOR AIRCRAFT STRUCTURES
T. NAGAMO, HIROKA NAKAMURA (Fuji Heavy Industries, Ltd., Tokyo, Japan), TOSHIYUKI NAKAKURA, and HIDEO SAKAI (Mitsui Toatsu Chemicals, Inc., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 612-615. In Japanese. refs

Thermal composite technology for a Mach 2.5 supersonic aircraft is presented. The basic properties of the PIX composite material and the formation technology are discussed and filament winding formation is addressed. Various kinds of adhesive methods for composite materials are described. Y.P.Q.

A92-43679
MODELING THE HEAT TREATMENT OF SUPERALLOYS
RAMANATH I. RAMAKRISHNAN and TIMOTHY E. HOWSON (Wyman-Gordon Co., Worcester, MA) JOM (ISSN 1047-4838), vol. 44, no. 6, June 1992, p. 29-32. refs
Copyright

Heat treatment of superalloys has traditionally been based on experience and trial and error. This article describes a more scientific approach to quantifying the effects of quenching using inverse and direct techniques based on the finite-element method. The inverse method uses transient temperature measurement in the interior of the part at a few appropriate locations to estimate the surface heat fluxes and/or heat transfer coefficients that characterize a quenchant. The direct method uses the estimated surface heat fluxes as boundary conditions for the heat transfer and thermal stress/displacement analyses. Author

A92-43684
COLD-CRUCIBLE DIRECTIONAL SOLIDIFICATION OF REFRACTORY METAL-SILICIDE EUTECTICS
K.-M. CHANG, B. P. BEWLAY, J. A. SUTLIFF, and M. R. JACKSON (General Electric Co., Schenectady, NY) JOM (ISSN 1047-4838), vol. 44, no. 6, June 1992, p. 59-63. refs
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Microcomposite structures generated by directional solidification of eutectics offer many unique microstructural advantages, including thermodynamic stability, directional alignment, and a fine dispersion of component phases. In an effort to improve the performance of advanced turbine engines, a Czochralski crystal growth method in conjunction with cold-crucible induction melting has been developed for the production of high-temperature eutectic composites. Cold-crucible directional solidification has been successfully applied to the growth of refractory metal-silicide eutectics into directional microcomposites. The eutectics studied include Cr-Cr3Si, Nb-Nb3Si, and V-V3Si, which have melting temperatures of 1705 C, 1880 C, and 1870 C, respectively. Author

A92-43685
AL-LI ALLOYS FIND THEIR NICHE
ROBERTO J. RIOJA and ROBERT H. GRAHAM (Alcoa Technical Center, Alcoa Center, PA) Advanced Materials & Processes (ISSN 0882-7958), vol. 141, no. 6, June 1992, p. 23-26.
Copyright

While it was initially hoped that Al-Li alloys such as 2090, 2091, and 8090 would serve as reduced-weight substitutes for the conventional 2xxx- and 7xxx-series aerospace alloys, experience with Al-Li over the last decade has uncovered property anisotropies for unrecrystallized products, low short-transverse properties in some thick products, and lack of design-allowable values for several products. Attention is presently given to the way in which these difficulties are being addressed by recourse to well-defined data bases on properties, manufacturability, and pricing; representative applications in the C-17 airlifter and EH101 helicopter are noted. O.C.

A92-44501
PLANAR FLUORESCENCE IMAGING OF A TRANSVERSE JET IN A SUPERSONIC CROSSFLOW
M. P. LEE, B. K. MCMILLIN, J. L. PALMER, and R. K. HANSON (Stanford University, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 729-735. Research supported by USAF. Previously cited in issue 06, p. 826, Accession no. A91-19312. refs
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A92-44617
ANALYSIS AND TESTING OF A COMPOSITE SANDWICH SHELL HORIZONTAL TAIL
MARK A. SHERROUSE and JOHN C. MCWHORTER, III (Mississippi State University, Mississippi State) IN: Composite materials: Testing and design. Vol. 10; Proceedings of the 10th Conference, San Francisco, CA, Apr. 24, 25, 1990. Philadelphia, PA, American Society for Testing and Materials, 1992, p. 253-263. refs
Copyright

The feasibility of using an all-composite sandwich shell without spars or ribs as a horizontal tail on a light general aviation aircraft is shown using results of torsion and bending tests. The structure used consisted of two symmetric quasi-isotropic sandwich skins with four plies of graphite-epoxy unidirectional prepreg per face and 10-mm honeycomb core laid up in an airfoil-shaped mold and cured at 120 C, with the two halves joined by adhesive to form a tapered cantilevered beam. A comparison of experimental results with those of the analysis using a NASTRAN model showed good agreement. I.S.

N92-26383# Naval Postgraduate School, Monterey, CA.
COMPOSITE STRENGTH STATISTICS FROM FIBER STRENGTH STATISTICS M.S. Thesis
ERIC P. JOHNSON Jun. 1991 112 p
(AD-A245616) Avail: CASI HC A06/MF A02

Utilization of composites in critical design applications requires an extensive engineering experience data base which is generally lacking, especially for rapidly developing constituent fibers. As a supplement, an accurate reliability theory can be applied in design. This investigation is part of a research effort to develop a probabilistic model of composite reliability capable of using data

produced in small laboratory test samples to predict the behavior of large structures with respect to their actual dimensions. This work included testing of composite strength which was then used in exploring the methodology of predicting composite reliability from the parent single filament fiber strength statistics. This required testing of a coordinate set of test samples which consisted of a composite and its parent fibers. Previously collected fiber strength statistics from two different production spools were used in conjunction with the current effort. This investigation established that, for a well made composite, the Local Load Sharing Model of reliability prediction exhibited outstanding correlation with experimental data and was sufficiently sensitive to predict deficient composite strength due to a specific fiber spool with an abnormally weak lower tail. In addition, it provided an upper bound on the composite reliability. This investigation is unique in that is used a coordinate set of data with an unambiguous genesis of parent fiber and subsequent composite. GRA

N92-26521# Northern Research and Engineering Corp., Woburn, MA.

TURBOCHARGED PRESSURIZED COMBUSTION SYSTEM Final Report, Nov. 1987 - Jul. 1990

A. F. CARTER Dec. 1991 91 p

(Contract GRI-5087-234-1608)

(PB92-142579; NREC-1656-1; GRI-91/0180) Avail: CASI HC A05/MF A01

A laboratory unit was designed and tested to demonstrate a turbine-based approach to pressurized combustion systems for a variety of industrial process heat requirements. The natural gas burner is located between a centrifugal compressor and a radial inflow turbine and operates at pressure levels up to 5 psig. The turbine extracts a small percentage of the heat from combustion to drive both the compressor ahead of the combustor and a fan providing additional air. Two versions of the system were demonstrated: fan air was heated by the turbine exhaust in a downstream heat exchanger to provide uncontaminated heat air and mixed with the turbine exhaust gases in the second version. The approach eliminates the need for electrical motor drives for the air movers. The system's gas turbine-type burner has low NO(x) emission characteristics. By choice of cycle operating parameters, a wide range of delivery temperature can be provided at process input pressures up to 2 psig. The pressure could be used to either increase the operating pressure levels in the downstream process or to provide high velocity inputs to enhance process efficiencies and/or productivities by means of improved heat transfer rates. The report also contains summaries of results obtained from two subcontracted efforts with respect to an assessment of the market turbine-based approach and the commercialization potential for products based on the approach. GRA

N92-27044# Rolls-Royce Ltd., Derby (England).

POWDER PROCESSING OF AERO-ENGINE COMPONENTS

D. DRIVER 15 Nov. 1990 20 p Presented at the PM 1990 World Conference on Powder Metallurgy, London, England, 3-6 Jul. 1990 Submitted for publication

(PNR-90813; ETN-92-90781) Copyright Avail: CASI HC A03/MF A01

More powerful and efficient jet propulsion requires that individual components run faster and hotter; as operating temperatures approach the materials melting point then the manufacturing options and the 'process window' within which the material can be manipulated correspondingly decrease. Casting is available as a near net shape manufacturing route but can be accompanied by extensive segregation for the complex alloys used in aeroengine applications. Powder processing therefore provides a route whereby highly alloyed materials can be rapidly solidified to form a relatively segregation free microstructurally refined, powder product of controlled size and cleanliness which can be consolidated to yield a consistent material suitable either for direct use within the engine or, by predictable process modeling, can subsequently be forged and heat treated to generate specific microstructural property combinations within particular regions of a component. As the use of metallic aeroengine materials is replaced by intermetallics and ultimately ceramics, then the opportunities for powder processing will increase accordingly. ESA

N92-27378*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

CERAMIC COMPOSITES: ENABLING AEROSPACE MATERIALS

S. R. LEVINE Jun. 1992 12 p Presented at the 37th International Gas Turbine and Aeroengine Congress and Exposition, Cologne, Germany, 1-4 Jun. 1992; sponsored by the 1992 Turbo Expo-Land, Sea and Air

(Contract RTOP 505-63-5A)

(NASA-TM-105599; E-6935; NAS 1.15:105599) Avail: CASI HC A03/MF A01

Ceramics and ceramic matrix composites (CMC) have the potential for significant impact on the performance of aerospace propulsion and power systems. In this paper, the potential benefits are discussed in broad qualitative terms and are illustrated by some specific application case studies. The key issues in need of resolution for the potential of ceramics to be realized are discussed. Author

N92-27486# Centre National de la Recherche Scientifique, Chatenay-Malabry (France).

THE COHERENT FLAMELET MODEL FOR PROPULSION APPLICATIONS

D. VEYNANTE, F. LACAS, P. BOUDIER (Institut Francais de Petrole, Grenoble.), B. DILLIES, J. M. SAMANIEGO, T. POINSOT, and S. CANDEL *In* AGARD, CFD Techniques for Propulsion Applications 14 p Feb. 1992 Sponsored in part by SNECMA and DRET

Copyright Avail: CASI HC A03/MF A06

This article reports our recent progress in the modeling of turbulent combustion for propulsion applications. The description of the reactive flow relies on the flamelet concept and uses a transport equation for the flame surface density. The coherent flamelet description which has evolved from a series of numerical and experimental studies is first reviewed and its recent improvements are explained. We then focus on the premixed version of the model. Two applications of relevance to aeronautical propulsion are then described. The first concerns a flame stabilized by a hot stream of combustion products. The second deals with a ramjet configuration comprising two lateral injection jets. In both cases, the model predictions are compared with experiments. It is shown that the model provides viable representations of these two cases. Author

N92-27531# Wright Lab., Wright-Patterson AFB, OH.

THE EFFECT OF JET FUEL EXPOSURE ON ADVANCED AEROSPACE COMPOSITES. PART 1: THERMAL AND CHEMICAL ANALYSIS Final Technical Report, May 1989 - May 1990

DAVID B. CURLISS Dec. 1991 36 p

(AD-A246559; WL-TR-91-4017) Avail: CASI HC A03/MF A01

The sensitivity of several aerospace composite materials to military jet engine fuel, JP-4, was investigated in this study. The effect of fuel on the physical and mechanical properties was evaluated. The absorption rates of JP-4 into the composites and the effects of JP-4 exposure on the mechanical properties of the composites were given in WRDC-TR-90-4064. Thermal analysis of the composite materials including TMA and DSC was performed and is reported here. During exposure to JP-4, the only composite materials that absorbed an appreciable amount of fuel were the APC-2 (+/- 45)2S and HTA (+/- 45)2S coupons. Chemical species desorbed from these composite specimens using a vacuum desorption apparatus developed in-house were analyzed using GC-MS and the results are reported here. As expected, HTA and APC-2 coupons tested at elevated temperatures after exposure to JP-4 had lower levels of the more volatile components of JP-4 than did the HTA and APC-2 coupons exposed to JP-4 and tested at room temperature. The more volatile components are more

mobile and more likely to desorb from the polymer at elevated temperatures. APC-2 was found to have significant quantities of Phenol present. This is attributed to the slightly polar character of the poly-(aryl ether ether ketone) (PEEK) matrix thermoplastic of APC-2. GRA

N92-27749# Fairfax Materials Research, Inc., Alexandria, VA.
THE MECHANICAL PROPERTIES OF METAL-VOID COMPOSITES Interim Progress Report
ROGER TAYLOR Jan. 1992 2 p
(Contract N00014-91-C-0247)
(AD-A246087) Avail: CASI HC A01/MF A01

Work under this contract is intended to conduct a theoretical feasibility study of the strength, toughness and vibrational damping properties of composite materials consisting of a metallic matrix with a high volume fraction (to 30 percent) of small (0.1-10 microns) pressurized voids. The premise of the approach is that a theoretical study, using both analytical and computer methods, offers a cost-effective means of assessing the probable properties of such composites and their projected utility in aerospace structures. GRA

N92-27752# Army Materials Technology Lab., Watertown, MA.
PROPERTIES OF A TZP/AL2O3 COMPOSITE AFTER LONG-TERM EXPOSURE AT 1000 C Final Report
JEFFREY J. SWAB and STEVEN C. STOWELL Dec. 1991 14 p
(Contract DA PROJ. 1L1-62101-AH-84)
(AD-A246407; MTL-TR-91-54) Avail: CASI HC A03/MF A01

A commercially available tetragonal zirconia polycrystal ceramic was examined for potential use in advanced engines. Room temperature strength and toughness were determined, as well as the static fatigue life between 800 C and 1200 C. All of these properties were determined before and after a 100 hour exposure at 1000 C. The room temperature flexure strength was 1838 MPa before exposure and it decreased 23 percent after exposure. The toughness did not change with the exposure. Static fatigue testing revealed that fracture below 1100 C was due to the cracks created during machining. At 1100 C and higher slow crack growth became the dominant failure mechanism. Overall, the high temperature static fatigue life is better than yttria tetragonal zirconia polycrystal materials without Alumina but it still does not meet the strength at temperature requirements for use in advanced engines. GRA

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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.

A92-41034
MECHANICS OF CURVED FIBER COMPOSITES
H. G. RAI, C. W. ROGERS, and D. A. CRANE (Bell Helicopter Textron, Inc., Fort Worth, TX) Journal of Reinforced Plastics and Composites (ISSN 0731-6844), vol. 11, no. 5, May 1992, p. 552-566. refs
Copyright

This paper investigates the effect of fiber waviness on the behavior of carbon-epoxy composites. A theoretical elastic model is developed to predict lamina modulus of elasticity as a function of fiber waviness and is used in an incremental loading scheme to predict the general stress-strain response. This theoretical response is found to be nonlinear in the same fashion as the experimental, measured response. An optical procedure is employed to determine the magnitude of fiber waviness in a current material IM6/3501-6 system. A convincing correlation is demonstrated between measured fiber waviness and the degree of waviness necessary to match the experimental stress-strain curve. Author

A92-41060
OBSERVATIONAL STUDY OF POOL BOILING UNDER MICROGRAVITY
TOSHIHARU OKA (Keio University, Yokohama, Japan), YOSHIYUKI ABE, KOTARO TANAKA (Electrotechnical Laboratory, Tsukuba, Japan), YASUHIKO H. MORI, and AKIRA NAGASHIMA (Keio University, Yokohama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 280-286. refs
Copyright

Pool boiling experiments under microgravity were conducted, utilizing parabolic flight maneuvers with a CNES Caravelle 6R aircraft. The experimental apparatus taken aboard the aircraft was constructed to enable simultaneous recording, by a video camera, of the side view of vapor bubbles generated on Joule-heated titanium foil immersed in a pool of n-pentane liquid, and the color pattern exhibited by a liquid-crystal layer, which was plated on the backside of the foil. This apparatus successfully recorded observations of behaviors of vapor bubbles, at various liquid subcoolings (7-32 K) and heat fluxes (1.1-42 kW/sq m), and spatial color variation of the crystal layer, possibly reflecting microlayer dynamics beneath the individual bubbles. In spite of the great difference in size and population of the bubbles, between microgravity and terrestrial conditions, no more than a moderate difference was found in overall heat transfer between the two conditions. Author

A92-41082
HEAT TRANSFER IN A CHANNEL WITH BUILT-IN WING-TYPE VORTEX GENERATORS
G. BISWAS and H. CHATTOPADHYAY (Indian Institute of Technology, Kharagpur, India) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 35, no. 4, April 1992, p. 803-814. refs
Copyright

The structure of flow- and heat-transfer characteristics are determined numerically for a rectangular channel with a built-in delta wing protruding from the bottom wall. The predictions are made through the numerical solution of complete Navier-Stokes and energy equations. Augmentation of heat transfer between the flowing fluid and channel wall is seen. The effect of a punched hole, beneath the wing-type vortex generator, on the heat-transfer and skin-friction characteristics is determined. The influence of the vortex generator's angle of attack and Reynolds number on heat transfer and skin friction is determined. The combined spanwise average Nusselt number showed increases as large as 34 percent even at the exit of a long channel at an angle of attack of 26 deg. Author

A92-41180
TECHNOLOGICAL EXCELLENCE IN HONEYCOMB SANDWICH AND COMPOSITE STRUCTURES FOR AEROSPACE APPLICATIONS
V. A. JOY, K. N. MURTHY, and C. G. K. NAIR (Hindustan Aeronautics, Ltd., Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 2, May 1991, p. 101-112.

The advantages provided by the honeycomb sandwich and composite structures developed for aerospace applications are discussed. Comparative properties of various composite materials (fibers, resin matrices, cured composites, and metallic aircraft materials) are described together with classes of composite materials used for aircraft application and the composite components in service. Special attention is given to a development program for the honeycomb and composite materials technology. I.S.

A92-41186
TRENDS IN PROPULSION TECHNOLOGY

A. E. MUTHUNAYAGAM (ISRO, Liquid Propulsion Systems Centre, Thiruvananthapuram, India) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 135-145. refs

The development history of aircraft and rocket propulsion technologies is reviewed, and future trends are discussed. Particular attention is given to technology developments in ISRO; launch vehicle programs developed in the Soviet Union, Japan, U.S.A., Great Britain, Germany, and France; and propulsion system concepts and options. O.G.

A92-41190
SELF RELIANCE IN AEROSPACE STRUCTURES
H. R. KRISHNA (Hindustan Aeronautics, Ltd., Aerospace Div., Bangalore, IN) (International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 173-176.

The ISRO projects being conducted by Hindustan Aeronautics Limited are reviewed. Particular attention is given to technology development for aerospace hardware, development of composites, indigenization, vendor development, quality and reliability, and future plans of ISRO. O.G.

A92-41238* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRANSONIC AEROELASTICITY ANALYSIS FOR ROTOR BLADES
LIE-MINE GEA, CHUEN-YEN CHOW (Colorado, University, Boulder), and I-CHUNG CHANG (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 477-484. Previously cited in issue 21, p. 3351, Accession no. A89-47669. refs
(Contract NCC2-508)
Copyright

A92-41241
COALESCENCE OF AEROELASTIC MODES IN FLUTTER ANALYSIS
MAHER N. BISMARCK-NASR (Instituto Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 505-507. refs
Copyright

The present treatment of flutter phenomena due to a coalescence of modes indicates that the stability of the system can be studied in a concise form, and that the solution of the complex eigenvalue problem can be avoided. The determination of the critical condition is reduced to that of the solution of two simultaneous equations in two unknowns: the flutter velocity, and the flutter frequency. Numerical applications are presented. O.C.

A92-41242
STRUCTURAL AND AERODYNAMIC DATA TRANSFORMATION USING INVERSE ISOPARAMETRIC MAPPING
R. M. V. PIDAPARTI (Purdue University, Indianapolis, IN) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 507-509. refs
Copyright

The inverse isoparametric mapping is presently used to transform such state variables as displacement, load, stress, pressure, temperature, etc., from structural grid points to aerodynamic grid points. The wing plane's form can be represented by either four-node or eight-node isoparametric finite elements. Extrapolation to the case of control surfaces becomes possible via combination of well-known extrapolation techniques and the inverse-mapping procedure. O.C.

A92-41244
TRANSITION OF THE FLUTTER MODE OF A TWO-DIMENSIONAL SECTION WITH AN EXTERNAL STORE
ZHI-CHUN YANG and LING-CHENG ZHAO (Northwestern Polytechnical University, Xian, People's Republic of China) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 511, 512. refs
Copyright

An example is presented which shows that Niblett's (1988) concept, derived from a comprehensive study of bending-torsion flutter and relating the flutter condition directly to the normal modes, furnishes an engineering guide to the identification of the wing-store flutter mode and its transition. The requisite information encompasses only the normal mode shapes derived from the direct results of ground vibration testing or vibration analysis. O.C.

A92-41282
INTERLAMINAR FRACTURE CHARACTERISTICS OF BONDING CONCEPTS FOR THERMOPLASTIC PRIMARY STRUCTURES
JOHN C. FISH, MARCIA L. VITLIP, STEPHEN P. CHEN (McDonnell Douglas Helicopter Co., Mesa, AZ), and KWANG S. SHIN (Arizona State University, Tempe) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1602-1608. Previously cited in issue 12, p. 1992, Accession no. A91-31949. refs
Copyright

A92-41296* National Aeronautics and Space Administration, Washington, DC.
COMPOSITE LAMINATED SHELLS UNDER INTERNAL PRESSURE
F. G. YUAN (North Carolina State University, Raleigh) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1669-1672. refs
(Contract NAGW-1331)
Copyright

A theoretical study is conducted of the response of filament-wound composite shells under internal pressure; a system of sixth-order ordinary differential equations is obtained by means of the cylindrically anisotropic elasticity field equations and Lekhnitskii's (1963) stress functions. The general expressions for the stresses and displacements in the laminated composite shells under internal pressure are discussed. Attention is given to the influence of the degree of material anisotropy and fiber orientation on the axial and induced twisting deformation. O.C.

