NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

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NASA SP-7037(191)
September 1985

National Aeronautics and Space Administration

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NASA SP-7037(191)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 191)

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

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1985
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 499 reports, journal articles, and other documents originally announced in August 1985 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

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

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

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

An annual cumulative index will be published.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA.

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REPORT NUMBER