A92-41297
COMMENT ON 'MODIFICATION OF THE VAN DRIEST DAMPING FUNCTION TO INCLUDE THE EFFECTS ON SURFACE ROUGHNESS'
PAUL S. GRANVILLE (U.S. Navy, David W. Taylor Naval Ship Research and Development Center, Bethesda, MD) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1673; Author's Reply, p. 1673, 1674. refs

A92-41323#
CROSSED BEAM CORRELATION MODELING AND EXPERIMENTAL TECHNIQUES FOR MEASURING DENSITY FLUCTUATIONS IN HYPERSONIC FLOWS
G. T. BOREK, B. R. PETERS, D. A. KALIN, and A. D. KATHMAN (Teledyne Brown Engineering, Sensor Systems Dept., Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 13 p. refs
(Contract DASG60-87-C-0042)
(AIAA PAPER 92-2779) Copyright

A numerical routine that simulates the statistical properties of cross beam correlation data in highly turbulent flows is presented. The routine was developed for the purpose of better understanding the experimentally obtained data during system validation. The code was used to investigate the effects of various noise sources on the data. Several signal processing algorithms including cross-covariance and autocovariance routines were developed to process both the simulated data and the experimental data. Initial

autocovariance analysis of the data shows a close agreement between experimental and simulated data. Attention is given to important discoveries made during the experimental investigations that have a direct impact on data quality. Especially important are the calibration procedures to ensure conservation of energy on the quad cell during tests, and the effect of turbulence-induced spot breakup and energy redistribution. P.D.

A92-41658
SIMILARITY SOLUTIONS FOR VISCOUS VORTEX CORES
ERNST W. MAYER and KENNETH G. POWELL (Michigan, University, Ann Arbor) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 238, May 1992, p. 487-507. refs
(Contract NSF EET-88-57500)
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Results are presented for a class of self-similar solutions of the steady, axisymmetric Navier-Stokes equations, representing the flows in slender (quasi-cylindrical) vortices. Effects of vortex strength, axial gradients and compressibility are studied. The presence of viscosity is shown to couple the parameters describing the core growth rate and the external flowfield, and numerical solutions show that the presence of an axial pressure gradient has a strong effect on the axial flow in the core. For the viscous compressible vortex, near-zero densities and pressures and low temperatures are seen on the vortex axis as the strength of the vortex increases. Compressibility is also shown to have a significant influence upon the distribution of vorticity in the vortex core. Author

A92-41801
ON THE THREE-DIMENSIONAL VIBRATION ANALYSIS OF SIMULTANEOUSLY SKEWED AND TWISTED CANTILEVERED PARALLELEPIPEDS
O. G. MCGEE (Ohio State University, Columbus) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 33, no. 7, May 30, 1992, p. 1383-1411. refs
(Contract NSF MSM-88-21143)
Copyright

The natural frequencies of simultaneously skewed and twisted cantilevered parallelepipeds are determined using the Ritz method. The present work is the first known three-dimensional study of the problem. Assumed displacement functions are in the form of algebraic polynomials which satisfy the fixed face conditions exactly, and which are mathematically complete. Reasonably accurate natural frequencies are calculated for low aspect ratio, thick parallelepipeds having arbitrary degrees of twist and skewness. Detailed numerical studies show that a three-dimensional analysis is essential in monitoring complicated coupled-mode sensitivities in the variation of nondimensional natural frequencies with increasing skew and twist angles and thickness ratio. Results obtained using the present method are compared with those obtained in a detailed three-dimensional finite element analysis, where the suitability and limitations of s-version solid element discretizations are clearly brought out. Author

A92-41834
SECOND ORDER PERTURBATION METHOD OF GAS TURBINE PERFORMANCE CALCULATION
GANG FANG, RUIXIAN CAI, and RUMOU LIN (Chinese Academy of Sciences, Institute of Engineering Thermophysics, Beijing; Zhonghua Gas Turbine Research and Development Corp., People's Republic of China) Journal of Engineering Thermophysics (ISSN 0253-231X), vol. 13, no. 1, Feb. 1992, p. 12-15. In Chinese. refs

The concept of the second-order perturbation method has been introduced and its error analysis is given. The method retains concise physical relationships between variables, and the variable application range is broadened by approximately twice, compared with linear perturbation methods, within same error limit. Some skills to consider the component characteristics and to simplify the performance calculation have been discussed. An operation line has been presented as an example using the second-order perturbation method to prove its engineering availability. Author

A92-41835
FLOW ANALYSIS FOR AXIAL COMPRESSOR INCLUDING SECONDARY FLOW EFFECTS
PING LI and XINHAI ZHOU (Northwestern Polytechnical University, Xian, People's Republic of China) Journal of Engineering Thermophysics (ISSN 0253-231X), vol. 13, no. 1, Feb. 1992, p. 33-38. In Chinese. refs

On the basis of solving the Navier-Stokes equations and specifying the corrected outlet angles, an analysis procedure considering the secondary flow effects has been developed for the computation of flow in an axial compressor. Detailed flow measurements in an experimental compressor are made for the investigation of secondary flow effects on the outlet angles. The computed results from this method are compared with experiment data, and the agreement is fairly good. Author

A92-41836
PERFORMANCE PREDICTIONS FOR CENTRIFUGAL COMPRESSOR IMPELLERS
YUNLIANG WANG and ZHONG XU (Xian Jiaotong University, People's Republic of China) Journal of Engineering Thermophysics (ISSN 0253-231X), vol. 13, no. 1, Feb. 1992, p. 46-48. In Chinese. refs

A92-42051
ANNUAL RELIABILITY AND MAINTAINABILITY SYMPOSIUM, *ORLANDO, FL, JAN. 29-31, 1991, PROCEEDINGS*
Symposium sponsored by IEEE, ASQC, AIAA, et al. New York, Institute of Electrical and Electronics Engineers, Inc., (ISSN 0149-144X), 1991, 713 p. For individual items see A92-42052 to A92-42092.
(ISBN 0-87942-661-6) Copyright

The present conference discusses the evaluation of production readiness, Space Shuttle airframe inspection trend analysis reports, a high-reliability computer disk drive, maintenance scheduling for critical aircraft parts, a model for reliability cost management, dependability modeling for computer systems, the evaluation of spacecraft product-assurance requirements, design criteria for meteoroid-damage tolerance of space structures, and the mixed-exponential failure process. Also discussed are a unified approach to failure mode effects and criticality analysis, zonal analysis in system-safety assessment, modeling and monitoring of equipment reliability decay, 'activation energy' in reliability, the cost of warranties, the optimization of fault-tolerant systems, reliability allocation with partial redundancy, the cost of testing software, the international standardization of evaluation procedures, durability analysis, random vibration testing for computers, and the minimization of process variability. O.C.

A92-42052
SPACE SHUTTLE AIRFRAME INSPECTION TREND-ANALYSIS REPORT
BONNIE K. STONE and HAROLD S. ISSEN (Lockheed Space Operations Co., Cocoa Beach, FL) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 15-19. refs
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In order to prepare the Space Shuttle Orbiter in its Processing Facility within the allotted 51 days, it is necessary to evaluate and fine-tune the inspection programs used while identifying all nonconformances. The Space Shuttle Airframe Inspection Trend Analysis Report has been developed to ensure optimal performance frequency as well as inspection effectiveness. The nonconformance reports initiated as a result of airframe inspections are analyzed with a view to flight cycle, inspection requirements, problem causes, and Orbiter zone; they have resulted in the identification of similar problems across the Orbiter fleet. O.C.

A92-42057
SIMULATION OF COMMERCIAL-AIRCRAFT RELIABILITY
WEIMIN YANG (Beijing University of Aeronautics and Astronautics, People's Republic of China), YUAN ZHU (Chinese Academy of

Sciences, Academic Energetics Research and Development Center, Beijing, People's Republic of China), QINGCI TU, and YIXING SHENG (Beijing University of Aeronautics and Astronautics, People's Republic of China) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 112-119.
Copyright

By applying Monte-Carlo simulation methods, a simulation model is established in this paper, which considers factors such as R&M characteristics of the aircraft, weather conditions, management, flight dispatching, number of aircraft, route structure, maintenance level, personnel skills, spare parts supply, etc. The analysis results can provide the decision-making basis to improve product's R&M for manufacturers and to adjust flight, dispatch procedure, logistic supports, etc., rationally for airlines. Author

A92-42071
ZONAL ANALYSIS - THE FINAL STEP IN SYSTEM SAFETY ASSESSMENT
RICHARD E. CALDWELL and DAVID B. MERDGEN (Douglas Aircraft Co., Long Beach, CA) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 277-279. refs
Copyright

The unexpected interaction of unrelated systems has often been implicated in design-related aircraft accidents. Zonal analysis, which is definable as the systematic inspection of geographical locations of components and interconnections in a system with a view to potential system-to-system interactions, is highly relevant to the consequences of high rotational energy systems (such as turbofan engines), corrosive liquids, and pressure vessels. Attention is presently given to the course of formal zonal analysis for the MD-11 airliner. O.C.

A92-42077
STATISTICAL ANALYSIS OF FIELD DATA FOR AIRCRAFT WARRANTIES
MARY J. LAKEY (McDonnell Aircraft Co., Saint Louis, MO) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 340-344. refs
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Air Force and Navy maintenance data collection systems were researched to determine their scientific applicability to the warranty process. New and unique algorithms were developed to extract failure distributions which were then used to characterize how selected families of equipment typically fails. Families of similar equipment were identified in terms of function, technology and failure patterns. Statistical analyses and applications such as goodness-of-fit test, maximum likelihood estimation and derivation of confidence intervals for the probability density function parameters were applied to characterize the distributions and their failure patterns. Statistical and reliability theory, with relevance to equipment design and operational failures were also determining factors in characterizing the failure patterns of the equipment families. Inferences about the families with relevance to warranty needs were then made. Author

A92-42084
COST EFFECTIVENESS OF ENVIRONMENTAL STRESS SCREENING (ESS) - A CASE HISTORY
AMBER L. NAGLE (USAF, Robins AFB, GA) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 494-496. refs

ESS efforts were made in connection with 20 newly-manufactured circuit cards. By precipitating defects that could have occurred on the aircraft in which they were to have been mounted, more substantial reliability gains and improved mission readiness were realized; these, in turn, represented a swifter return-on-investment. It is estimated that $28,000 was saved through the screening of the 20 circuit cards. This highly favorable outcome for the pilot ESS project led to the mounting of an intensive program. O.C.

A92-42086
DESIGN-FOR-RELIABILITY THROUGH DURABILITY ANALYSIS
WILBUR W. BHAGAT and BRUCE A. TAGG (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 516-520. refs
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The 'durability analysis' method presented can be applied to avionics in the course of the design process to enhance hardware reliability and service life, in virtue either of design changes instituted on the basis of the method's findings or through consideration of design tradeoffs based on hardware criticality and maintenance-support economics. Illustrative examples of durability analysis are given, together with guidance on the hardware components to be selected for such analysis. The cost of retrofit efforts after a component enters service can by these means be saved. O.C.

A92-42145
METAL MATRIX COMPOSITE FABRICATION PROCESSES FOR HIGH PERFORMANCE AEROSPACE STRUCTURES
C. PONZI (Alenia S.p.A., Rome, Italy) (Meeting on Industrial Production of Composite Materials, Milan, Italy, May 6, 7, 1991, Proceedings. A92-42141 17-24) Composites Manufacturing (ISSN 0956-7143), vol. 3, no. 1, 1992, p. 32-42. refs
Copyright

A survey is conducted of extant methods of metal matrix composite (MMC) production in order to serve as a basis for prospective MMC users' selection of a matrix/reinforcement combination, cost-effective primary fabrication methods, and secondary fabrication techniques for the achievement of desired performance levels. Attention is given to the illustrative cases of structural fittings, control-surface connecting rods, hypersonic aircraft air inlet ramps, helicopter swash plates, and turbine rotor disks. Methods for technical and cost analysis modeling useful in process optimization are noted. O.C.

A92-42315
RADIATION AND COUPLING BETWEEN ANTENNAS MOUNTED ON A COMPLEX METALLIC STRUCTURE
M. BALMA and D. BRESCIANI (Alenia S.p.A., Caselle Torinese, Italy) IN: 1991 IEEE International Symposium on Electromagnetic Compatibility, Cherry Hill, NJ, Aug. 12-16, 1991, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 279-284. refs
Copyright

A hybrid UTD-MoM technique is applied to evaluate the radiation and the coupling among antennas mounted on the same structure. The most common application is represented by the electromagnetic characterization of an aircraft provided with either aperture antennas or wire antennas. After expanding the radiated far field with spherical sampling functions, both the directivity and the radiated power are evaluated by means of an analytical integration on the radiation pattern. Then the coupling among the antennas is computed and compared with some measurements performed on some simple geometrical bodies as far as on a scaled aircraft model. Author

A92-42317
COMPARISON OF R2SPG WAVEFORMS WITH SIMULATED EMP
LOTHAR O. HOEFT, RONALD J. KARASKIEWICZ, JOSEPH S. HOFSTRA (BDM International, Inc., Albuquerque, NM), WILLIAM D. PRATHER, and WILLIAM R. AYRES (USAF, Phillips Laboratory, Kirtland AFB, NM) IN: 1991 IEEE International Symposium on Electromagnetic Compatibility, Cherry Hill, NJ, Aug. 12-16, 1991, Symposium Record. New York, Institute of Electrical and

Electronics Engineers, Inc., 1991, p. 304-308. refs
Copyright

A92-42320
USING THE SINGLE POINT EXCITATION TECHNIQUE TO MEASURE APERTURE IMPEDANCE OVER A BROAD FREQUENCY RANGE
L. O. HOEFT, J. S. HOFSTRA (BDM International, Inc., Albuquerque, NM), and WILLIAM D. PRATHER (USAF, Phillips Laboratory, Kirtland AFB, NM) IN: 1991 IEEE International Symposium on Electromagnetic Compatibility, Cherry Hill, NJ, Aug. 12-16, 1991, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 372, 373. refs
Copyright

Single Point Excitation for Hardness Surveillance (SPEHS) techniques have been used to produce surface fields over a broad frequency range (essentially 1 to 100 MHz). These fields were used to measure the aperture impedance of hardened and degraded windows and doors of the EMP Test Bed Aircraft (EMPTAC). Measurements were made using wing root (normal SPEHS) as well as antenna excitation. Above one MHz, aperture impedance is dominated by the aperture's transfer inductance. Values of aperture impedance were comparable to, but did not exactly match, those measured using the aperture tester technique. The SPEHS technique has great potential because it facilitates shielding and conductive penetration measurements when the aircraft is pressurized and/or in flight. Author

A92-42502
THE EVALUATION OF NON-TANK SURFACE TREATMENTS FOR ALUMINIUM BONDING REPAIRS
C.-L. ONG, W.-Y. SHU, and S. B. SHEN (Chung Shan Institute of Science and Technology, Taichung, Republic of China) International Journal of Adhesion and Adhesives (ISSN 0143-7496), vol. 12, no. 2, April 1992, p. 79-84. refs
Copyright

Five nontank methods for the surface treatments of aluminum were compared in terms of the lap-shear bond strengths of treated and air-exposed specimens, including abrasion, gelled sodium dichromate/sulfuric acid paste etching, phosphoric acid nontank anodize, PasaJell 105 paste etching, and HF/Alodine 1200. Bare aluminum 2024-T3 sheets of 1.6-mm thickness were used for the single lap-shear specimens, and 7075-T6 sheets of 3.2-mm thickness were used for the Boeing wedge test. The results of wedge tests showed that surfaces prepared by abrasion and HF/Alodine 1200 methods had poor durabilities. On the other hand, the PasaJell 105 treatment generated good surface stability, with bond strength and durability as effective as the common phosphoric acid nontank anodize process. I.S.

A92-42529
BIENNIAL FLUID DYNAMICS SYMPOSIUM ON ADVANCED PROBLEMS AND METHODS IN FLUID MECHANICS, 19TH, KOZUBNIK, POLAND, SEPT. 3-8, 1989, SELECTED PAPERS
Archiwum Mechaniki Stosowanej (ISSN 0373-2029), vol. 43, no. 5, 1991, 130 p. For individual items see A92-42530 to A92-42536.
Copyright

Recent advances in experimental and computational fluid mechanics are discussed in a series of review essays. Topics addressed include transitions to complex flow in thermal convection, optimum hypersonic wings and wave riders, relativistic hydrodynamics, and wind-tunnel wall corrections for unsteady flow (steady wall adaptation and CFD techniques). Consideration is given to axisymmetric laminar interacting boundary layers, differential forms and fluid dynamics, breaking water waves, strong temperature gradients in turbulent wakes, and liquid-crystal 'blue' phases. T.K.

A92-42607
A FIBER OPTIC TEMPERATURE SENSOR FOR AEROSPACE APPLICATIONS
STEPHEN C. JENSEN, SHELLE D. TILSTRA, GEOFFREY A. BARNABO, DAVID C. THOMAS, and RICHARD W. PHILLIPS (Rosemount, Inc., Aerospace Div., Burnsville, MN) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 87-95. refs
Copyright

A fiber-optic temperature sensor has been developed for aerospace applications on the basis of the time rate of decay (TRD) principle, with a view to an operational temperature range of -60 to 350 C. This TRD system has completed qualification testing and will then undergo flight tests. Attention is presently given to the design and performance of four low temperature sensors that are subelements of the larger sensor system; in order to convert analog signals into over/under temperature indications, simple comparators are implemented in software. O.C.

A92-42653
TECHNIQUE FOR ESTIMATING THE STRENGTH OF GAS TURBINE GUIDE VANES WITH STRESS RAISERS [METODIKA OTSENKI PROCHNOSTI NAPRAVLIAIUSHCHIKH APPARATOV GAZOVYKH TURBIN S KONTSENTRATORAMI]
A. R. BELIAKOV, L. B. GETSOV, K. M. KONONOV, V. K. TUTYNIN, and A. S. PREOBRAZHENSKII (Ob'edinenie Proletarskii Zavod, St. Petersburg, Russia) Problemy Prochnosti (ISSN 0556-171X), no. 4, 1992, p. 37-44. In Russian. refs
Copyright

A technique for calculating the safety factor of gas turbine guide vanes which takes into account stress concentrations is presented. The technique is based on the theory of adaptability and experimentally determined stress concentration factors. Results obtained for KhN60VT alloy, a commonly used guide vane ring casing material, are presented as an example. O.G.

A92-42654
POSSIBILITY OF INCREASING DURABILITY OF BLADES WITH DAMAGES [O VOZMOZHNOSTI POVYSHENIIA DOLGOVECHNOSTI LOPATOK S POVREZHDENIIAMI]
V. A. BOGUSLAEV (Proizvodstvennoe Ob'edinenie Motorostroitel', Zaporozhe, Ukraine) Problemy Prochnosti (ISSN 0556-171X), no. 4, 1992, p. 45-49. In Russian. refs
Copyright

The efficiency of a hardening method for titanium alloy gas-turbine compressor blades has been studied. It is shown that the hardening method is capable of increasing the durability of damaged blades by more than a factor of two. Cracks in these blades occur in a narrower zone and mainly on the side of the leading edge as compared with nonhardened blades. O.G.

A92-42665
AN AERODYNAMIC HYPOTHESIS FOR THE WING AEROELASTICITY PROBLEM [OB ODNOI AERODINAMICHESKOI GIPOTEZE DLIA RESHENIIA ZADACH AEROUPRUGOSTI KRYLA]
I. I. EFREMOV (Kievskii Politekhnicheskii Institut, Kiev, Ukraine) Prikladnaia Mekhanika (ISSN 0032-8243), vol. 28, no. 4, April 1992, p. 63-70. In Russian. refs
Copyright

The asymptotic theory is used to study wing oscillations near a plane screen. The discussion focuses on oscillations and stability of a thin freely supported plane in incompressible flow. It is shown that the plate is dynamically stable but statically loses balance at a certain value of flow velocity. O.G.

A92-42797
FLOW AROUND TWO SQUARE CYLINDERS IN STAGGERED ARRANGEMENTS
KAZUHITO FUJIWARA, HIDEO MATSUO, KENJI ONO, and TETSUYUKI HIROE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 276-284. In Japanese. refs

Flow around two square cylinders is investigated by the measurement of the surface pressure, the flow visualization, and the supplementary numerical simulation. Two different types of

flow patterns are observed which are characteristic of staggered arrangements. In either case, the gap flow is formed between two cylinders, which is biased toward the upstream cylinder. The biased flow then undergoes two different changes in the subsequent period, depending on the relative location of cylinders. In the first case, it flows on straightforward and finally builds up a strong vortex behind the upstream cylinder. In the second case, it changes the direction and deviates toward the downstream cylinder. A strong vortex is now built up behind the downstream cylinder. However, the second flow is not stable and can not exist by itself. The fluctuation between the first and the second flows always appears in this case. The transition between the two flow regimes is abrupt under the continuous change in the cylinder arrangement.
Author

A92-42949
FINITE ELEMENT ANALYSIS OF TIRE CRITICAL SPEEDS
R. A. BROCKMAN (Dayton, University, OH), J. H. CHAMPION, and J. P. MEDZORIAN (USAF, Wright Research and Development Center, Wright-Patterson AFB, OH) Computers and Structures (ISSN 0045-7949), vol. 43, no. 3, May 3, 1992, p. 581-593. refs
(Contract F33615-C-86-3401)
Copyright

This paper introduces a semi-analytic finite element technique for predicting standing wave motions (critical speed phenomena) in pneumatic tires. A general formulation is presented which encompasses inflation and rotation of the tire as well as vibratory motions superimposed upon the inflated and rotating state. The use of sinusoidal basis functions for the circumferential variation of each displacement component reduces the finite element model to two dimensions, and improves solution accuracy for higher-frequency modes. Under suitable assumptions the harmonic components uncouple, and the three-dimensional problem may be solved as a sequence of smaller two-dimensional analyses. The proposed technique provides improved accuracy over three-dimensional analysis at a small fraction of the cost and modeling effort. Author

A92-43107
SOME CONSIDERATION FOR EVALUATION OF STRUCTURAL INTEGRITY OF AGING AIRCRAFT
HIROYUKI TERADA and HIROO ASADA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 76-79. refs

The objective of this paper is to examine the achievement and the limitation of state-of-the-art of the methodology of damage tolerant design and the subjects to be solved for further improvement. The topics discussed are: the basic concept of full-scale fatigue testing, fracture mechanics applications, repair of detected damages, inspection technology, and determination of inspection intervals, reliability assessment for practical application, and the importance of various kinds of data acquisition. Author

A92-43109
DYNAMIC RESPONSE AND AEROELASTIC ANALYSIS OF A PROPELLER BLADE OF A PROP-FAN ENGINE
GENE JOO and HAE-KYUNG LEE (Seoul National University, Republic of Korea) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 84-87. refs

Blades are modeled as cantilevered sandwich plates with Gr/Ep composite faces and orthotropic cores and also as curved twisted beams for the aeroelastic analysis. A free vibration analysis for the cantilevered sandwich plate model is performed using Rayleigh-Ritz method. Calculated results are compared with FEM codes and free vibration test results. A free vibration equation for the aeroelastic analysis is obtained by small linear perturbation about the nonlinear static equilibrium position of the curved and twisted beam model. An aeroelastic stability is analyzed along with unsteady aerodynamic analysis results with 2-D cascade effects. For analyzing dynamic response of the real prop-fan blade mode, F.E.M. codes are used. In order to verify computed results, SR-3 composite prop-fan blades with various stacking sequencies are manufactured. Natural frequencies of prop-fan specimen are obtained by modal testing method using impact hammer and FFT analyzer. Author

A92-43126
BAYESIAN RELIABILITY ANALYSIS IN CONNECTION WITH THE EVALUATION OF MULTIPLE-SITE DAMAGE
HIROSHI ITAGAKI (Yokohama National University, Japan), H. ASADA, and S. ITO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 152-155. In Japanese. refs

A rivet splice model for analyzing multiple-site damage is presented. The effectiveness of the periodic inspection of multiple-site fatigue cracks along a rivet joint is discussed. The relative frequency distribution of visible crack length and joint posterior probability density are described. Y.P.Q.

A92-43133
OPTIMUM STRUCTURAL DESIGN OF A CANTILEVERED RECTANGULAR ELASTIC WING WITH A GUST LOAD ALLEVIATION SYSTEM
SHINJI SUZUKI and YONEZAWA SATOSHI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 180-183. In Japanese. refs

Equations for the optimum structural design of a cantilevered rectangular wing are presented. The Liapunov method is applied and the targets of the optimization are discussed. The structural optimization is analyzed. Y.P.Q.

A92-43156
QUALITY MANAGEMENT OF LANDING GEAR WITH PULLING SUPPORT SYSTEM
M. NIKAI (Japan Air System, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 284-287. In Japanese.

The maintenance of aircraft landing gear is discussed. Systems for the quality management are given and the pulling support system is emphasized. The quality inspection and landing gear overhaul operation is outlined. Y.P.Q.

A92-43206
DISTANCE AND ANGLE MEASURING METHOD USING LASER LIGHT AND REREFLECTION PLATES
NOBUO KAMATSU and S. TSUMURA (Osaka National University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 488-491. In Japanese. refs

The theory of using laser light and rereflection plates for distance and angle measurement is presented. The characteristics of the laser scanner are described. Y.P.Q.

A92-43213
ON THE CHARACTERISTICS OF SERVO ACTUATORS ATTACHED TO A MODEL SPACEPLANE FOR DYNAMIC WIND-TUNNEL TEST
TAKASHI SHIMOMURA, SHUICHI SASA, MASAAKI YANAGIHARA, and MASAHIKO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 516-519. refs

This paper describes identification of servo actuators of a model spaceplane. The actuators contain two nonlinear elements which are saturation on an input and backlash on an output. The existence of them makes identification to be difficult, so some ideas are required. An identification method for such a system is proposed, and parameters characterizing the actuators are estimated from experimental data. Author

A92-43240
THE MANEUVER PERFORMANCE AND CONTROL OF A HOVERCRAFT
N. KAWABATA and Y. MIURA (Nihon University, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 624-627. In Japanese. refs

The model configurations of a radio controlled hovercraft is presented. The improvement of the stability and control system and maneuver performance is discussed. Y.P.Q.

A92-43885
FAULT TOLERANT EHA ARCHITECTURES
TOM SADEGHI (New York, State University, Binghamton) and ARTHUR LYONS (General Electric Co., Aircraft Control Systems Dept., Binghamton, NY) IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985), vol. 7, no. 3, March 1992, p. 32-42. refs
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An evaluation is conducted of fault-tolerant electrohydrostatic actuator (EHA) architectures applicable to prospective military aircraft, defining fault tolerances in terms of mission-success probability and safety reliability. The functional-level failure modes of an EHA and its interfacing equipment are used to analyze levels of fault coverage and redundancy required by MIL-F-9490 and MIL-STD 882B. A summary is presented of estimates of fault tolerance, performance, and weight of candidate EHA architectures, to allow selection of an architecture suited for a specific application. O.C.

A92-44326
COMPUTER-BASED AREAL SURFACE TEMPERATURE AND LOCAL HEAT TRANSFER MEASUREMENTS WITH THERMOCHROMIC LIQUID CRYSTALS (TLC)
K.-H. PLATZER, C. HIRSCH, D. E. METZGER, and S. WITTIG (Karlsruhe, Universitaet, Federal Republic of Germany) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 1, May 1992, p. 26-32. refs
(Contract DFG-SFB-167)
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The experimental technique presented is designed to obtain detailed local heat transfer data on both stationary as well as rotating disk-cavity surfaces applicable to gas turbines. The method employed utilizes thin coatings of thermochromic liquid crystals (TLC) as surface temperature indicators under aerodynamically steady but thermally transient experimental conditions. The color display of the liquid crystals is monitored by a video camera. The video signals are captured in real time by a computer-based color recognition system to extract areal temperature and heat transfer information. Some typical results are presented and compared with literature data to illustrate the potential of the system.
Author

A92-44327
INSTANTANEOUS VISUALIZATION OF SURFACE FLOWS
J. TENSI (Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers, France) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 1, May 1992, p. 33-36. refs
Copyright

Two negative ion classes, namely NO3(-)(HNO3)n and HSO4(-)(H2SO4)q(HNO3), were identified in the stratosphere, and from these ions neutral HNO3 and H2SO4 in the gas phase were determined. A technique is proposed which makes it possible to detect a series of trace gas species in the middle atmosphere with a one-km height resolution from the ion composition. This technique is considered to be promising for the study of heterogeneous chemical reactions on aerosols and gas phase variations during evaporation and condensation. O.G.

A92-44380* National Aeronautics and Space Administration, Washington, DC.
HEAT PIPE AND SURFACE MASS TRANSFER COOLING OF HYPERSONIC VEHICLE STRUCTURES
GENE T. COLWELL (Georgia Institute of Technology, Atlanta) and JAMES M. MODLIN (U.S. Army, Strategic Defense Command, Huntsville, AL) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 492-499. Research supported by NSF and NASA. refs
Copyright

The problem of determining the feasibility of cooling hypersonic vehicle leading-edge structures exposed to severe aerodynamic surface heating using heat pipe and mass transfer cooling techniques is addressed. A description is presented of a numerical finite-difference-based hypersonic leading-edge cooling model incorporating poststartup liquid metal heat pipe cooling with surface transpiration and film cooling to predict the transient structural temperature distributions and maximum surface temperatures of hypersonic vehicle leading edge. An application of this model to the transient cooling of a typical aerospace plane wing leading-edge section. The results of this application indicated that liquid metal heat pipe cooling alone is insufficient to maintain surface temperatures below an assumed maximum level of 1800 K for about one-third of a typical aerospace plane ascent trajectory through the earth's atmosphere. C.D.

A92-44381
SURFACE COOLING OF SCRAMJET ENGINE INLETS USING HEAT PIPE, TRANSPIRATION, AND FILM COOLING
JAMES M. MODLIN (U.S. Army, Strategic Defense Command, Huntsville, AL) and GENE T. COLWELL (Georgia Institute of Technology, Atlanta) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 500-504. refs
Copyright

This article reports the results of applying a finite-difference-based computational technique to the problem of predicting the transient thermal behavior of a scramjet engine inlet exposed to a typical hypersonic flight aerodynamic surface heating environment, including type IV shock interference heating. The leading-edge cooling model utilized incorporates liquid metal heat pipe cooling with surface transpiration and film cooling. Results include transient structural temperature distributions, aerodynamic heat inputs, and surface coolant distributions. It seems that these cooling techniques may be used to hold maximum skin temperatures to near acceptable values during the severe aerodynamic and type IV shock interference heating effects expected on the leading edge of a hypersonic aerospace vehicle scramjet engine. Author

A92-44618
COMPOSITE MATERIAL STUB-BLADE WING JOINT
WALTER M. FRANKLIN and BRYAN W. KREIMENDAHL (Lockheed Aeronautical Systems Co., Burbank, CA) IN: Composite materials: Testing and design. Vol. 10; Proceedings of the 10th Conference, San Francisco, CA, Apr. 24, 25, 1990. Philadelphia, PA, American Society for Testing and Materials, 1992, p. 264-278. refs
Copyright

The viability of a composite stub-blade wing joint for high-altitude long-endurance aircraft was investigated in a joint-design study. The results of an analysis show that the resulting joint design is capable of carrying moderately high bending, shear, and torsional loads. The stub-blade wing joint design is weight-competitive with the traditional tension-type wing joint. In addition, it offers attractive features such as the ease of assembly and disassembly, the ease of fabrication, and an aerodynamic smoothness. I.S.

A92-44630
STRESS FIELD SENSITIVITY OF A COMPOSITE PATCH REPAIR AS A RESULT OF VARYING PATCH THICKNESS
MICHAEL P. SIENER (USAF, Sacramento Air Logistics Center, McClellan AFB, CA) IN: Composite materials: Testing and design. Vol. 10; Proceedings of the 10th Conference, San Francisco, CA, Apr. 24, 25, 1990. Philadelphia, PA, American Society for Testing and Materials, 1992, p. 444-464. refs
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The feasibility of increasing the efficiency of a composite scarf joint and, hence, of the composite patch repair, was investigated by using single lap joint configurations based on a variety of patch material thicknesses and stiffnesses, and testing for the elastic response and the strength capability. Stress analyses of these configurations were carried out and compared to the results from tests. It was found that, by reorienting plies in the principal stress direction, it is possible to reduce the number of plies and thickness required to form a usable composite repair patch. The results also show that it may be necessary to incorporate the nonlinear adhesive behavior into the model to account for the extensional response of the adherends. I.S.

A92-44732
SUPER PLASTIC FORMING TECHNOLOGY APPLIED TO AEROENGINE AND SPACE EQUIPMENT
KATSUMI MANDAI Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32. no. 2, March 1992, p. 61-65. In Japanese.

Titanium alloys, especially Ti-6Al-4V, are widely used for the aeroengine and space equipment because of their high strength ratio and excellent resistance to heat and corrosion. But this material is difficult to manufacture by conventional plastic forming technology. It has been reported that Ti-6Al-4V shows extensive ductility (superplasticity), more than 1000 percent under the condition of both low straining rate and high temperature ranges. Superplastic forming technology applying this characteristic is widely known as one of the most cost-effective methods to save material. At the plant, gas argon blowing equipment for the superplastic forming technology has been developed and 'V2500 nose fairing' and 'fuel tank of the H-II rocket second stage reaction control system' have been manufactured. This paper describes the superplastic forming equipment and the two products above. Author

A92-44733
BASIC STUDY OF ADHESIVE BONDING FOR FIBER-COMPOSITES - ADHESIVE BONDING TECHNOLOGIES ON JET ENGINE PARTS
TAKAHITO ARAKI and TADAHIRO WASHIZU Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32. no. 2, March 1992, p. 66-68. In Japanese. refs

Adhesive bonding technology in jet engine parts has become more important due to recent applications of fiber-composite parts in jet engines. Adhesive bonding to the fiber-composites were studied for some kinds of composites which have a matrix resin such as epoxy, polyimide, and PEEK. Lap shear specimens were made from two types of combined adherends: composite to composite and composite to metal. Lap shear tests were conducted according to the ASTM D-3163 procedures. The lap shear coupons were blasted with Al2O3 grit. It appeared that different processes and different adherend combinations evidently changed the strength and the heat resistance strength of bonding. The amorphous bonding technique used a polyether imide (PEI) film that was coconsolidated with the PEEK/CF adherends follow by secondary bonding. Author

N92-26258# Aeronautical Research Labs., Melbourne (Australia).
AN OUTLINE OF A NUMERICAL SCHEME FOR CALCULATING TWO-DIMENSIONAL TIME LINEARISED TRANSONIC FLOW USING THE GREEN'S FUNCTION METHOD
I. H. GRUNDY Aug. 1991 15 p
(AD-A246349; ARL-STRUC-TM-527; DODA-AR-006-091) Avail: CASI HC A03/MF A01

A numerical scheme is outlined for the calculation of 2-D time-linearized transonic flow about an aerofoil or collection of components, using the Green's function method. Computed results are presented for various configurations for the simpler subproblem of steady subsonic flow. GRA

N92-26441# Diamond Air Service, Inc. (Japan). Flight Operations.
OUTLINES OF PARABOLIC FLIGHT [PARABORIKKU FURAITO NI TSUITE]
TAROU KAGEYAMA *In* NASDA, Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 1-9 21 Aug. 1991 In JAPANESE
Avail: CASI HC A02/MF A01

Microgravity experiments that utilize the parabolic flight path of aircraft are outlined. Among the topics discussed are the following: the underlying principles, normal parabolic flight patterns, flight restrictions, the level of microgravity produced, and the flight duration. Two of the main advantages that microgravity flight experiments provide, are cost effectiveness and a wide range of available gravity levels. Author (NASDA)

N92-26555*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GEAR TOOTH STRESS MEASUREMENTS OF TWO HELICOPTER PLANETARY STAGES
TIMOTHY L. KRANTZ 1992 10 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoeniz, AZ, 13-16 Sep. 1992; sponsored by ASME
(Contract RTOP 505-63-36; DA PROJ. 1L1-62211-A-47-A)
(NASA-TM-105651; E-7015; NAS 1.15:105651;
AVSCOM-TR-91-C-038; AD-A252378) Avail: CASI HC A02/MF A01

Two versions of the planetary reduction stages from U.S. Army OH-58 helicopter main rotor transmissions were tested at NASA Lewis. One sequential and one nonsequential planetary were tested. Sun gear and ring gear teeth strains were measured, and stresses were calculated from the strains. The alternating stress at the fillet of both the loaded and unloaded sides of the teeth and at the root of the sun gear teeth are reported. Typical stress variations as the gear tooth moves through mesh are illustrated. At the tooth root location of the thin rimmed sun gear, a significant stress was produced by a phenomenon other than the passing of a planet gear. The load variation among the planets was studied. Each planet produced its own distinctive load distribution on the ring and sun gears. The load variation was less for a three planet, nonsequential design as compared to that of a four planet, sequential design. The reported results enhance the data base for gear stress levels and provide data for the validation of analytical methods. Author

N92-26560*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FULL-SCALE TRANSMISSION TESTING TO EVALUATE ADVANCED LUBRICANTS
DAVID G. LEWICKI, HARRY J. DECKER, and JOHN T. SHIMSKI (Naval Air Propulsion Test Center, Trenton, NJ.) 1992 9 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(Contract RTOP 505-63-36; DA PROJ. 1L1-62211-A-47-A)
(NASA-TM-105668; E-7032; NAS 1.15:105668;
AVSCOM-TR-91-C-035; AD-A252382) Avail: CASI HC A02/MF A01

Experimental tests were performed on the OH-58A helicopter main rotor transmission in the NASA Lewis 500 hp helicopter transmission test stand. The testing was part of a lubrication program. The objectives are to develop and show a separate lubricant for gearboxes with improved performance in life and load carrying capacity. The goal was to develop a testing procedure to fail certain transmission components using a MIL-L-23699 based reference oil and then to run identical tests with improved lubricants and show improved performance. The tests were directed at parts that failed due to marginal lubrication from Navy field experience. These failures included mast shaft bearing micropitting, sun gear and planet bearing fatigue, and spiral bevel gear scoring. A variety of tests were performed and over 900 hrs of total run time accumulated for these tests. Some success was achieved in developing a testing procedure to produce sun gear and planet

bearing fatigue failures. Only marginal success was achieved in producing mast shaft bearing micropitting and spiral bevel gear scoring. Author

N92-26592# Defence Research Establishment, Ottawa (Ontario).
ANALYSIS OF EMP RESPONSE OF STRUCTURES USING FREQUENCY DOMAIN ELECTROMAGNETIC INTERACTION CODES
MARC DION and SATISH KASHYAP May 1991 36 p
(AD-A245758; DREO-1078) Avail: CASI HC A03/MF A01

This report concerns the use of frequency domain computer codes such as the Numerical Electromagnetic Code (NEC) for computing the time domain Electromagnetic Pulse (EMP) response of structures such as antennas, aircraft or communication shelters. The proper representation of the EMP excitation and the selection of a number of appropriate frequencies to obtain a correct time domain EMP response are studied. The effects of adapting the modelling of the problem for different frequency ranges is discussed. Guidelines are given for obtaining a correct time domain response with the efficient use of computer time. GRA

N92-26680*# High Technology Corp., Hampton, VA.
DISTRIBUTED ACOUSTIC RECEPTIVITY IN LAMINAR FLOW CONTROL CONFIGURATIONS Final Report
MEELAN CHOUDHARI Washington NASA May 1992 47 p
(Contract NAS1-18240; RTOP 537-03-23-03)
(NASA-CR-4438; NAS 1.26:4438) Avail: CASI HC A03/MF A01

A model problem related to distributed receptivity to free-stream acoustic waves in laminar flow control (LFC) configurations is studied, within the Orr-Sommerfield framework, by a suitable extension of the Goldstein-Ruban theory for receptivity due to localized disturbances on the airfoil surface. The results, thus, complement the earlier work on the receptivity produced by local variations in the surface suction and/or surface admittance. In particular, we show that the cumulative effect of the distributed receptivity can be substantially larger than that of a single, isolated suction strip or slot. Furthermore, even if the receptivity is spread out over very large distances, the most effective contributions come from a relatively short region in vicinity of the lower branch of the neutral stability curve. The length scale of this region is intermediate to that of the mean of these two length scales. Finally, it is found that the receptivity is effectively dominated by a narrow band of Fourier components from the wall-suction and admittance distributions, roughly corresponding to a detuning of less than ten percent with respect to the neutral instability wavenumber at the frequency under consideration. The results suggest that the drop-off in receptivity magnitudes away from the resonant wavenumber is nearly independent of the frequency parameter. Author

N92-26698# Sandia National Labs., Albuquerque, NM.
REYNOLDS NUMBER DEPENDENCE OF THE DRAG COEFFICIENT FOR LAMINAR FLOW THROUGH FINE-SCALE SCREENS
T. J. OHERN and J. R. TORCZYNSKI 1991 21 p Presented at the AIAA/ASME National Fluid Dynamics Congress, Los Angeles, CA, 15-18 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE92-002930; SAND-91-1429C; CONF-920605-2) Avail: CASI HC A03/MF A01

The laminar flow downstream of fine mesh screens is studied experimentally and numerically. Two different screen types are examined experimentally, both with open areas greater than 50 percent and wire dimensions less than 100 micro-m. Such screens produce flow disturbances of much smaller scale than those examined in most previous studies of flow conditioning screens and grid generated turbulence. Instead of using standard woven wire screens, high uniformity screens are used which are fabricated by photo-etching holes into 50.8 micro-m thick Inconel sheets. The holes thus produced are square with rounded corners, arranged to form a square array, with a minimum wire thickness (located halfway between wire crossings) of D = 50.8 micro-m. A flow facility has been constructed for experiments with these screens. Air at 85 kPa and 295 K is passed through each screen at upstream velocities of 1 to 12 m/s, yielding Reynolds numbers Re(sub D) = (rho)UD/mu in the range 2 less than or equal to Re(sub D) less than or equal to 35. Pressure drops across the screens are measured at these conditions using pressure transducers and manometers. From these data, the Reynolds number dependence of the drag coefficient c(sub D) is determined. Three dimensional flow simulations are performed using the spectral element code NEKTON. The geometry of the photo-etched screens is simulated by a similar geometry with the same open area and minimum wire thickness. The drag coefficients are determined from the computed pressure differences across the screens and are in reasonable agreement with the experimental values, although the agreement degrades slightly with increasing Reynolds number. Such correlations are applicable for the present screens so long as the correct choices for screen open area fraction O and minimum wire thickness D are used in correlation. DOE

N92-26816# John Deere Technologies International, Inc., Wood-Ridge, NJ. Rotary Engine Div.
DEVELOPMENT OF NATURAL GAS ROTARY ENGINES Final Report, Jun. 1986 - Jun. 1991
J. R. MACK Aug. 1991 50 p
(Contract GRI-5086-233-1262)
(PB92-149665; GRI-91/0290) Avail: CASI HC A03/MF A01

Development of natural gas-fueled rotary engines was pursued on the parallel paths of converted Mazda automotive engines and of establishing technology and demonstration of a test model of a larger John Deer Technologies Incorporated (JDTI) rotary engine with power capability of 250 HP per power section for future production of multi-rotor engines with power ratings 250, 500, and 1000 HP and upward. Mazda engines were converted to natural gas and were characterized by a laboratory which was followed by nearly 12,000 hours of testing in three different field installations. To develop technology for the larger JDTI engine, laboratory and engine materials testing was accomplished. Extensive combustion analysis computer codes were modified, verified, and utilized to predict engine performance, to guide parameters for actual engine design, and to identify further improvements. A single rotor test engine of 5.8 liter displacement was designed for natural gas operation based on the JDTI 580 engine series. This engine was built and tested. It ran well and essentially achieved predicted performance. Lean combustion and low NOW emission were demonstrated. Author

N92-26853# Sandia National Labs., Albuquerque, NM.
EULERIAN COMPUTATIONAL METHODS
M. MCGLAUN 1991 14 p Presented at the 2nd International Symposium on Intense Dynamic Loading and its Effects, Chengdu, China, 9-12 Jun. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008017; SAND-91-2865C; CONF-920688-5) Avail: CASI HC A03/MF A01

Continuum dynamics codes are categorized as Lagrangian or Eulerian according to the motion of the mesh. A Lagrangian code's mesh moves with the material, so no mass flows between cells. An Eulerian code's mesh is stationary, so mass flows between the cells. Eulerian codes have improved to the point where they are routinely used to solve a broad variety of large deformation solid and fluid dynamics problems ranging from air flow over an airplane wing to meteor impact on space structures. This presentation will concentrate on multi-fluid Eulerian codes capable of modeling transient wave propagation in solids. These codes use a two-step process to integrate the physics across a time step. The first step, referred to as the Lagrangian step, integrates the physics on a Lagrangian mesh across the time step. The field values are then at the new time, but they are on the distorted Lagrangian mesh. The second step, referred to as the remap step, remaps the data on the distorted Lagrangian mesh back to the original Eulerian mesh thus completing one time step. The algorithms used in the first step are similar to those used in modern Lagrangian codes but they must be extended to handle multi-material cells. The algorithms used in the second step are

complex and must be very carefully chosen to minimize errors. These algorithms include second-order, monotone advection equations to calculate the quantities flowing between cells. They also require algorithms that construct material interfaces inside multi-material cells. The strength and limitations of currently used numerical techniques will be discussed. New code development activities that combine the best features of both Lagrangian and Elurian codes will also be discussed. These new codes will employ the strengths of both technologies to address problems that cannot be adequately solved at this time. DOE

N92-26908# Ship Research Inst., Tokyo (Japan).
RESEARCH ACTIVITIES ON CFD AT THE SHIP RESEARCH INSTITUTE [SENPAKU GIJUTSU KENKYUSHO NI OKERU CFD KENKYU NO DOKO]
YOSHIAKI KODAMA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 3-4 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The CFD (Computational Fluid Dynamics) method is used for the analysis of flow pattern in the area of ship fluid flow analysis. Research activities of the following themes utilizing the CFD method at the Ship Research Inst. were briefly described: viscous flow around the ship body, waves generated in free surface, the flow pattern around propellers, and interference between propellers and ship stern by the accompanying flow. The CFD can be utilized with advantages for the numerical simulation under hypothetical flow patterns. As one example of CFD application, control of water flow around the ship body by magnetohydrodynamics was simulated. The Lorentz force is developed in the sea water, when electric current is applied under high magnetic field. This Lorentz force can be useful for the control of fluid field. Author (NASDA)

N92-26909# Tohoku Univ., Sendai (Japan). Faculty of Engineering.
THREE DIMENSIONAL BOUNDARY LAYER TRANSITION ON A YAWED CYLINDER [NANAME ENCHU NO SANJIGEN KYOKAISO SENI]
YASUAKI KOHAMA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 5-9 Oct. 1990 In JAPANESE Original contains color illustrations
Avail: CASI HC A01/MF A01

The crossflow instability in three dimensional flow is influenced by sweepback angles of main wings and pressure distribution on wing surface. This crossflow instability is treated in two zones of pressure distribution on wing surface, one as a highly pressure decreasing zone at the front edge of wing and the other as a mildly pressure decreasing zone at other wing zone. In this paper, the criteria of crossflow instability generation and the turbulent flow transition process were analyzed using cylindrical model for the qualitative estimation of the strong pressure gradient of the crossflow instability. As for the aerodynamic heating process, the effects of transition zone on the heat conduction to the wall was investigated using heat sensitive liquid crystal. As the results of the investigation, in the transition zone where only primary instability emerged, the turbulent intensity was found not to increase and the heat conductivity to somewhat increase. Author (NASDA)

N92-26911# Railway Technical Research Inst., Tokyo (Japan).
AERODYNAMIC DRAG ON THE BULLET TRAINS [SHINKANSEN DENSHA NO KUKI TEIKO]
TATSUO MAEDA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 15-17 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The running resistance of electric trains can be divided into two resistances, one is the air resistance and the other is the mechanical resistance. The reduction of air resistance of high speed electric trains is especially important, as air resistance of trains increases faster than mechanical resistance in high speed. The air resistance of a long electric train like the 'Shinkansen' (Bullet Train) is evaluated as the combination of the pressure resistance which is exerted at the head and tail parts of the train and of the friction resistance which is exerted along side surfaces of the train and is proportional to the train length. The air resistance is measured from the difference of air resistance between long and short trains by the wind tunnel tests. The air friction resistance is measured from the pressure increase on the side surface of the train, when the train enters a tunnel. The combined resistance (air resistance and mechanical resistance) of the electric trains moving in the tunnel was measured and the resistance difference in and out of the tunnels were assumed to be the air resistance of the train. With this experiment, accuracies of measurement methods were analyzed. Author (NASDA)

N92-26913# Nihon Univ., Tokyo (Japan). Coll. of Science and Engineering.
FLOW AROUND AN ISOLATED SURFACE ROUGHNESS IN THE LAMINAR BOUNDARY LAYER [KORITSU SODO MAWARI NO NAGARE NI TSUITE]
TATSUO MOTOHASHI *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 23-24 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The roughness of aircraft wings is an important factor for the air resistance of an aircraft. In order to reduce the air resistance, a method to keep boundary layers as laminar flow is often adapted. With this method, emergence of turbulent flow due to the roughness is not well understood. Especially when the roughness is somewhat large, strong disturbances are caused by the roughness, and turbulent flow occurs suddenly: the mechanism is not well understood. Experimental results in the air flow about isolated roughness (small stubs embedded on the boundary layer) were reported. The air about the isolated roughness were classified as three types according to the roughness: Reynolds number of about under 200, 200 to 500, and over 500. In the range of Reynolds number from 200 to 500, the air flow becomes unstable due to the interference of eddy flow and boundary layer and finally becomes turbulent flow. Diagrams on the air flow about roughness, equal turbulence lines, and equal shear strain line in the down flow of roughness (stubs) were shown. Author (NASDA)

N92-26915# National Research Lab. of Metrology, Tokyo (Japan).
APPLICATION OF RIBLET SURFACE TO PIPE FLOW [TEIKO GENSHO GIJUTSU NO KANNAIRYU HENO OYO NI TSUITE]
SHINICHI NAKAO *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 29-30 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The reduction of turbulent friction resistance to save energy consumption is important not only for aircrafts and ships but especially for pipelines' transportation of fluids. The following two turbulent friction resistance reduction technologies were applied for fluid flow in pipes: with flexible wall, and riblet. The experimental results and analysis are shown. In the experiment, a Teflon tube of 51 mm diameter and 0.05 mm thickness was used. The following three measurements were performed: (1) static axial pressure distribution in the pipe; (2) flow variables measurement by X type heated wire anemometer in the radial direction; and (3) vibration frequency and displacement in the pipe measurement by an eddy current displacement meter. The flow resistance increased at the Reynolds number of 10,000. The reason was attributed to the distortion of pipe wall due to the circumferential stress unequality when the tube was set. The resistance decreased about two percent at the Reynolds number of 30,000. This was due to a 0.25 mm increase in tube diameter. The test results were as follows: (1) the flow resistance was decreased about eight to ten percent; (2) the forms of grooves were V type or U type; and (3) the h+ of grooves was in the range of eight to 12 and s+ of grooves was ten to 20. (h is the height of grooves and s is the distance between grooves.) The riblet method is effective in reducing the surface friction resistance by etching longitudinal grooves on the wall surface. Author (NASDA)

N92-26922# National Aerospace Lab., Tokyo (Japan).
CROSS-FLOW INSTABILITIES AND PRESSURE GRADIENTS IN BOUNDARY LAYERS [YOKONAGARE FUANTEI TO ATSURYOKU KOBAI]
NOBUTAKE ITO *In its* Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 49-51 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

A three dimensional boundary layer is characterized by the velocity component normal to the external nonviscous flow, that is, by the existence of the transverse flow. One of the causes is the combination of the sweptback angle of the wings and the pressure gradient in the direction of a chord and the other is the pressure gradient in the direction of a wing width. Generally, these two phenomena coexist in the three dimensional boundary layer of the sweptback wings. The transverse flow velocity is represented as the sum of velocity components of the two transverse flows. The simple example of this general three dimensional boundary layer occurs when a wedge type body is placed with a yaw against uniform flow and the pressure gradient is applied to the direction of front edge of the body. The accurate solution for this type of three dimensional boundary layer equation and the linear stability calculation using the Orr-Sommerfeld equation are studied. The calculated results contain many unknown facts. It is shown that, if the pressure gradient in the direction of wing width is not considered, only a part of stability in the three dimensional boundary layer is observed and the most important characteristics are neglected. Author (NASDA)

N92-27038# Rolls-Royce Ltd., Derby (England). Control Systems Dept.
USE OF MARKOV METHODS IN ANALYSIS OF FAULT-TOLERANT SYSTEMS WITH FLEXIBLE REPAIR POLICIES
PAUL WHITE 1 Jun. 1990 5 p
(PNR-90801; ETN-92-90774) Copyright Avail: CASI HC A01/MF A01

Some of the problems that have arisen in the application of traditional reliability methods to fault tolerant systems, particularly with the widely used fault tree approach are considered. The application of the Markov state flow equation to reliability analysis is considered and it is shown how many of the aforementioned problems disappear with this approach and how the basic equation can be manipulated to include repair policies, discrete events, and to calculate system reliability. Then the issues are taken on to the next step by considering how to set up a reliability model from system design information in such a way as to ensure the Markov states and transitions are correct and so as to ensure that the reliability analysis gives an upper bound for system failure. The concept of formulation of design information and automatic generation of a reliability model for any given system is explained and an example analysis given based on a typical jet engine control system. The advantages of the Markov method are examined, and the problems that still remain are considered together with how they are overcome with the Reliability Model Generation (RMG) method. ESA

N92-27045# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Abt. Aerodynamik und Flugmechanik.
THEORETICAL PRINCIPLES OF A EULER METHOD FOR THE CALCULATION OF THREE DIMENSIONAL FLOWS [THEORETISCHE GRUNDLAGEN EINER EULER-METHODE ZUR BERECHNUNG VON 3-DIMENSIONALEN STROEMUNGEN]
MARCEL SCHLEICHER 14 Nov. 1989 25 p In GERMAN
(F+W-TF-2012; ETN-92-90819) Avail: CASI HC A03/MF A01

The theoretical background of an explicit upwind scheme for solving Euler equations in structured meshes is presented. The scheme produces shape resolution. The volume is decomposed in a number of individual units. Each unit is the carrier of constant functional values. Flow functions are defined at unit walls. They allow dating of functional values in the individual units. The direction of the characteristics are considered for the calculation of the flow functions. They carry only physically significant information from the interior of the unit to the unit wall. ESA

N92-27193*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATIONAL METHOD TO PREDICT THERMODYNAMIC, TRANSPORT, AND FLOW PROPERTIES FOR THE MODIFIED LANGLEY 8-FOOT HIGH-TEMPERATURE TUNNEL
S. VENKATESWARAN, L. ROANE HUNT, and RAMADAS K. PRABHU (Lockheed Engineering and Sciences Co., Hampton, VA.) Jul. 1992 36 p
(Contract RTOP 506-43-31-05)
(NASA-TM-4374; L-17013; NAS 1.15:4374) Avail: CASI HC A03/MF A01

The Langley 8 foot high temperature tunnel (8 ft HTT) is used to test components of hypersonic vehicles for aerothermal loads definition and structural component verification. The test medium of the 8 ft HTT is obtained by burning a mixture of methane and air under high pressure; the combustion products are expanded through an axisymmetric conical contoured nozzle to simulate atmospheric flight at Mach 7. This facility was modified to raise the oxygen content of the test medium to match that of air and to include Mach 4 and Mach 5 capabilities. These modifications will facilitate the testing of hypersonic air breathing propulsion systems for a wide range of flight conditions. A computational method to predict the thermodynamic, transport, and flow properties of the equilibrium chemically reacting oxygen enriched methane-air combustion products was implemented in a computer code. This code calculates the fuel, air, and oxygen mass flow rates and test section flow properties for Mach 7, 5, and 4 nozzle configurations for given combustor and mixer conditions. Salient features of the 8 ft HTT are described, and some of the predicted tunnel operational characteristics are presented in the carpet plots to assist users in preparing test plans. Author

N92-27352# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
FRACTAL IMAGE COMPRESSION OF RAYLEIGH, RAMAN, LIF AND LDV DATA IN TURBULENT REACTING FLOWS Final Report, 30 Sep. 1990 - 29 Sep. 1991
WARREN C. STRAHLE and JECHIAL I. JAGODA Nov. 1991 32 p
(Contract AF-AFOSR-0247-90)
(AD-A246960; AFOSR-92-0088TR) Avail: CASI HC A03/MF A01

Experiments and analysis were completed concerning a diagnostic program on a two dimensional subsonic windtunnel with a backward facing step and combustion. Combustibles were introduced as a hydrogen-argon mixture from a porous floor behind the step. Completed were LDV and Raman spectroscopy for mean and rms velocity (two components) and temperature. Analysis used a two equation turbulence model which predicted the gross features of the flow but somewhat underpredicted reattachment length. Two dimensional and three dimensional fractal interpolation techniques were developed for reduction of noise to signal ratio in the complex turbulent flow. New methods of fractal analysis of time series were developed. GRA

N92-27394# Booz-Allen and Hamilton, Inc., Bethesda, MD.
HEAVY DUTY TRANSPORT RESEARCH NEEDS ASSESSMENT
13 Sep. 1991 183 p
(Contract DE-AC01-89ER-30148)
(DE92-010622; DOE/ER-30148/T1) Avail: CASI HC A09/MF A02

As a result of the desire to decrease the dependence of the U.S. on foreign petroleum as a transportation fuel, this report assesses the research needs to further develop heavy duty engines. The topics covered include diesel engines, alternative fuels, electric vehicle technology, gas turbine engines, and Stirling cycle alternative engines. DOE

N92-27407# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
EXPERIMENTAL INVESTIGATION OF THE UNSTEADY PRESSURE FIELD AROUND AN OSCILLATING BLADE [EXPERIMENTELLE UNTERSUCHUNG DES INSTATIONAEREN DRUCKFELDES UM EINE SCHWINGENDE SCHAUFEL]
C. POENSGEN Jun. 1990 123 p In GERMAN
(MITT-90-01; ETN-92-90829) Avail: CASI HC A06/MF A02

A two dimensional unsteady process for predicting the unsteady pressure distribution around an oscillating blade in homogeneous flow is presented. A data base was developed for the computation process. In order to reduce costs, the experimental building was designed in such a way that the experimental boundary conditions could be reproduced by the computation process. It was shown that the pressure amplitude for an oscillating compressor blade is independent from the oscillating displacement, as long as this is kept small. It appears, for that experimental case, that the influences of rotor wake and of the oscillatory motion on the resulting unsteady pressure field can be linearly superposed in first order of magnitude. ESA

N92-27452# Royal Aerospace Establishment, Farnborough (England). Propulsion Dept.
APPLICATION OF S1BYL2 TO THE AGARD WG18 COMPRESSOR TEST CASES
W. J. CALVERT *In* AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Previously announced as N91-30147
Copyright Avail: CASI HC A03/MF A06

S1BYL2 is an inviscid-viscous blade-to-blade method for calculating the detailed aerodynamics and overall performance of compressor blades. It may be applied either on its own to predict the flow for individual blade sections, such as the midspan of a linear cascade, or in conjunction with a throughflow calculation to predict the performance of a complete axial compressor. New predictions for the V2 and ARL SL19 cascades and for the high speed compressor cases are presented. It is hoped that this will be one of many sets of calculations for these cases, so that an improved understanding of each case may be obtained, together with an appreciation of the strengths and weaknesses of different computational approaches. Author

N92-27459*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A CRITICAL EVALUATION OF A THREE-DIMENSIONAL NAVIER-STOKES METHOD AS A TOOL TO CALCULATE TRANSONIC FLOWS INSIDE A LOW-ASPECT-RATIO COMPRESSOR
CHUNILL HAH and STEVEN L. PUTERBAUGH (Air Force Systems Command, Wright-Patterson AFB, OH.) *In* AGARD, CFD Techniques for Propulsion Applications 14 p Feb. 1992 Original contains color illustrations
Copyright Avail: CASI HC A03/MF A06

A numerical study to evaluate a three-dimensional Navier-Stokes method as a tool to predict the detailed flow field inside a low-aspect-ratio compressor at various operating conditions was conducted. The details of the flow structure inside a low aspect ratio compressor (three-dimensional shock structure, shock-boundary layer interaction, and tip leakage vortex) and the overall aerodynamic performance at design and off-design conditions are numerically analyzed and the results are compared with the available experimental data. The flow field inside a state-of-the-art transonic compressor is used for the purpose of the evaluation. D.R.D.

N92-27460# Paris VI Univ. (France).
ON THE COMPUTATION OF UNSTEADY TURBOMACHINERY FLOWS. PART 1: EULER EQUATIONS IN VIBRATING CASCADES
GEORG A. GEROLYMOS *In* AGARD, CFD Techniques for Propulsion Applications 19 p Feb. 1992 Sponsored in part by SNECMA
Copyright Avail: CASI HC A03/MF A06

A methodology is presented for unsteady flow analysis in vibrating transonic compressor cascades, using Euler equations. After a brief discussion of the problem, the numerical algorithm is presented, for the 3-D case, with particular emphasis on grid displacement procedures, slip surface fitting, boundary conditions, and their effect on computational results. Chorochronic flow periodicity and model superposition are briefly discussed. Several results from realistic aircraft engine turbomachinery configurations are presented. The lack of, and urgent need for 3-D experimental data combining unsteady pressure measurements and vibrating mode shapes are stressed. The methods are then validated through comparison with time linearized flat plate cascade theory (analytical) and experimental data from annular and linear cascades. A method for computing the aeromechanical coupling is presented. Finally, a discussion is presented of viscous effects. Author

N92-27467*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VISCOUS THREE-DIMENSIONAL CALCULATIONS OF TRANSONIC FAN PERFORMANCE
RODRICK V. CHIMA *In* AGARD, CFD Techniques for Propulsion Applications 19 p Feb. 1992 Previously announced as N92-17346
Copyright Avail: CASI HC A03/MF A06

A 3-D flow analysis code was used to compute the design speed operating line of a transonic fan rotor, and the results were compared with experimental data. The code is an explicit finite difference code with an algebraic turbulence model. The transonic fan, called Rotor 67, was tested experimentally at NASA Lewis conventional aerodynamic probes and with user anemometry and was included as one of the AGARD test cases for the computation of internal flows. The experimental data are described. Maps of total pressure ratio and adiabatic efficiency vs mass flow were computed and are compared with the experimental maps, with good agreement. Detailed comparisons between calculations and experiment are made at two operating points, one near peak efficiency and the other near stall. Blade-to-blade contour plots are used to show the shock structure. Comparisons of circumferentially integrated flow quantities downstream of the rotor show spanwise distributions of several aerodynamic parameters. Calculated Mach number distributions are compared with laser anemometer data within the blade row and the wake to quantify the accuracy of the calculations. Particle traces are used to show the nature of secondary flow. Author

N92-27468# United Technologies Optical Systems, Inc., West Palm Beach, FL. Theoretical and Computational Fluid Dynamics Group.
NAVIER-STOKES ANALYSIS OF TURBINE BLADE HEAT TRANSFER AND PERFORMANCE
DANIEL J. DORNEY and ROGER L. DAVIS *In* AGARD, CFD Techniques for Propulsion Applications 12 p Feb. 1992 (Contract N00140-88-C-0677)
Copyright Avail: CASI HC A03/MF A06

A three dimensional Navier-Stokes analysis of heat transfer and aerodynamic performance is presented for a low speed linear turbine cascade. The numerical approach used consists of an alternate direction, implicit, approximate factorization, time marching technique. An objective was to establish the computational grid density requirements necessary to accurately predict blade surface and endwall heat transfer, as well as the exit plane aerodynamic total pressure loss and flow angle distributions. Also, a study was performed to determine a viable implementation strategy for the 3-D modeling of transition and turbulence in the turbine blade passage. Results are presented which show that the present procedure can accurately predict 3-D turbine blade heat transfer as well as the absolute level and spanwise distribution of aerodynamic performance quantities. Author

N92-27470# National Technical Univ., Athens (Greece). Lab. of Thermal Turbomachines.
UNSTEADY EULER CALCULATIONS IN 3D INTERNAL AERODYNAMICS

M. HADZIDAKIS, F. KARAGIANNIS, P. CHAVIAROPOULOS, and K. D. PAPAILIOU *In* AGARD, CFD Techniques for Propulsion Applications 8 p Feb. 1992
Copyright Avail: CASI HC A02/MF A06

An implicit finite difference algorithm is presented which solves the unsteady Euler equations in three dimensional ducts. The Helmholtz decomposition is examined of the unsteady velocity field into a potential and a rotational part. The geometry does not change with time, thus the unsteady nature of the flow is due to the time dependent inflow and outflow boundary conditions. The flow at the inlet is supposed to be rotational. Vorticity is introduced by means of velocity, total enthalpy, or even entropy profile slope. The results cover a wide range of reduced frequencies in the subsonic flow regime. Author

N92-27471# Rolls-Royce Ltd., Derby (England).
THE APPLICATION OF A NAVIER-STOKES CFD METHOD TO CIVIL ENGINE INTAKE FLOWS
N. T. BIRCH, E. H. KITCHEN, and R. J. G. NORTON (Rolls-Royce, Inc., Atlanta, GA.) *In* AGARD, CFD Techniques for Propulsion Applications 10 p Feb. 1992 Sponsored in part by Ministry of Defence
Copyright Avail: CASI HC A02/MF A06

Three-dimensional flows around civil engine intakes were calculated by a Navier-Stokes method. The full Reynolds-averaged Navier-Stokes equations for viscous flow are solved by an explicit time-marching cell-centered finite-volume algorithm. To ensure numerical stability, Jameson's formulation of fourth-order and second-order smoothing is used. Second-order smoothing is switched on only in regions of strong pressure gradient such as shocks. The flow may be laminar or turbulent; turbulence is treated by a mixing-length eddy viscosity model. The algorithm is applied on a body-fitted C-type computational grid. Author

N92-27472# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CFD CONTRIBUTIONS DURING HYPERSONIC AIRPLANE INTAKE DESIGN
N. C. BISSINGER and A. EBERLE *In* AGARD, CFD Techniques for Propulsion Applications 24 p Feb. 1992 Sponsored in part by BMFT
Copyright Avail: CASI HC A03/MF A06

Above certain Mach numbers, flows in wind tunnels can no longer fully simulate the actual flow physics. In the design of optimal propulsion systems, which are capable of economically propelling aircraft to hypersonic Mach numbers, understanding of the 'real' flow is mandatory. This paper will address recently developed numerical elements of an advanced CFD code in terms of computational speed and accuracy. Results will be presented of several calculations performed to gain insight into the flow in hypersonic intakes. Author

N92-27475# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PRESENTATION OF A COMPUTATIONAL CODE FOR 3-D COMPRESSIBLE FLOW IN COMPLEX CHANNELS AND CAVITIES [PRESENTATION D'UN CODE DE CALCUL D'ECOULEMENTS COMPRESSIBLES 3-D DANS DES CANAUX ET DES CAVITES DE FORME COMPLEXE]
D. DUTOYA, M. ERRERA, P. J. MICHARD, and A. RISTORI *In* AGARD, CFD Techniques for Propulsion Applications 21 p Feb. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A91-45650
Copyright Avail: CASI HC A03/MF A06

A computation code named MATHILDA was developed at ONERA to study mass and energy transfer through internal cooling systems composed of complex shaped channels and cavities in which the flow is controlled by the interaction between inertial forces and irreversible phenomena. This code integrates the 3D time dependent Navier-Stokes equations, along with some additional transfer equations. The fluid is compressible, and flow may vary from low subsonic to supersonic. The turbulence model can be either a two-equation model or an algebraic model. Author

N92-27478# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Group.
AEROTHERMODYNAMICS OF NOZZLE FLOWS FOR ADVANCED HYPERSONIC PROPULSION SYSTEMS
C. WEILAND, G. HARTMANN, and S. MENNE *In* AGARD, CFD Techniques for Propulsion Applications 11 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

One of the major tasks for the development of novel airbreathing space transportation systems, operating from usual airports by horizontal take off and landing, is the integration of an advanced propulsion system in the cell of that spacecraft. The air intake and in particular the free expansion nozzle affect not only the efficiency of the engine but also the forces and moments, and with that, the control of the complete spacecraft. Therefore, it is necessary to know in detail the flow fields through such nozzles and its interaction with the external airflow. Another project deals with conventional rocket motor nozzles whereby injection of turbine exhaust gases in the expansion part of the nozzle the wall of the nozzle is cooled (filmcooling concept) and the thrust is slightly increased. Theoretical investigation of these and other nozzles is the objective of this paper. Euler and boundary layer methods will be applied to predict the flow fields of the nozzles where special emphasis is laid on the consideration of real gas effects. The theory of the Euler method will be described in detail while for the second order boundary layer method the governing equations are presented and the range of its applicability is shortly discussed. Finally results for a variety of nozzles will be given. Author

N92-27479# Technische Univ., Aachen (Germany, F.R.). Inst. for Jet Propulsion and Turbomachinery.
APPLICATION OF FINITE ELEMENT METHOD TO HYPERSONIC NOZZLE FLOW COMPUTATIONS
W. KOSCHEL, W. RICK, and S. BIKKER *In* AGARD, CFD Techniques for Propulsion Applications 14 p Feb. 1992 Sponsored in part by DFG
Copyright Avail: CASI HC A03/MF A06

An explicit Taylor-Galerkin Finite Element Method (FEM) algorithm, used for the solution of Euler/Navier-Stokes equations, is applied for the computation of steady-state frozen equilibrium flow in single expansion ramp nozzles (SERN) and in plug nozzles for hypersonic propulsion systems. External flow conditions are taken into account. For the determination of nozzle performance a detailed 2D/3D-flow analysis in regions with complex geometries was performed using unstructured computational grids with adaptive mesh refinement. Some results for the investigated nozzle configurations at different flight conditions are presented and discussed. Additionally, thrust vectoring by modification of the lower nozzle flap shape was studied. Author

N92-27480# Manchester Coll. of Science and Technology (England). Dept. of Mechanical Engineering.
COMPUTATIONAL MODELLING OF TURBULENT FLOW IN S-BENDS
N. I. ABOU-HAIDAR, H. IACOVIDES, and B. E. LAUNDER *In* AGARD, CFD Techniques for Propulsion Applications 16 p Feb. 1992 Sponsored in part by Rolls-Royce Ltd.
(Contract GR/F/70495)
Copyright Avail: CASI HC A03/MF A06

The paper considers the computation of turbulent flow through circular sectioned S-bends, a flow generically similar to those arising in various types of jet-engine intake ducting. A fully elliptic, finite-volume discretization of the Reynolds equations is adopted. For the main part of the flow the standard algebraic second-moment (ASM) closure is adopted while over the thin, viscosity-affected sublayer, adjacent to the wall, three types of model were explored: namely, one- and two-equation eddy viscosity models and a two-equation ASM closure. Although the main features of the flow development are well captured even with the simplest near-wall treatment, the pressure drop through the second half of the S-bend

is seriously underestimated. The successive refinement of the model across the sublayer is found to bring the computed behavior into very close accord with the detailed experimental data. The findings indicate the desirability of using a high-level turbulence model not just in the main part of the flow but across the low-Reynolds-number sublayer also. Author

N92-27482# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
THE 3-D NAVIER-STOKES FLOW AND TEMPERATURE FIELD COMPUTATION FOR A FORCED MIXER NOZZLE
K. KATHEDER *In* AGARD, CFD Techniques for Propulsion Applications 12 p Feb. 1992
Copyright Avail: CASI HC A03/MF A06

To increase the temperature mixing efficiency in the common nozzle of an existing turbofan engine, a forced mixer is to be developed. Its design is based on empirically derived knowledge and requires some verification testing. To minimize the scope of testing, a numerical investigation has been performed, computing the complete flow path through the mixer up to the thrust nozzle. The computational domain is formed by a body fitted H-type grid. The simulated air flow is compressible adiabatic including variable specific heat and viscosity and the standard k-epsilon model is used. Resulting velocity and temperature fields are presented together with the temperature mixing efficiency. Use of the velocity field to shape the scallops at the mixer trailing edge is demonstrated. Comparison with test results indicates that computational fluid dynamics (CFD) is a useful engineering tool to check and improve a new design before testing. Author

N92-27490# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THREE DIMENSIONAL CALCULATIONS OF REACTIVE FLOWS WITHIN AIRCRAFT COMBUSTION CHAMBERS INCLUDING SOME COMBUSTION MODELS [CALCULS TRIDIMENSIONNELS D'ECOULEMENTS REACTIFS DANS LES CHAMBRES DE COMBUSTION AERONAUTIQUES EFFECTUES A L'AIDE DE DEUX MODELES DE COMBUSTION]
FABIENNE PIT, HELENE TICHTINSKY, PASCALE GILBANK, and FRANCIS DUPOIRIEUX *In* AGARD, CFD Techniques for Propulsion Applications 15 p Feb. 1992 In FRENCH; ENGLISH summary Previously announced in IAA as A92-16089
Copyright Avail: CASI HC A03/MF A06

Some three dimensional calculations have been performed in order to predict the reactive flow within aircraft combustion chambers. Two kinds of combustion models have been tested: on one hand a model which makes the assumption of fast chemistry but can however take roughly into account some aspects of the chemical kinetics through an ignition delay and, on the other hand, the Lagrangian-Eulerian PEUL model which can deal directly with some Arrehenius laws by means of the interaction by exchange with the mean (IEM) submodel and hence does not include some assumptions of fast reaction. Author

N92-27546# California Univ., Irvine.
FUNDAMENTAL STUDIES ON DROPLET INTERACTIONS IN DENSE SPRAYS Annual Technical Report, 1 Nov. 1990 - 31 Oct. 1991
W. A. SIRGNANO, S. E. ELGHOBASHI, I. KIM, and C. H. CHIANG 2 Dec. 1991 21 p
(Contract AF-AFOSR-0064-90)
(AD-A246918; AFOSR-92-0100TR) Avail: CASI HC A03/MF A01

Computational studies of interactive, vaporizing droplets have been made in order to understand better dynamics of dense sprays. Axisymmetric situations with droplets moving in tandem and three-dimensional situations with droplets moving in parallel have been considered. Detailed velocity and thermochemical properties fields have been determined. Lift and drag coefficients, Nusselt numbers, and Sherwood numbers for the droplets have been obtained. Correlations of these numbers with instantaneous Reynolds number and transfer number have been obtained. The flow field has been solved by implicit finite-difference solutions of the Navier-Stokes equations. Explanations for the modifications of lift and drag forces, trajectories, and transport phenomena due to droplet interactions have been formulated. Results have been obtained for fuel droplets, especially in high temperature environments, and, to a limited extent, for liquid oxygen (LOX) droplets in a hot, reducing environment. The results, especially the correlations, should prove useful in spray modeling. GRA

N92-27600# Naval Postgraduate School, Monterey, CA.
COMPARISON OF JANUS AND FIELD TEST AIRCRAFT DETECTION RANGES FOR THE LINE-OF-SIGHT FORWARD HEAVY SYSTEM M.S. Thesis
EUGENE P. PAULO Sep. 1991 49 p
(AD-A246047) Avail: CASI HC A03/MF A01

The feasibility of accrediting the Janus combat simulation for use with an Army concept called Model-Test-Model is analyzed. Aircraft detection ranges from an operational field test are compared to similar ranges generated by the Janus combat simulation. Means and distributions of detection ranges for both helicopter and fixed-wing aircraft are studied. Methods of collecting detection data in field tests and representing aircraft in Janus must be improved for Janus to be accredited for aircraft detection range analysis of field tests. Author (GRA)

N92-27615 Department of the Navy, Washington, DC.
MID-RANGE UV COMMUNICATIONS Patent
MYER GELLER, inventor (to Navy) and GEORGE A. EVANOFF, JR., inventor (to Navy) 29 Oct. 1991 9 p Filed 3 Mar. 1989
(AD-D015213; US-PATENT-5,062,154;
US-PATENT-APPL-SN-318988; US-PATENT-CLASS-359-154)
Avail: US Patent and Trademark Office

Mid-range communications are improved with a transmitter having an elongate omni-directionally radiating tube of ultraviolet (UV) energy that are focussed by a compound parabolic reflector to within a designated azimuth and/or elevation.The configuration of the reflector gives a broad beam directivity over a receiver target area to the exclusion of other bearings and elevations such that selected receiving stations can be designated between moving or unstable communication platforms, such as aircraft or ships. Because scattering occurs at angles larger than the direct beam, the requirement for accurate tracking mechanisms is further relaxed. Furthermore, these extra scattered photons increase the link distance. The need for very small divergence transmitters, like lasers, is eliminated permitting inexpensive, efficient UV lamps to be used with compound reflectors as transmitter sources. GRA

N92-27649*# NSI Technology Services Corp., Research Triangle Park, NC.
METHODOLOGY FOR THE DETERMINATION OF CRITICALITY CODES AND RECERTIFICATION INTERVALS FOR TANK MOUNTED AIR COMPRESSORS (TMAC) AND BASE MOUNTED AIR COMPRESSORS (BMAC)
WILLIAM T. HARGROVE 1991 33 p Presented at the NASA Pressure Systems Seminar, Bay St. Louis, MS, 5-7 Nov. 1991
(Contract NAS5-30343)
(NASA-CR-189268; NAS 1.26:189268) Avail: CASI HC A03/MF A01

This methodology is used to determine inspection procedures and intervals for components contained within tank mounted air compressor systems (TMAC) and base mounted air compressor systems (BMAC). These systems are included in the Pressure Vessel and System Recertification inventory at GSFC. Author

N92-27653*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A FAST, UNCOUPLED, COMPRESSIBLE, TWO-DIMENSIONAL, UNSTEADY BOUNDARY LAYER ALGORITHM WITH SEPARATION FOR ENGINE INLETS
ROBERT L. ROACH, CHRIS NELSON, BARBARA SAKOWSKI, DOUGLAS DARLING, and ALLAN G. VANDEWALL (Case Western Reserve Univ., Cleveland, OH.) Jul. 1992 9 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME,

and ASEE
(Contract RTOP 505-62-20)
(NASA-TM-105686; E-7065; NAS 1.15:105686; AIAA-92-3082)
Avail: CASI HC A02/MF A01

A finite difference boundary layer algorithm was developed to model viscous effects when an inviscid core flow solution is given. This algorithm solved each boundary layer equation separately, then iterated to find a solution. Solving the boundary layer equations sequentially was 2.4 to 4.0 times faster than solving the boundary layer equations simultaneously. This algorithm used a modified Baldwin-Lomax turbulence model, a weighted average of forward and backward differencing of the pressure gradient, and a backward sweep of the pressure. With these modifications, the boundary layer algorithm was able to model flows with and without separation. The number of grid points used in the boundary layer algorithm affected the stability of the algorithm as well as the accuracy of the predictions of friction coefficients and momentum thicknesses. Results of this boundary layer algorithm compared well with experimental observations of friction coefficients and momentum thicknesses. In addition, when used interactively with an inviscid flow algorithm, this boundary layer algorithm corrected for viscous effects to give a good match with experimental observations for pressures in a supersonic inlet. Author

N92-27671# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
SPECIAL COURSE ON UNSTRUCTURED GRID METHODS FOR ADVECTION DOMINATED FLOWS
May 1992 362 p Special course held in Rhode-Saint-Genese, Belgium, 2-6 Mar. 1992 and at Moffett Field, CA, 28 Sep. - 2 Oct. 1992; sponsored in cooperation with VKI
(AGARD-R-787; ISBN-92-835-0671-5) Copyright Avail: CASI HC A16/MF A03

Lecture notes for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Unstructured Grid Methods for Advection Dominated Flow' have been assembled in this report. The objective of this course was to provide state of the art information, as well as recent developments in unstructured grid methods, suitable for the computation of high Reynolds number compressible and incompressible flows, and other related subjects. A wide range of applications is presented, which includes incompressible free surface problems, transonic aerodynamics, and hypersonic reentry flows.

N92-27680# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium). CFD Group.
A FRONTAL APPROACH FOR NODE GENERATION IN DELAUNAY TRIANGULATIONS
J.-D. MUELLER, P. L. ROE (Michigan Univ., Ann Arbor.), and H. DECONINCK *In* AGARD, Special Course on Unstructured Grid Methods for Advection Dominated Flows 7 p May 1992
Copyright Avail: CASI HC A02/MF A03

A new algorithm for the generation of the interior nodes for Delaunay triangulation is given. The method uses a background grid to interpolate local mesh size parameters that are taken from the triangulation of the given boundary nodes. Geometric criteria are used to find a set of nodes in a frontal manner. This set is subsequently introduced into the existing mesh, thus providing an updated Delaunay triangulation. The procedure is completed when no more improvement of the grid by inserting new nodes can be achieved. Author

N92-27715# Rocky Research Corp., Boulder City, NV.
SOLID-VAPOR ADSORPTION REFRIGERATION SYSTEM DEVELOPMENT Final Report, Mar. 1990 - May 1991
U. ROCKENFELLER, L. KIROL, and B. GRAEBEL Dec. 1991 47 p
(Contract GRI-5089-296-1941)
(PB92-164383; GRI-91/0382) Avail: CASI HC A03/MF A01

The study describes the development of heat-activated industrial refrigeration systems using ammoniated complex compound sorption media. The focus was on single-stage cycles for low temperature (+20 F and below) refrigeration. Compared to vapor compression refrigeration, these cycles have the advantages of lower operating energy costs, reduction of peak electrical demand and associated demand charges, and reduced maintenance costs due to replacement of the compressor with solid-state sorbers. In many cases, particularly for refrigeration at -40 F and below, complex compound sorption cycles also have the potential for lower first cost than conventional electrically driven refrigeration systems. Technical issues addressed included the following: economic optimization of sorber design, demonstration of cyclic stability of the sorption reactions, construction material compatibility, and reactor scale-up. Sorption reactions for refrigeration at -40 and -70 F were demonstrated. Optimum heat exchanger configuration, complex compound loading, and cycle time were determined. GRA

N92-27723*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
PROFESSOR JESSE W. BEAMS AND THE FIRST PRACTICAL MAGNETIC SUSPENSION
P. E. ALLAIRE, R. R. HUMPHRIS, and D. W. LEWIS *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 25-32 May 1992
Avail: CASI HC A02/MF A04

Dr. Jesse W. Beams developed the first practical magnetic suspension for high speed rotating devices. The devices included high speed rotating mirrors, ultracentrifuges, and high speed centrifugal field rotors. A brief biography of Dr. Beams is presented, and the following topics are discussed: (1) early axial magnetic suspension for ultracentrifuges; and (2) magnetic suspension for high centrifugal fields. Author

N92-27731*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
STABILITY AND PERFORMANCE OF NOTCH FILTER CONTROL FOR UNBALANCE RESPONSE
C. R. KNOSPE *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 181-205 May 1992
Avail: CASI HC A03/MF A04

Many current applications of magnetic bearings for rotating machinery employ notch filters in the feedback control loop to reduce the synchronous forces transmitted through the bearings. The capabilities and limitations of notch filter control are investigated. First, a rigid rotor is examined with some classical root locus techniques. Notch filter control is shown to result in conditional stability whenever complete synchronous attenuation is required. Next, a nondimensional parametric symmetric flexible three mass rotor model is constructed. An examination of this model for several test cases illustrates the limited attenuation possible with notch filters at and near the system critical speeds when the bearing damping is low. The notch filter's alteration of the feedback loop is shown to cause stability problems which limits performance. Poor transient response may also result. A high speed compressor is then examined as a candidate for notch filter control. A collocated 22 mass station model with lead-lag control is used. The analysis confirms the reduction in stability robustness that can occur with notch filter control. It is concluded that other methods of synchronous vibration control yield greater performance without compromising stability. Author

N92-27735*# Academy of Sciences (USSR), Moscow. Inst. of Chemical Physics.
LEVITATION OF YBA2CU3O(7-X) SUPERCONDUCTOR IN A VARIABLE MAGNETIC FIELD
ALEXANDER N. TERENTIEV and ANATOLIY A. KUZNETSOV *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 267-278 May 1992
Avail: CASI HC A03/MF A04

The influence of both a linear alternating and rotational magnetic field component on the levitation behavior of a YBa2Cu3O(7-x) superconductor was examined. The transition from a plastic regime of levitation to an elastic one, induced by an alternating field component, was observed. An elastic regime in contrast to a plastic

one is characterized by the unique position of stable levitation and field frequency dependence of relaxation time to this position. It was concluded that the vibrations of a magnet levitated above the superconductor can induce a transition from a plastic regime of levitation to an elastic one. It was found that a rotational magnetic field component induced rotations of a levitated superconductor. Rotational frictional motion of flux lines is likely to be an origin of torque developed. A prototype of a motor based on a levitated superconductor rotor is proposed. Author

N92-27737*# Koyo Seiko Co. Ltd., Kokubuhiganjo (Japan).
CHARACTERIZATION OF SUPERCONDUCTING MAGNETIC BEARINGS (DYNAMIC STIFFNESS AND DAMPING COEFFICIENT IN AXIAL DIRECTION)
RYOICHI TAKAHATA, HIROCHIKA UEYAMA, and TSUTOM YOTSUYA (Osaka Prefectural Industrial Technology Research Inst., Enokojima, Japan) *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 289-296 May 1992
Avail: CASI HC A02/MF A04

High T(sub c) superconductor as a stator and permanent magnets for a rotor were assembled into a superconducting magnetic bearing. The dynamic stiffness and the damping coefficient of the superconducting magnetic bearing in axial direction were measured. The dynamic stiffness depended on an axial gap between superconductor and permanent magnet. The superconducting magnetic bearings are advantageous for a passive bearing, because they have a vibration damping effect that a permanent magnet bearing does not have. The tendency of its vibration damping coefficient indicated an increase as the resonant frequency increased. Author

N92-27738*# Pratt and Whitney Aircraft, East Hartford, CT.
FEASIBILITY OF MAGNETIC BEARINGS FOR ADVANCED GAS TURBINE ENGINES
DAVID HIBNER and LEWIS ROSADO (Wright Lab., Wright-Patterson AFB, OH.) *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 299-316 May 1992
Avail: CASI HC A03/MF A04

The application of active magnetic bearings to advanced gas turbine engines will provide a product with major improvements compared to current oil lubricated bearing designs. A rethinking of the engine rotating and static structure design is necessary and will provide the designer with significantly more freedom to meet the demanding goals of improved performance, increased durability, higher reliability, and increased thrust to weight ratio via engine weight reduction. The product specific technology necessary for this high speed, high temperature, dynamically complex application has been defined. The resulting benefits from this approach to aircraft engine rotor support and the complementary engine changes and improvements have been assessed. Author

N92-27739*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
LOW POWER MAGNETIC BEARING DESIGN FOR HIGH SPEED ROTATING MACHINERY
P. E. ALLAIRE, E. H. MASLEN, R. R. HUMPHRIS, C. K. SORTORE, and P. A. STUDER (Magnetic Concepts, Silver Spring, MD.) *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 317-329 May 1992
Avail: CASI HC A03/MF A04

Magnetic suspension technology has advanced to the point of being able to offer a number of advantages to a variety of applications in the rotating machinery and aerospace fields. One strong advantage is the decrease in power consumption. The design and construction of a set of permanent magnet biased, actively controlled magnetic bearing for a flexible rotor are presented. Both permanent magnets and electromagnets are used in a configuration which effectively provides the necessary fluxes in the appropriate air gaps, while simultaneously keeping the undesirable destabilizing forces to a minimum. The design includes two radial bearings and a thrust bearing. The theoretical development behind the design is briefly discussed. Experimental performance results for a set of operating prototype bearings is presented. The results include measurements of load capacity, bearing stiffness and damping, and the dynamic response of the rotor. With few exceptions, the experimental results matched very well with the predicted performance. The power consumption of these bearings was found to be significantly reduced from that for a comparable set of all electromagnetic bearings. Author

N92-27740*# Moscow Inst. of Aviation Technology (USSR).
PROGRESS OF MAGNETIC SUSPENSION SYSTEMS AND MAGNETIC BEARINGS IN THE USSR
A. V. KUZIN *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 331-359 May 1992 Previously announced in IAA as A91-38579
Avail: CASI HC A03/MF A04

This paper traces the development and progress of magnetic suspension systems and magnetic bearings in the USSR. The paper describes magnetic bearings for turbomachines, magnetic suspension systems for vibration isolation, some special measuring devices, wind tunnels, and other applications. The design, principles of operation, and dynamic characteristics of the system are presented. Author

N92-27760# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN ANALYSIS OF TOTAL QUALITY MANAGEMENT IN AERONAUTICAL SYSTEMS DIVISION M.S. Thesis
MARK D. CAUDLE Sep. 1991 145 p
(AD-A246661; AFIT/GSM/LSG/91S-6) Avail: CASI HC A07/MF A02

This study investigated the major schools of thought on various aspects of quality management and quality improvement. Areas covered included definitions of waste and quality, views on the cost of quality, tools and techniques used for quality improvement, and management philosophies and frameworks for continuous improvement. In addition, this study analyzed the structure and training content of the current Total Quality Management program at Aeronautical Systems Division (ASD). Pre- and post-test surveys on employee attitudes toward organizational effectiveness were analyzed from the Advanced Cruise Missile System Program Office (SPO), the F-15 SPO, and the ASD Deputy Chief of Staff for Human Resources (ASD/DP). Data was supplemented with semi-structured, personal interviews with ASD personnel involved in TQM. Survey analysis showed that the ACM SPO significantly improved, ASD/DP significantly digressed, and the F-15 SPO remained basically consistent. This led to the conclusion that ASD allows too much flexibility in the implementation of TQM in the three-letter organizations. GRA

N92-27789*# Southampton Univ. (England). Inst. of Cryogenics.
MAGNETIC SUSPENSION USING HIGH TEMPERATURE SUPERCONDUCTING CORES
R. G. SCURLOCK *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 507-517 May 1992
Avail: CASI HC A02/MF A04

The development of YBCO high temperature superconductors, in wire and tape forms, is rapidly approaching the point where the bulk transport current density j vs magnetic field H characteristics with liquid nitrogen cooling will enable its use in model cores. On the other hand, BSCCO high temperature superconductor in wire form has poor j-H characteristics at 77 K today, although with liquid helium or hydrogen cooling, it appears to be superior to NbTi superconductor. Since liquid nitrogen cooling is approx. 100 times cheaper than liquid helium cooling, the use of YBCO is very attractive for use in magnetic suspension. The design is discussed of a model core to accommodate lift and drag loads up to 6000 and 3000 N respectively. A comparison is made between the design performance of a liquid helium cooled NbTi (or BSCCO) superconducting core and a liquid nitrogen cooled YBCO superconducting core. Author

N92-27794*# Forschungszentrum Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Grenzflaechenforschung und Vakuumphysik.
WIDE GAP, PERMANENT MAGNET BIASED MAGNETIC BEARING SYSTEM
KARL BODEN *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 575-594 May 1992
Avail: CASI HC A03/MF A04

The unique features and applications of the presented electrical permanent magnetic bearing system essentially result from three facts: (1) the only bearing rotor components are nonlaminated ferromagnetic steel collars or cylinders; (2) all radial and axial forces are transmitted via radial gaps; and (3) large radial bearing gaps can be provided with minimum electric power consumption. The large gaps allow for effective encapsulation and shielding of the rotors at elevated or low temperatures, corrosive or ultra clean atmosphere or vacuum or high pressure environment. Two significant applications are described: (1) a magnetically suspended x ray rotary anode was operated under high vacuum conditions at 100 KV anode potential, 600 C temperature at the rotor collars and speed 18000 rpm with 13 mm radial bearing gap; and (2) an improved Czochralski type crystal growth apparatus using the hot wall method for pulling GaAs single crystals of low dislocation density. Both crystal and crucible are carried and transported by magnetically suspended shafts inside a hermetically sealed housing at 800 C shaft and wall temperature. The radial magnetic bearing gap measures 24 mm. Author

N92-27799*# Virginia Univ., Charlottesville. Center for Magnetic Bearings.
DESIGN OF BEARINGS FOR ROTOR SYSTEMS BASED ON STABILITY
D. DHAR, L. E. BARRETT, and C. R. KNOSPE *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 673-690 May 1992
Avail: CASI HC A03/MF A04

Design of rotor systems incorporating stable behavior is of great importance to manufacturers of high speed centrifugal machinery since destabilizing mechanisms (from bearings, seals, aerodynamic cross coupling, noncolocation effects from magnetic bearings, etc.) increase with machine efficiency and power density. A new method of designing bearing parameters (stiffness and damping coefficients or coefficients of the controller transfer function) is proposed, based on a numerical search in the parameter space. The feedback control law is based on a decentralized low order controller structure, and the various design requirements are specified as constraints in the specification and parameter spaces. An algorithm is proposed for solving the problem as a sequence of constrained 'minimax' problems, with more and more eigenvalues into an acceptable region in the complex plane. The algorithm uses the method of feasible directions to solve the nonlinear constrained minimization problem at each stage. This methodology emphasizes the designer's interaction with the algorithm to generate acceptable designs by relaxing various constraints and changing initial guesses interactively. A design oriented user interface is proposed to facilitate the interaction. Author

N92-27800*# Bath Univ. (England). School of Mechanical Engineering.
AN EVALUATION OF SOME STRATEGIES FOR VIBRATION CONTROL OF FLEXIBLE ROTORS
C. R. BURROWS *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 691-705 May 1992
Avail: CASI HC A03/MF A04

There is evidence that the reliability of magnetic bearings has achieved an acceptable level in applications when high cost can be tolerated. This acceptability would be enhanced if the inherent capability of magnetic bearings as active control elements were fully used. The technological and commercial promise of magnetic bearings will be fulfilled only if attention is focussed on the control problems associated with their use. The open loop adaptive control algorithm provides an efficient method of controlling the vibration of rotors without the need of a prior knowledge of parameter values. It overcomes the disadvantages normally associated with open loop control while avoiding the problem of instability associated with closed loop control algorithms. The algorithm is conceptually satisfying because it uses the capability of magnetic bearings as fully active vibration control elements rather than limiting them to act as adjustable stiffness and damping elements, as is the case when they are used with local position and velocity feedback. Author

N92-27864# Mitre Corp., Bedford, MA.
JTIDS ELECTROMAGNETIC COMPATIBILITY IN THE 960-1215 MHZ BAND Final Report
ROBERT S. LOKUTA Jan. 1992 142 p
(Contract F19628-89-C-0001)
(AD-A247834; MTR-11135; ESD-TR-91-224) Avail: CASI HC A07/MF A02

The Joint Tactical Information Distribution System (JTIDS) operates in the 960-1215 MHz frequency band. This band is allocated world-wide on a primary basis for aeronautical radio navigation. JTIDS was designed to be electromagnetically compatible with the Air Traffic Control systems that operate in this band. Over the past 15 years, extensive bench tests, flight tests, and analyses were conducted to assess the electromagnetic compatibility (EMC) of JTIDS in the 960-1215 MHz band. This report summarizes the results and conclusions of these efforts, presents some supporting data and provides specific guidance for the operation of JTIDS within the National Air Space. Guidance and recommendations are also provided to assist in the definition and scope of a JTIDS EMC test and analysis effort. GRA

N92-27879*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYSIS AND MODIFICATION OF A SINGLE-MESH GEAR FATIGUE RIG FOR USE IN DIAGNOSTIC STUDIES
JAMES J. ZAKRAJSEK, DENNIS P. TOWNSEND, FRED B. OSWALD, and HARRY J. DECKER May 1992 20 p
(Contract RTOP 505-63-36; DA PROJ. 1L1-62211-A-47A)
(NASA-TM-105416; E-6826; NAS 1.15:105416; AVSCOM-TR-91-C-049; AD-A252381) Avail: CASI HC A03/MF A01

A single-mesh gear fatigue rig was analyzed and modified for use in gear mesh diagnostic research. The fatigue rig allowed unwanted vibration to mask the test-gear vibration signal, making it difficult to perform diagnostic studies. Several possible sources and factors contributing to the unwanted components of the vibration signal were investigated. Sensor mounting location was found to have a major effect on the content of the vibration signal. In the presence of unwanted vibration sources, modal amplification made unwanted components strong. A sensor location was found that provided a flatter frequency response. This resulted in a more useful vibration signal. A major network was performed on the fatigue rig to reduce the influence of the most probable sources of the noise in the vibration signal. The slave gears were machined to reduce weight and increase tooth loading. The housing and the shafts were modified to reduce imbalance, looseness, and misalignment in the rotating components. These changes resulted in an improved vibration signal, with the test-gear mesh frequency now the dominant component in the signal. Also, with the unwanted sources eliminated, the sensor mounting location giving the most robust representation of the test-gear meshing energy was found to be at a point close to the test gears in the load zone of the bearings. Author

N92-27880*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
A STUDY OF JUNCTURE FLOW IN THE NASA LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL Final Technical Report, May 1990 - May 1992
NDAONA CHOKANI May 1992 93 p
(Contract NCC1-98)

(NASA-CR-190430; NAS 1.26:190430) Avail: CASI HC A05/MF A01

A numerical investigation of the interaction between a wind tunnel sidewall boundary layer and a thin low-aspect-ratio wing has been performed for transonic speeds and flight Reynolds numbers. A three-dimensional Navier-Stokes code was applied to calculate the flow field. The first portion of the investigation examined the capability of the code to calculate the flow around the wing, with no sidewall boundary layer present. The second part of the research examined the effect of modeling the sidewall boundary layer. The results indicated that the sidewall boundary layer had a strong influence on the flow field around the wing. The viscous sidewall computations accurately predicted the leading edge suction peaks, and the strong adverse pressure gradients immediately downstream of the leading edge. This was in contrast to the consistent underpredictions of the free-air computations. The low momentum of the sidewall boundary layer resulted in higher pressures in the juncture region, which decreased the favorable spanwise pressure gradient. This significantly decreased the spanwise migration of the wing boundary layer. The computations indicated that the sidewall boundary layer remained attached for all cases examined. Weak vortices were predicted in both the upper and lower surface juncture regions. These vortices are believed to have been generated by lateral skewing of the streamlines in the approaching boundary layer. Author

N92-27886# *Notre Dame Univ., IN. Dept. of Aerospace and* Mechanical Engineering.

EXPERIMENTAL INVESTIGATION OF TURBULENCE BEHAVIOR IN SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTIONS Report, 1 Oct. 1990 - 30 Sep. 1991

30 Sep. 1991 12 p

(Contract N00014-88-K-0670)

(AD-A247792) Avail: CASI HC A03/MF A01

The primary objective of this research is to enhance our understanding of the flow field physics associated with shock wave turbulent boundary layer interactions and thereby enable more accurate predictive models to be developed. It is widely recognized that shock wave turbulent boundary layer interactions are very important in a variety of high speed aerodynamic applications and yet, despite much attention to this topic in the past, the dynamic mechanisms involved remain poorly understood. The compression ramp generated shock wave turbulent boundary layer interaction is experimentally investigated in this study. It is a primary objective of this research to isolate the mechanism(s) responsible for the amplification of turbulent stresses through the shock. The interplay between the combined effects of bulk compression, concave curvature, 'direct' amplification and pressure gradient will be clarified. In addition, the dynamic mechanism(s) responsible for shock wave oscillation and the role this oscillation plays in the turbulent stress amplification through the shock will also be examined. Measurements documenting the mechanism of turbulent stress relaxation downstream of shock are also obtained. GRA

N92-27918# CFD Research Corp., Huntsville, AL.

PRESSURE-BASED HIGH-ORDER TVD METHODOLOGY FOR DYNAMIC STALL CONTROL Final Report, 1 Jun. - 30 Nov. 1991

H. Q. YANG and A. J. PRZEKWAS 31 Jan. 1992 152 p

(Contract F49620-91-C-0042)

(AD-A247056; AFOSR-92-0015TR) Avail: CASI HC A08/MF A02

The quantitative prediction of the dynamics of separating unsteady flows, such as dynamic stall, is of crucial importance. This six-month SBIR Phase 1 study has developed several new pressure-based methodologies for solving 3D Navier-Stokes equations in both stationary and moving (body-comforting) coordinates. The present pressure-based algorithm is equally efficient for low speed incompressible flows and high speed compressible flows. The discretization of convective terms by the presently developed high-order TVD schemes requires no artificial dissipation and can properly resolve the concentrated vortices in the wing-body with minimum numerical diffusion. It is demonstrated that the proposed Newton's iteration technique not only increases the convergence rate but also strongly couples the iteration between pressure and velocities. The proposed hyperbolization of the pressure correction equation is shown to increase the solver's efficiency. The above proposed methodologies were implemented in an existing CFD code, REFLEQS. The modified code was used to simulate both static and dynamic stalls on two- and three-dimensional wing-body configurations. Three-dimensional effect and flow physics are discussed. GRA

N92-28084# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.

ADVANCES IN FIBRE-OPTIC TECHNOLOGY IN COMMUNICATIONS AND FOR GUIDANCE AND CONTROL [TECHNIQUES DE POINTE EN MATIERE DE FIBRES OPTIQUES DANS LE DOMAINE DES COMMUNICATIONS ET POUR LE GUIDANGE ET LE PILOTAGE]

May 1992 175 p Lectures held in Rome, Italy, 18-19 May 1992, in Leiden, Netherlands, 21-22 May 1992, and in Monterey, CA, 26-27 May 1992

(AGARD-LS-184; ISBN-92-835-0673-1) Copyright Avail: CASI HC A08/MF A02

Fiber-optics is progressively changing from the research stage to the field of application. However, new possibilities are emerging, which will bring a new revolution in the field of telecommunications, such as coherent transmission, new transmission material transparent to mid-infrared radiation, active fibers, and soliton propagation. Fiber-optics is gaining increasing importance in tactical missile and aircraft guidance and control. This has been driven by the commercial development of fiber optic cable and related components. The requirements for military guidance and control applications are highly demanding for the characteristics of fibers and necessary related components (transmitters, receivers, connectors, etc.).

N92-28171# University of Northern Illinois, De Kalb.

ESTIMATING THE RELIABILITY OF A SYSTEM ON THE BASIS OF SAMPLE PATHS Final Report, 15 Jun. 1989 - 14 Dec. 1991

NADER EBRAHIMI and T. RAMALINGAM 14 Dec. 1991 4 p

(Contract AF-AFOSR-0402-90)

(AD-A248585; AFOSR-92-0257TR) Avail: CASI HC A01/MF A01

Synergism or the so-called dependence among the components of multivariate process induces a host of probabilistic structures among the hitting times of the processes. Conventionally, hitting times have been studied for isolated processes or for families of processes exhibiting specific dependence structures. Whereas this approach has been very useful, stochastic modeling of hitting times per se is equally fruitful. For example, it is possible to derive useful bounds for the reliability of a complex system like the wing of an aircraft if the joint dependence structure of the hitting times to failure of the components of the system is known adequately. The joint behavior of two or more hitting times, one each from the components of multivariate processes is, therefore, of paramount importance in a plethora of disciplines. Research has continued on the development of positive (negative) dependence ideas and applied them to a number of areas. GRA

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A92-42095

SURFACE-LAYER GUSTS FOR AIRCRAFT OPERATION

G. S. YOUNG (Pennsylvania State University, University Park) and L. KRISTENSEN (Riso National Laboratory, Roskilde, Denmark) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 59, no. 3,

May 1992, p. 231-242. refs
(Contract N00014-90-J-4012)
Copyright

The aviation gust-estimation technique of Kristensen et al. (1991) is extended to include the diabatic surface layer, using the Monin-Obukhov similarity theory. To this end, the Monin-Obukhov similarity algorithms requiring single-level wind and multilevel virtual temperature measurements, and nomogram approaches requiring only standard aviation surface observations, are developed. The advantages of the improved technique is demonstrated with example calculations. I.S.

A92-42097
A SENSITIVE FAST-RESPONSE PROBE TO MEASURE TURBULENCE AND HEAT FLUX FROM ANY AIRPLANE
TIMOTHY L. CRAWFORD and RONALD J. DOBOSY (NOAA, Air Resources Laboratory, Oak Ridge, TN) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 59, no. 3, May 1992, p. 257-278. Research supported by NOAA. refs
Copyright

The theory, configuration, and accuracy of an inexpensive probe to measure turbulence from a small aircraft are presented. The probe employs a nine-hole pressure-sphere design along with inprobe high-frequency pressure, temperature, and acceleration sensors. This sensor suite is specifically designed to extend mass, momentum and energy eddy-flux measurement to the higher frequencies characteristic of marine and nocturnal boundary layers. The probe is part of a mobile flux system, independent of the conveyance, which does not require a separate inertial navigation system. The new nine-port pressure sphere turbulence probe allows accurate turbulent velocity measurement with proper probe installation and appropriate technique for dynamic pressure.
Author

A92-42785
VISIBILITY IN THE ATMOSPHERE AND FLIGHT SAFETY [VIDIMOST' V ATMOSFERE I BEZOPASNOST' POLETOV]
ALEKSANDR M. BARANOV Leningrad, Gidrometeoizdat, 1991, 208 p. In Russian. refs
(ISBN 5-286-00416-4) Copyright

The effect of limited visibility on flight safety is examined, and the need for considering visibility conditions in order to improve the safety and increase the cost effectiveness of flights is emphasized. Factors determining visibility and methods of measuring visibility at weather stations and airports are discussed with particular reference to current practices in member countries of the ICAO. Visibility data are presented for various aerosynoptic conditions at various altitudes. Data are also presented on visibility variability over short periods of time, including minute-long intervals. V.L.

A92-44070
METHODS FOR DETERMINING ATMOSPHERIC CORRECTION FOR RADIO-RANGEFINDER MEASUREMENTS OF INCLINED TRAJECTORIES [METODY OPREDELENIIA ATMOSFERNOI POPRAVKI PRI RADIODAL'NOMERNYKH IZMERENIIAKH NAKLONNYKH TRASS]
A. S. MEDOVIKOV, V. A. LYKOV, P. E. SHIROKOV, and N. E. KONDRAT'EVA (Vladimirskii Politekhnicheskii Institut, Vladimir, Russia) Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 5, 1991, p. 36-43. In Russian. refs
Copyright

A92-44081
MODELING THE EFFECT OF HELICOPTER DOWNWASH ON WARM FOG [MODELIROVANIE VOZDEISTVIIA NA TEPLYI TUMAN STRUEI OT NESUSHCHEGO VINTA VERTOLETA]
K. I. VASIL'EVA IN: Cloud physics and active modifications. Moscow, Gidrometeoizdat, 1991, p. 28-35. In Russian. refs
Copyright

Results of the numerical simulation of warm-fog clearing by helicopter downwash are presented. It is shown that a helicopter weighing up to 20 t can be used to produce a clearing with a radius of up to 140 m in sea fog with a visibility of about 100 m.
L.M.

A92-44084
USE OF THE TMS-65 HEATING EQUIPMENT AT AIRPORTS TO CREATE FOG-DISPERSAL ZONES ABOVE THE RUNWAY TO FACILITATE TAKEOFF [OB ISPOL'ZOVANII TEPLOVOI AERODROMNOI USTANOVKI TMS-65 S TSEL'IU SOZDANIIA ZONY PROSVETA V TUMANE NAD VPP DLIA VZLETA SAMOLETA]
I. M. ZAKHAROVA IN: Cloud physics and active modifications. Moscow, Gidrometeoizdat, 1991, p. 58-65. In Russian. refs
Copyright

The feasibility of using TMS-65 heating equipment to clear fog above runways is evaluated. The trajectory of the hot air jet emitted from the equipment is evaluated, and the number of such devices necessary to produce the required fog dispersal is determined.
L.M.

N92-26350# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere.
MEASUREMENTS IN THE INHOMOGENEOUS CONVECTIVE BOUNDARY LAYER USING THREE POWERED GLIDERS
ANNE M. JOCHUM, ANJA KLEBELSBERG, HERMANN WILLEKE, and NORBERT ENTSTRASSER *In its* Contributions to Atmospheric Physics in Honor of Dr. Manfred Reinhardt on His 65th Birthday p 223-228 Sep. 1991
Berichtswesen, Postfach 90 60 58, Cologne, Fed.Republic of Germany, HC 60 Deutsche marks

Three instrumented powered gliders were built and used for turbulence measurements in the atmospheric boundary layer. The present status of the system is summarized. Results from a recent field experiment which demonstrate the horizontal variability of near surface evaporation fluxes on scales of the order of several km are presented. ESA

N92-26581 Arizona Univ., Tucson.
AIRCRAFT PHOTOVOLTAIC POWER-GENERATING SYSTEM Ph.D. Thesis
OSCAR LEONARD DOELLNER 1991 190 p
Avail: Univ. Microfilms Order No. DA9210289

Photovoltaic cells, appropriately cooled and operating in the combustion-created high radiant-intensity environment of gas-turbine and jet engines, may replace the conventional (gearbox-driven) electrical power generators aboard jet aircraft. This study projects significant improvements not only in aircraft electrical power-generating-system performance, but also in overall aircraft performance. Jet-engine design modifications incorporating this concept not only save weight (and thus fuel), but are - in themselves - favorable to jet-engine performance. The dissertation concentrates on operational, constructional, structural, thermal, optical, radiometrical, thin-film, and solid-state theoretical aspects of the overall project. Dissert. Abstr.

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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.

A92-41195
SOFTWARE PACKAGE FOR PRELIMINARY DESIGN OF HELICOPTER
J. NAGABHUSHANAM, S. CHAKRABARTI, S. N. OMKAR, and T. R. VASANTH (Indian Institute of Science, Bangalore, India)

(International Conference on Aerospace Trends.2001 - From Aeroplane to Aerospace Plane, Thiruvananthapuram, India, June 27, 28, 1991, Proceedings. A92-41184 17-12) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 43, no. 3, Aug. 1991, p. 213-219. refs

A user interactive software package for preliminary helicopter design is presented which is based on a structured programming approach. The software package encompasses seven modules, each of which is designed to perform a specific aspect of the preliminary design investigation. Task performed by these modules include generation of parametric trends for the existing helicopter, reading a design specification, preparation of a priori design parameter sets, the computation of a feasible design, the search for an optimum design, and the preparation of geometrical layouts. O.G.

A92-41199
PARALLEL GRID GENERATION/OPTIMIZATION USING BLOCK-DOMAIN DECOMPOSITION

S. W. BOVA and G. F. CAREY (Texas, University, Austin) Communications in Applied Numerical Methods (ISSN 0748-8025), vol. 8, no. 4, April 1992, p. 243-256. Research supported by NSF and DOE. refs
Copyright

The use of a parallel Schwarz-type domain decomposition procedure for 2D block-structured grid generation, together with grid optimization for smoothness, orthogonality and solution accuracy, is investigated. The grid optimization algorithm considered is based on the Brackbill-Saltzman construction, a variational method which seeks to generate optimum grids by minimizing a weighted integral of three grid properties. The resulting grid generation equations are quasi-linear, elliptic, partial differential equations, and therefore relatively expensive to solve. Good speed-up factors are obtained, with efficiencies above 90 percent on the shared-memory Alliant FX-8 multiprocessor, and on the Symult Systems Series 2010, a message-passing, distributed memory system. In order to obtain such speed-ups for typical problems, approximately 99 percent of the code must be capable of concurrent execution. Grid refinement studies with adaptation to the compressible flow solution using the Euler equations suggest that a significant improvement in the resolution of shock waves can be achieved efficiently by this scheme. Author

A92-41419
NEW SYSTOLIC ARRAY FOR ALL-NEAREST-NEIGHBOURS PROBLEM

Y.-C. LIN (National Taiwan Institute of Technology, Taipei, Republic of China) Electronics Letters (ISSN 0013-5194), vol. 28, no. 11, May 21, 1992, p. 1073, 1074. refs
Copyright

A linear semisystolic array and its systolic version for the all-nearest-neighbors problem are presented. The systolic array improves on previous linear systolic arrays for the problem in the computing time of a problem instance and the block pipelining period of consecutive problem instances. C.D.

A92-42073
SOFTWARE SAFETY ANALYSIS IN HETEROGENEOUS MULTIPROCESSOR CONTROL SYSTEMS

TIMOTHY J. SHIMEALL, RICHARD J. MCGRAW, JR., and JANET A. GILL (U.S. Naval Postgraduate School, Monterey, CA) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 290-294. Research supported by U.S. Navy. refs
Copyright

Many modern digital control systems use multiprocessor architectures. This paper discusses the analysis of the safety of the software in these control system architectures, presenting an integration of two techniques, software fault tree analysis and timed Petri net analysis. This integration is demonstrated using an analysis of a military flight control system. Author

A92-42172
ROBUST STABILISATION OF MULTIVARIABLE FEEDBACK SYSTEMS WITH DESIRED PERFORMANCE REQUIREMENT

M.-H. TU (National Chiao Tung University, Hsinchu, Republic of China) and C.-M. LIN (Chung Shan Institute of Science and Technology, Longtan, Republic of China) IEE Proceedings, Part D - Control Theory and Applications (ISSN 0143-7054), vol. 139, no. 3, May 1992, p. 259-266. refs
Copyright

A design criterion is developed to achieve the following goals simultaneously: (1) input-output decoupling of multivariable feedback systems; (2) complete and arbitrary closed-loop pole assignment; (3) desired zero assignment for reference signal tracking, and (4) robust stabilization of multivariable feedback systems subjected to time-varying nonlinear uncertainties. Thus, the requirements of performance as well as stability robustness of a multivariable feedback system will be simultaneously met by employing this design criterion. Moreover, by minimizing H-infinity-norm of each channel of the closed-loop transfer matrix, the robustness optimization of the system can be obtained, i.e., the maximum slope of the sector-bounded nonlinear uncertainties that can be tolerated in each channel of the system can be predicted. A practical example, the lateral flight control of control configured vehicle is given to illustrate the validity of the proposed design algorithm. Author

A92-42780
AUTOMATION OF FLIGHT VEHICLE DESIGN [AVTOMATIZATSIIA PROEKTIROVANIIA LETATEL'NYKH APPARATOV]

VIACHESLAV V. VOLODIN Moscow, Izdatel'stvo Mashinostroenie, 1991, 256 p. In Russian. refs
(ISBN 5-217-01447-4) Copyright

The theoretical principles of the development of CAD systems for the design of flight vehicles are presented. Attention is given to methods for providing various types of support for CAD systems, including the types of support that have been largely neglected in the literature (e.g., linguistic, organizational, and methodological). Topics discussed include a systems approach to design automation, methodology of the general development of CAD systems, and methodological aspects of the detailed design of CAD. V.L.

A92-43178
INSPECTION OF STABILITY DETERIORATION WITH AN ADAPTIVE REGULATOR

RYOJI KATAYANAGI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 376-379. In Japanese.

An optimum regulator for the feedback control system of the aircraft is presented. The state equations are given and the performance of the closed loop system is discussed. The inspection of the stability deterioration is described. Y.P.Q.

A92-43181
FLIGHT CONTROL SYSTEM DESIGN

H. OTA (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 388-391. In Japanese.

A linear quadratic Gaussian (LQG) compensator synthesis approach is applied to flight control system design. The Kalman filter (KF) and linear quadratic regulator (LQR) are given for the control design. The open and closed loop poles are analyzed. Y.P.Q.

A92-43187
NONSTATIONARY MANUAL CONTROL. III

H. MATSUMOTO (Toshiba Corp., Tokyo, Japan) and N. GOTO (Kyushu University, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 412-415. In Japanese. refs

Simulation of the nonstationary manual control of an aircraft is presented. Test methods and procedures are introduced. The pilot control data are recorded, and spectral analysis of the manual control system is illustrated. Y.P.Q.

A92-43399* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PARALLEL SOLVER FOR TRAJECTORY OPTIMIZATION SEARCH DIRECTIONS
M. L. PSIAKI and K. H. PARK (Cornell University, Ithaca, NY) Journal of Optimization Theory and Applications (ISSN 0022-3239), vol. 73, no. 3, June 1992, p. 519-546. refs
(Contract NAG1-1009)
Copyright

A key algorithmic element of a real-time trajectory optimization hardware/software implementation is presented, the search step solver. This is one piece of an algorithm whose overall goal is to make nonlinear trajectory optimization fast enough to provide real-time commands during guidance of a vehicle such as an aeromaneuvering orbiter or the National Aerospace Plane. Many methods of nonlinear programming require the solution of a quadratic program (QP) at each iteration to determine the search step. In the trajectory optimization case, the QP has a special dynamic programming structure. The algorithm exploits this special structure with a divide- and conquer type of parallel implementation. The algorithm solves a (p.N)-stage problem on N processors in O(p + log2 N) operations. The algorithm yields a factor of 8 speed-up over the fastest known serial algorithm when solving a 1024-stage test problem on 32 processors. Author

N92-26458# Naval Postgraduate School, Monterey, CA.
NAVAL POSTGRADUATE SCHOOL AIRCRAFT SYNTHESIS PROGRAM (USER'S MANUAL) M.S. Thesis
JOHN T. PARKER Sep. 1991 301 p
(AD-A246198) Avail: CASI HC A14/MF A03

A menu driven computer program has been developed to serve as a user's interface with ACSYNT, the NASA-AMES program for aircraft synthesis. The interface program, CREATE, drastically reduces the amount of time required to learn how to use ACSYNT, thus, allowing the power of ACSYNT to be used more effectively by the aircraft design curriculum at the Naval Postgraduate School. CREATE has been developed to reduce the required number of inputs to ACSYNT and is ideal for use with the early phases of the Aeronautical Engineering Curriculum. It can provide rapid feedback when examining the effects that different aircraft parameters have on the overall aircraft performance, thus, enhancing the students understanding of the relationships between the numerous variables of aircraft studies. Included in the thesis are four examples that demonstrate some of the capabilities of ACSYNT and the use of CREATE. GRA

N92-26524# Massachusetts Inst. of Tech., Cambridge.
ALGORITHMS FOR BLENDING SURFACE GENERATION M.S. Thesis
PETER C. FILKINS Jun. 1991 126 p
(Contract N00123-89-G-0580)
(AD-A245686) Avail: CASI HC A07/MF A02

This thesis presents a general algorithm for the representation and approximation of blending surfaces between two non-uniform rational B-spline (NURBS) surfaces using surfaces of the same class. The algorithm permits the approximation of blending surfaces with up to curvature continuous boundary conditions along the intersection of the blending surface with the primary surfaces to be joined. These intersections are called the linkage curves. The blending surfaces are approximated by low degree Beta-spline surfaces, created using a lofting method. Isoparameter curves of the approximating blending surface are constructed based on differential geometry properties of the underlying surfaces. First derivative properties are required to satisfy tangent plane continuity boundary conditions. To satisfy curvature continuity conditions, the cross-link curves are constructed to match the curvature of a normal section of the underlying surface at the end point of the cross-link curves on the linkage curves. An adaptive sampling procedure is used to improve the approximation. Finally, the algorithm is applied to the practical problem of designing a fillet for the intersection of a marine propeller blade with a hub. An adaptation of the method which creates a standard marine propeller fillet automatically is also presented. GRA

N92-26620# Naval Postgraduate School, Monterey, CA.
A MODELING STRATEGY FOR LARGE-SCALE OPTIMIZATION BASED ON ANALYSIS AND VISUALIZATION PRINCIPLES M.S. Thesis
CHERYL A. BITHER and JULIE A. DOUGHERTY Sep. 1991 100 p
(AD-A246570) Avail: CASI HC A05/MF A02

A modeling strategy for the validation and analysis of large-scale optimization models is defined and demonstrated. The strategy is based on nine principles of analysis and eight principles of visualization that are applied in a user controlled hierarchical structure which is customized to a particular optimization problem. For each model a set of analytic tools, such as spreadsheets and graphs, is structured to validate and verify data and analyze the model and its results. These tools can be quickly recreated with data from subsequent runs of the model and from the sensitivity analysis and comparisons. As a demonstration, the strategy is applied to PHOENIX, a large-scale U.S. Army helicopter force planning model. The strategy incorporates available technology using commercially prepared software and a computer workstation. The application of techniques such as hypertext, data access, and backward compatibility enhance the ease of use and effectiveness of this approach. GRA

N92-27830*# Old Dominion Univ., Norfolk, VA.
SYSTEM REQUIREMENTS SPECIFICATION FOR SMART STRUCTURES MODE
In its Geometric Modeling for Computer Aided Design 38 p Jun. 1992
Avail: CASI HC A03/MF A02

Specified here are the functional and informational requirements for software modules which address the geometric and data modeling needs of the aerospace structural engineer. The modules are to be included as part of the Solid Modeling Aerospace Research Tool (SMART) package developed for the Vehicle Analysis Branch (VAB) at the NASA Langley Research Center (LaRC). The purpose is to precisely state what the SMART Structures modules will do, without consideration of how it will be done. Each requirement is numbered for reference in development and testing. Author

N92-27831*# Old Dominion Univ., Norfolk, VA.
SURFACE GENERATION AND EDITING OPERATIONS APPLIED TO STRUCTURAL SUPPORT OF AEROSPACE VEHICLE FUSELAGES M.S. Thesis
SUSAN K. SCHWARTZ *In its* Geometric Modeling for Computer Aided Design 41 p Jun. 1992
(Contract NCC1-99)
Avail: CASI HC A03/MF A02

The Solid Modeling Aerospace Research Tool (SMART) is a computer aided design tool used in aerospace vehicle design. Modeling of structural components using SMART includes the representation of the transverse or cross-wise elements of a vehicle's fuselage, ringframes, and bulkheads. Ringframes are placed along a vehicle's fuselage to provide structural support and maintain the shape of the fuselage. Bulkheads are also used to maintain shape, but are placed at locations where substantial structural support is required. Given a Bezier curve representation of a cross sectional cut through a vehicle's fuselage and/or an internal tank, this project produces a first-guess Bezier patch representation of a ringframe or bulkhead at the cross-sectional position. The grid produced is later used in the structural analysis of the vehicle. The graphical display of the generated patches allows the user to edit patch control points in real time. Constraints considered in the patch generation include maintaining 'square-like' patches and placement of longitudinal, or lengthwise along the fuselage, structural elements called longerons. Author

N92-27903# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain). Lab. de Guiado.
FUZZY GUIDANCE SYSTEM EVALUATION
J. R. MARTIN, F. SANCHEZ, P. V. CUENCA, L. M. RODRIGUEZ, and J. B. ECIJA *In* AGARD, Air Vehicle Mission Control and Management 15 p Mar. 1992
Copyright Avail: CASI HC A03/MF A03

A study is described that compares the capability of a fuzzy logic controller with a classical controller P+D (proportional plus derivative). The model used for this investigation is the attitude control of a microsatellite launcher, during the first stage of flight. This model has been chosen because it performs on a very unstable plant; the launcher is conceived without stabilization surfaces and only the body is considered as a generator of aerodynamics forces. Movable-nozzle Thrust Vector Control (TVC) will be used as a flight control device. The problem is studied under three degrees of freedom simulation at two levels, software and hardware. The concept formulated in this work is the analysis of the fuzzy rules that perform robust control during the flight. It has been used on perturbations, a wind profile and misalignments in the launcher. The wind model generates a wind velocity vector, which is constant throughout each run. The wind velocity vector is parallel to the surface of the earth. Author

N92-27980# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN EXPLORATORY APPLICATION OF NEURAL NETWORKS TO THE SORTIE GENERATION FORECASTING PROBLEM M.S. Thesis
JAMES M. DAGG Sep. 1991 181 p
(AD-A246626; AFIT/GLM/LSM/91S-11) Avail: CASI HC A09/MF A02

This exploratory study assesses the accuracy of backpropagation neural networks in predicting sortie generations, given pre-specified levels of air base resources. Single hidden layer networks and two-way interaction regression metamodels were fitted to simulated data previously generated by way of a factional design for ten factors at two levels, and subsequently tested (cross-validated) via an independent testing sample. It was determined that regression metamodels were generally superior in predicting unseen cases, while their network counterparts exhibited far better goodness-of-fit characteristics. The research consistently emphasizes that goodness-of-fit in no way necessarily implies goodness-of-prediction, in that different non-equivalent statistical measures are required to assess both these phenomena. In spite of their relatively poor performance in predicting the test sample used in this study, experimental results indicate that future research focused on applying neural network modeling techniques to sortie generation prediction and the identification of critical air base resources is warranted. GRA

N92-28150*# Research Inst. for Computing and Information Systems, Houston, TX.
RESEARCH INTO THE DEVELOPMENT OF A KNOWLEDGE ACQUISITION TAXONOMY Monthly Interim Progress Reports, Sep. 1990 - Jan. 1991
PAMELA K. FINK (Southwest Research Inst., San Antonio, TX.) Jan. 1991 30 p
(Contract NCC9-16; RICIS PROJ. ET-26)
(NASA-CR-189939; NAS 1.26:189939) Avail: CASI HC A03/MF A01

Monthly progress reports for September 1990 to January 1991 are given. Topics that are briefly covered include problem solving and learning taxonomies, knowledge acquisition techniques, software design, air traffic control, and space shuttle flight control. 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.

A92-41240
STRUCTURE-BORNE NOISE TRANSMISSION IN THE PROPFAN TEST ASSESSMENT AIRCRAFT
JAMES F. UNRUH (Southwest Research Institute, San Antonio, TX) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 3, May-June 1992, p. 499-504. Previously cited in issue 02, p. 231, Accession no. A91-12480. *refs*
Copyright

A92-41266
ACOUSTIC SOURCES IN A TRIPPED FLOW PAST A RESONATOR TUBE
M. C. THOMPSON, K. HOURIGAN, M. C. WELSH (CSIRO, Highett, Australia), and E. BROCHER (Aix-Marseille II, Universite, Marseille, France) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1484-1491. refs
Copyright

A numerical model employing the vortex method is used to investigate the separated flow around a trip rod placed upstream of a resonator tube. The acoustic power generated by the flow is calculated using Howe's theory of aerodynamic sound. When the trip rod is placed far enough upstream, natural vortex shedding from the rod proceeds and no net acoustic energy of the tube resonant mode is generated. However, when the rod is placed close to the tube, the vortex shedding becomes locked to the acoustic field, changes to a symmetric mode, and the flow generates net resonant acoustic energy per acoustic cycle. These results are consistent with previous experimental observations and provide insight into the flow structures responsible for the transfer of energy from the flowfield to the resonant acoustic field.
Author

A92-41324#
EXPERIMENTALLY SUPPORTED INVESTIGATIONS INTO THE OPTICAL PERFORMANCE OF MULTI-APERTURE WINDOW CONCEPTS
L. C. BROOKS, D. A. KALIN, and M. R. BANISH (Teledyne Brown Engineering, Optical Systems Dept., Huntsville, AL) AIAA and SDIO, *Annual Interceptor Technology Conference*, Huntsville, AL, May 19-21, 1992. 12 p. refs
(Contract DASG60-87-C-0042)
(AIAA PAPER 92-2781) Copyright

An experimental and analytic investigation was undertaken to examine the optical performance of a multiaperture window concept for use in hypersonic, endoatmospheric vehicles. The window was simulated using a simple two-dimensional flat plate with multiple circular apertures. Analyses were performed to examine transmission, thermal emission, and aero-optic effects (image blur, jitter, and Strehl reduction). A series of imaging tests was conducted in both the short wave infrared (SWIR) and midwave infrared (MWIR) wavebands through the multi-aperture window and a monolithic (baseline) window. The images recorded through both window schemes were analyzed and compared to investigate the effects of multi-aperture windows on aero-optic performance. The results from these experiments could be used in a concept definition or trade study for potential optically guided vehicle systems.
Author

A92-41331#
A VALIDATED CODE TO PREDICT THE PERFORMANCE OF ONBOARD BROADBAND OPTICAL SEEKERS THROUGH A TURBULENT TRANSONIC FLOW
MICHELE BANISH, ROD CLARK, and ALAN KATHMAN (Teledyne Brown Engineering, Huntsville, AL) AIAA and SDIO, Annual

Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 9 p. refs
(AIAA PAPER 92-2792) Copyright

Attention is given to two analytical schemes for the prediction of 'aerooptic', aerodynamically-influenced optical performance for airborne sensors over a range of sensing wavebands. Analytic expressions which can confidently be used from the subsonic to the hypersonic regimes are developed, and experimental and analytical results are compared with a view to the relationship of wavelength-dependent optical distortion to the design and performance of prospective airborne optical systems. It is noted that the quantification of blurring must be conducted with contained-energy diameter measures rather than FWHM calculations. O.C.

A92-41332#
A TIME-INTEGRATED IMAGE MODEL FOR AERO-OPTIC ANALYSIS
A. D. KATHMAN, L. C. BROOKS, D. A. KALIN, and R. L. CLARK (Teledyne Brown Engineering, Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 10 p. refs
(Contract DASG60-87-C-0042)
(AIAA PAPER 92-2793) Copyright

An experimental investigation was conducted to determine the variation in aero-optic effects as a function of camera integration time. Laboratory tests were performed in a supersonic dual nozzle flow field simulator that emulated the mixing layer aero-optic effects found in endo-atmospheric hypersonic flight. Measurements of optical image degradation were taken for several integration periods in a turbulent mixing layer. The experimental results demonstrated a shortcoming in the accepted treatment of a camera's temporal integration period. A more complete theoretical treatment was developed which can be used to simulate a complete range of integration periods. Theoretical predictions were made and found to demonstrate the same characteristics as the experimental data. A second set of analytic and experimental simulations were conducted to confirm this phenomenon and validate the new analytic method. Author

A92-41340#
BINARY OPTIC-CORRECTED CONFORMAL WINDOWS FOR OPTICAL SEEKERS
DANIEL M. BROWN and ERIC G. JOHNSON (Teledyne Brown Engineering, Sensor Systems Dept., Huntsville, AL) AIAA and SDIO, Annual Interceptor Technology Conference, Huntsville, AL, May 19-21, 1992. 13 p. refs
(AIAA PAPER 92-2802) Copyright

A sapphire window which is conformal with an ogive missile dome is corrected for optical aberrations using binary optics technology. About eleven waves of correction are applied using only two simple refractors and one binary optical element on a flat plate. The correctors restore the seeker to diffraction limited performance. This design experiment demonstrates the feasibility of developing conformal windows exibiting diffraction limited performance using binary optics technology. Author

A92-41359 Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IONOSPHERIC PLASMA FLOW OVER LARGE HIGH-VOLTAGE SPACE PLATFORMS. I - ION-PLASMA-TIME SCALE INTERACTIONS OF A PLATE AT ZERO ANGLE OF ATTACK. II - THE FORMATION AND STRUCTURE OF PLASMA WAKE
J. WANG (JPL, Pasadena, CA; MIT, Cambridge, MA) and D. E. HASTINGS (MIT, Cambridge, MA) Physics of Fluids B (ISSN 0899-8221), vol. 4, no. 6, June 1992, p. 1597-1629. refs
(Contract NAG3-695)
Copyright

The paper presents the theory and particle simulation results for the ionospheric plasma flow over a large high-voltage space platform at a zero angle of attack and at a large angle of attack. Emphasis is placed on the structures in the large, high-voltage regime and the transient plasma response on the ion-plasma time scale. Special consideration is given to the transient formation of the space-charge wake and its steady-state structure. I.S.

A92-42601
FIBER OPTIC SYSTEMS FOR MOBILE PLATFORMS IV; PROCEEDINGS OF THE MEETING, SAN JOSE, CA, SEPT. 18, 1990
NORRIS E. LEWIS, ED. (Litton Systems, Inc., Poly-Scientific Div., Blacksburg, VA) and EMERY L. MOORE, ED. (Litton Systems, Inc., Guidance and Control Systems Div., Woodland Hills, CA) Meeting sponsored by SPIE. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1369), 1991, 145 p. For individual items see A92-42602 to A92-42612.
(SPIE-1369; ISBN 0-8194-0430-6) Copyright

The present conference on fiber-optic (FO) systems discusses topics in shipboard, automotive, spacecraft, and aeronautical FO applications. Attention is given to an FO interferometric ellipsoidal shell hydrophone, an FO backbone for a submarine combat system, EM environmental effects on shipboard FO installations, and recent developments in polymeric FO systems for automotive use. Also discussed are a wavelength-multiplexed FO position encoder for aircraft control systems, a code-division multiple-access system for integrated modular avionics, fly-by-light systems for commercial aircraft, FO temperature sensors for aerospace applications, a hybrid FO/electrical network for launch vehicles, the effects of ionizing radiation on FO systems, and FO systems in liquid propellant rocket environments. O.C.

A92-42606
SINGLEMODE FIBER OPTIC ROTARY JOINT FOR AIRCRAFT APPLICATIONS
WARREN H. LEWIS and MICHAEL B. MILLER (Litton Systems, Inc., Poly-Scientific Div., Blacksburg, VA) IN: Fiber optic systems for mobile platforms IV; Proceedings of the Meeting, San Jose, CA, Sept. 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 79-86.
(Contract F30602-86-C-0124; N66604-87-R-1195)
Copyright

The alignment techniques, bearing designs, and optical system configuration used by a low optical feedback/low insertion loss single-mode optical rotary joint are presented. Attention is given to the test results obtained for temperature, shock and vibration, and humidity cycles. Initial design criteria have been substantially exceeded by the system components fabricated to date; only the humidity-related performance goals have yet to be reached, due to the intrinsic permeability of the rotating interface by water vapor in initially hot, humid atmospheric conditions that support condensation upon subsequent cooling. O.C.

A92-42732
MINIMUM-DRAG BODIES MOVING IN LOCALITY-LAW MEDIA [O TELAKH NAIMEN'SHEGO SOPROTIVLENIIA, DVIGAIUSHCHIKHSIA V SREDAKH PRI NALICHII ZAKONA LOKAL'NOSTI]
N. A. OSTAPENKO and G. E. IAKUNINA Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), no. 1, Jan.-Feb. 1992, p. 95-106. In Russian. refs
Copyright

A solution is presented for the variational problem of a minimum-drag body moving with a constant velocity in a medium in which the force exerted by the medium on an elementary surface area unit of the body depends only on its orientation relative to the motion direction (locality law). The representations of the normal (pressure) and tangential (friction) components of the force cover a wide range of conditions that are realized during the motion of a body in gases and dense media. V.L.

A92-42778
LOCAL INTERACTION THEORY [TEORII LOKAL'NOGO VZAIMODEISTVIIA]
ROMAN N. MIROSHIN and ISKANDER A. KHALIDOV Leningrad,

Izdatel'stvo Leningradskogo Universiteta, 1991, 276 p. In Russian. refs
(ISBN 5-288-00516-8) Copyright

A mathematical formalism for models of local interaction between a body and a medium is developed which makes it possible to expand the range of problems that can be solved. Such problems include analytical estimation of the response of a medium to a body and reconstruction of the local characteristics or shape of a body from global characteristics. The discussion covers the fundamentals of the theory of local interaction, relationship between local interaction theory and the problem of Markov moments, direct and inverse problems of local interaction, and aerodynamic applications. V.L.

A92-43160
A PERSPECTIVE ON HELICOPTER NOISE
T. MASUGO (Kumaki Polytechnic University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 300-303. In Japanese.

The noise standard for helicopters is discussed. Helicopter noise reduction is considered, and design configurations that can reduce the main rotor noise are analyzed. Y.P.Q.

A92-44197
ACOUSTIC TRANSMISSION THROUGH A 2-D ORTHOTROPIC MULTI-LAYERED INFINITE CYLINDRICAL SHELL
A. BLAISE and C. LESUEUR (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) Journal of Sound and Vibration (ISSN 0022-460X), vol. 155, no. 1, May 22, 1992, p. 95-109. Research supported by CNES. refs
Copyright

An investigation is presented of the transmission loss of two-dimensional orthotropic multilayered infinite cylindrical shells. Equations of motion are established by using a variational displacement formulation; these equations remain unchanged in form whatever the number of layers. Numerical results are presented illustrating the influence of acoustic and structural parameters on the transmission loss. Author

A92-44377
THERMAL RADIATION EFFECTS ON A SHOCKED PARTICLE-LADEN GAS
J. L. HAFERMAN, R. G. SCHMITT, T. F. SMITH, and P. B. BUTLER (Iowa, University, Iowa City) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 467-475. refs
(Contract N60530-89-C-0383)
Copyright

A mathematical model is presented that describes the particle-gas interactions that occur when a shock wave propagates through a particle-laden gas. In most of the previous work in this field, thermal radiation was neglected when solving the energy conservation equation throughout the shock relaxation zone. The present study represents an extension of the previous analyses to include thermal radiation in the governing conservation equations. The present analysis focuses on the dynamic and thermodynamic events taking place within the domain of the relaxation zone, as well as the coupling of the relaxation zone and the preheat zone. Viewed in a shock-fixed coordinate system, the preheating and relaxation zones each have a constant length (steady-state assumption) for specified conditions and, for convenience, all properties within each zone can be referenced to the distance from the shock front. The results presented show the influence of thermal radiation on shock wave structure, and predict the distance ahead of the shock front that thermal radiation penetrates the particle-laden gas, thereby providing preshock heating to both the particles and the gas. Author

A92-44512* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
UNSTEADY AIRLOADING PANEL METHOD FOR PROPFANS
D. B. HANSON (United Technologies Corp., Windsor Locks, CT) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 806-814. Previously cited in issue 02, p. 226, Accession no. A91-12430. refs
(Contract NAS3-23720)
Copyright

N92-26733 Georgia Inst. of Tech., Atlanta.
HYPERSONIC AEROSPACE VEHICLE LEADING EDGE COOLING USING HEAT PIPE, TRANSPIRATION AND FILM COOLING TECHNIQUES Ph.D. Thesis
JAMES MICHAEL MODLIN 1991 131 p
Avail: Univ. Microfilms Order No. DA9136243

An investigation was conducted to study the feasibility of cooling hypersonic vehicle leading edge structures exposed to severe aerodynamic surface heat fluxes using a combination of liquid metal heat pipes and surface mass transfer cooling techniques. A generalized, transient, finite difference based hypersonic leading edge cooling model was developed that incorporated these effects and was demonstrated on an assumed aerospace plane-type wing leading edge section and a SCRAMJET engine inlet leading edge section. The hypersonic leading edge cooling model was developed using an existing, experimentally verified heat pipe model. Two applications of the hypersonic leading edge cooling model were examined. An assumed aerospace plane-type wing leading edge section exposed to a severe laminar, hypersonic aerodynamic surface heat flux was studied. A second application of the hypersonic leading edge cooling model was conducted on an assumed one-quarter inch nose diameter SCRAMJET engine inlet leading edge section exposed to both a transient laminar, hypersonic aerodynamic surface heat flux and a type 4 shock interference surface heat flux. The investigation led to the conclusion that cooling leading edge structures exposed to severe hypersonic flight environments using a combination of liquid metal heat pipe, surface transpiration, and film cooling methods appeared feasible. Dissert. Abstr.

N92-27171# Naval Postgraduate School, Monterey, CA.
STUDIES IN CHAOS USING STOCHASTIC METHODS M.S. Thesis
EDWARD A. HEALY, JR. Jun. 1991 81 p
(AD-A246919) Avail: CASI HC A05/MF A01

Methods of chaos have been used to classify many heretofore inexplicable nonlinear dynamical systems in fields as diverse as ecology to engineering and economics to meteorology. This thesis presents the mathematical background needed to understand chaos as well as the engineering techniques used to study the nature of dynamical systems. Several dynamical systems are studied using two probabilistic measures of chaos, fractal correlation dimension, and the multivariate scaling analysis. A new technique for developing a multivariate scaling analysis using a time embedding procedure is presented. The dynamical systems studied include the Lorenz equations, Duffing's equation, and helicopter flight vibrations. GRA

N92-27924# Army Aviation Technical Test Center, Fort Rucker, AL.
STEADY-STATE ACOUSTICAL NOISE MEASUREMENTS IN AVIATION SYSTEMS Final Report
28 Feb. 1992 11 p
(AD-A247831; AATTC-TOP-7-3-530) Avail: CASI HC A03/MF A01

This TOP describes procedures for measuring acoustical noise levels in Army helicopters. It covers tests for steady-state acoustical noise at crewstations and in the passenger compartment. GRA

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.

A92-43241
WIG TRANSPORTATION EFFICIENCY CONSIDERING THE INFLUENCE OF NO-LOAD SITUATION
S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 628-631. In Japanese. refs

The configurations and endurance of PAR-WIG aircraft are presented. The no-load situation and structural weight of the airframe are analyzed. The transportation efficiency of the WIG is evaluated. Y.P.Q.

A92-43548
JOINT AVIATION AUTHORITIES: DEVELOPMENT OF AN INTERNATIONAL STANDARD FOR SAFETY REGULATION - THE FIRST STEPS ARE BEING TAKEN BY THE JAA
NICOLA ARRIGONI Air & Space Law (ISSN 0927-3379), vol. 17, no. 3, June 1992, p. 130-132.
Copyright

An overview is presented of the Joint Aviation Authorities (JAA), an organization of 19 European countries set up originally to establish joint certification requirements for the approval of aircraft design. JAA's work has broadened to include operations, airworthiness, noise, and flight crew licensing and certification. R.E.P.

N92-26765# Naval Postgraduate School, Monterey, CA.
A PROTOTYPE SEMANTIC INTEGRITY FRONT END EXPERT SYSTEM FOR A RELATIONAL DATABASE M.S. Thesis
GEORGE J. SALITSKY 26 Sep. 1991 141 p
(AD-A246084) Avail: CASI HC A07/MF A02

Information is a critical resource in today's enterprises. Whether they are industrial, commercial, educational, or military, these organizations maintain an ever increasing amount of information in databases. Ensuring the accuracy of information in a database is paramount to the organizations that maintain these databases. Many decisions are made from the information extracted from the database, and incorrect data will lead to incorrect decision making. This thesis examines the feasibility of using expert systems for enforcing semantic integrity constraints to relational databases. To accomplish this goal, the thesis develops a classification for semantic integrity constraints, applies it to develop rules for the Navy's Naval Aircraft Flight Record application, and builds a front end expert system to enforce these rules dynamically. The expert system enforces integrity rules for all maintenance operations. GRA

N92-26830# Wichita State Univ., KS. National Inst. for Aviation Research.
TEST PLAN FOR THE INTERNATIONAL AIRCRAFT OPERATOR INFORMATION SYSTEM
JOHN J. HUTCHINSON, JOHN ELLIS, BARBARA K. SMITH, and JIM NORTH Feb. 1992 10 p
(Contract DTFA03-89-C-00057)
(DOT/FAA/CT-91/18) Avail: CASI HC A02/MF A01

This test plan outlines a methodology for determining whether the International Aircraft Operator Information System is ready to become fully operational as a prototype system. The system was operational on a very limited basis beginning in Aug. 1990. During the review, Federal Aviation Administration (FAA) personnel will be able to examine information system documentation, data base contents, information system processes, and reports. The actual tests will consist of entering the system, generating queries, and reviewing audits. In the course of carrying out these activities it will be possible to review all of the aspects of the system. Author

N92-26863# UFA, Inc., Newton, MA.
EXPERT SYSTEM MANAGEMENT SYSTEM Final Report, Jan. 1987 - Sep. 1990
ARTHUR GERSTENFELD and KIET D. HOANG 30 Aug. 1991 43 p
(Contract F33615-88-C-1720)
(AD-A247102; WL-TR-91-1063) Avail: CASI HC A03/MF A01

The Expert System Management System (ESMS) Small Business Innovative Research Contract developed a distributed fault-tolerant expert system shell for multiple expert systems in a multiprocessor environment. The ESMS contained four domain specific expert systems called Manager Expert System, Route Planner Expert System, Weapon Expert System, and Situation Awareness and Display Expert System. The ESMS expert system shell was written in LISP and runs on four Explorer II computers. Each of the expert systems were responsible for their own area of expertise, but each communicated and cooperated with the other experts along with a real-time man-in-the-loop flight simulator. The four expert systems developed were host independent, relocatable, and interruptable when a higher priority task arrived. The ESMS was able to detect network and processor failures, along with being able to reconfigure the system according to the available resources. The system was both event and data driven, and shared global variables. The system was interfaced with a MicroVAX 2 computer to the MIL-STD-1553 data bus in order to receive waypoints and aircraft data from a real-time man-in-the-loop simulation. GRA

N92-27518# MiTech, Inc., Washington, DC.
WORKSHOP ON INTEGRATED CREW RESOURCE MANAGEMENT (CRM) Final Report
RONALD JOHN LOFARO, ed. May 1992 173 p Workshop held 19-21 Nov. 1991
(Contract DTFA01-90-Y-01009)
(DOT/FAA/RD-92/5) Avail: CASI HC A08/MF A02

The continuing development and implementation of Crew Resource Management (CRM) training and assessment began in the late 1970's. There is interest in exploring paradigms and techniques which address an integrated, simultaneous assessment of CRM skills and the more traditional 'stick and rudder' (flight control) skills. A preliminary model for analysis and assessment in integrated CRM was developed. This paradigm, and its potential uses, were investigated by an Air Transport Association (ATA) of America focus group. The focus group was part of an ATA working group and subcommittee on Advanced Qualification Program (AQP). The workshop was designed and facilitated, and results prepared by, the Research Development Service. Author

N92-27528# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
PROFILE OF AN EFFECTIVE ENGINEERING MANAGER M.S. Thesis
KENNETH W. THOMAS, SUSAN P. HOCEVAR, GAIL F. THOMAS, and FRANK J. BARRETT Dec. 1991 43 p
(AD-A246525; NPS-AS-92-006) Avail: CASI HC A03/MF A01

This study was designed to investigate the behavioral factors that determine the effectiveness of branch engineering managers at the Naval Avionics Center (NAC) in Indianapolis. Data were collected using a survey designed especially for this study. Ratings of effectiveness variables were obtained from both engineers (subordinates) and the division manager (superior) for each branch manager. Correlations were run between these effectiveness variables and specific managerial behaviors as rated by engineers in each branch. Somewhat different sets of behaviors or critical skill areas were found to be related to three different sets of effectiveness variables. A composite picture highlights the importance of the branch managers' communication activities and identifies four communication functions crucial to the effectiveness of the branch manager. These functions are (1) Listening and

Responding to Branch Managers, (2) Providing Guidance to Branch Members, (3) Encouraging Collaboration Among Branch Members, and (4) Communicating the Needs of the Branch. This empirical data can be used as input for designing management development programs, selecting engineering managers, and conducting performance appraisals. GRA

N92-28114*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 13: THE INFORMATION-SEEKING HABITS AND PRACTICES OF ENGINEERS
THOMAS E. PINELLI 1991 22 p Repr. from Science and Technology Libraries, v. 11, no. 3, 1991 p 5-25
(NASA-TM-107931; NAS 1.15:107931; AD-A251967) Avail: CASI HC A03/MF A01

It is argued that only by maximizing the research and development process can the United States maintain and possibly capture its international competitive edge. Key to this goal is the provision of information services and products which meet the information needs of engineers. Evidence exists which indicates that traditional information services and products may, in fact, not be meeting the information needs of engineers. The primary reason for this deficiency is three fold. First, the specific information needs of engineers are neither well known nor well understood. Second, what is known about the information seeking habits and practices of engineers has not been applied to existing engineering information services. Third, the information professionals continue to over-emphasize technology instead of concentrating on the quality of the information itself and the ability of the information to meet the needs of the user. Author

N92-28183*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 14: AN ANALYSIS OF THE TECHNICAL COMMUNICATIONS PRACTICES REPORTED BY ISRAELI AND US AEROSPACE ENGINEERS AND SCIENTISTS
REBECCA O. BARCLAY, THOMAS E. PINELLI, DAVID ELAZAR, and JOHN M. KENNEDY (Indiana Univ., Bloomington.) 1991 18 p Presented at the International Professional Communication Conference, Orlando, FL, 1 Nov. 1991
(NASA-TM-107924; NAS 1.15:107924; AD-A252564) Avail: CASI HC A03/MF A01

As part of Phase 4 of the NASA/DoD Aerospace Knowledge Diffusion Research Project, two pilot studies were conducted that investigated the technical communications practices of Israeli and U.S. aerospace engineers and scientists. Both studies had the same five objectives: first, to solicit the opinions of aerospace engineers and scientists regarding the importance of technical communications to their profession; second, to determine the use and production of technical communications by aerospace engineers and scientists; third, to seek their view about the appropriate content of an undergraduate course in technical communications; fourth, to determine aerospace engineers' and scientists' use of libraries, technical information centers, and on-line databases; and fifth, to determine the use and importance of computer and information technology to them. A self-administered questionnaire was mailed to randomly selected U.S. aerospace engineers and scientists who are working in cryogenics, adaptive walls, and magnetic suspension. A slightly modified version was sent to Israeli aerospace engineers and scientists working at Israel Aircraft Industries, LTD. Responses of the Israeli and U.S. aerospace engineers and scientists to selected questions are presented in this paper. Author

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GENERAL

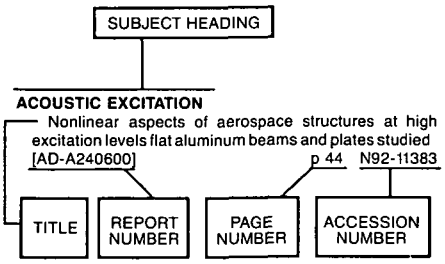
A92-41820
THE TURBO-RAMJET GRIFFON [LE GRIFFON A TURBO-STATOREACTEUR]
A. TURCAT (Academie Nationale de l'Air et de l'Espace, Toulouse, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 105, 106. In French.
Copyright

A review is presented of the development and testing of the turbo-ramjet engine in the wind tunnel and various flying testbeds to its installation and flights powering the Griffon II aircraft. A number of the more important engineering modifications incorporated into the powerplant and aircraft installations are described. R.E.P.

A92-41824
THE BEGINNINGS OF THE HYPERSONIC AND THE RENEWAL OF THE SUPERSONIC RAMJET [LES DEBUTS DE L'HYPERSONIQUE ET LE RENOUVEAU DU STATOREACTEUR SUPERSONIQUE]
PIERRE BERTON (ONERA, Chatillon, France) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 16, 2nd Quarter, 1992, p. 119-124. In French.
Copyright

An overview is presented of the numerous French ramjet development programs that evolved between 1965 and 1985. Attention is given to the contributions made during the research, testing and development of ramjet missile projects including the Griffon mixed turbine, the Mach 5 STATALTEX, VEGA, and CTA1. Consideration is give to the experimental hypersonic engine development of the Scorpion and Esope programs in high temperature wind tunnel testing. R.E.P.

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 document content, a title extension is added, separated from the title by three hyphens. The 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.

A

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Utilizing the fault monitoring system for the A320 aircraft p 700 A92-43157
ABERRATION
Binary optic-corrected conformal windows for optical seekers
[AIAA PAPER 92-2802] p 779 A92-41340
ABILITIES
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A modeling strategy for large-scale optimization based on analysis and visualization principles
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[AD-A247831] p 780 N92-27924
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Low power magnetic bearing design for high speed rotating machinery p 772 N92-27739
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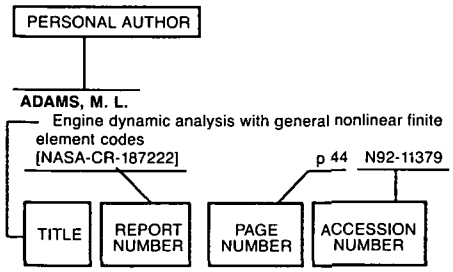
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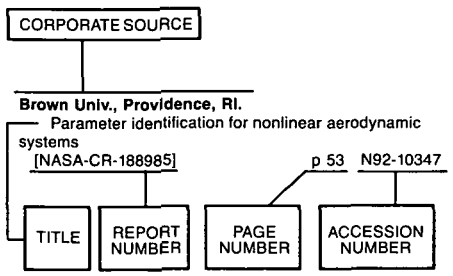
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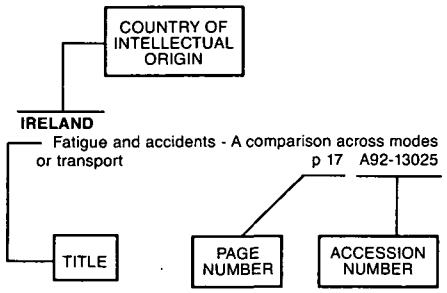
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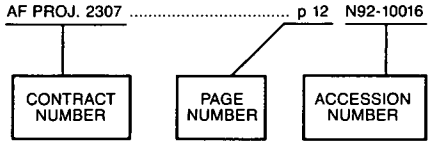
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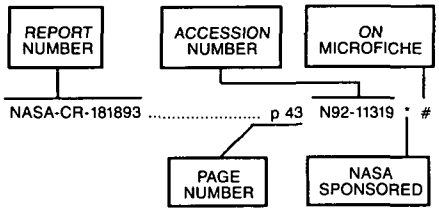
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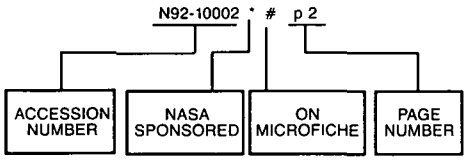
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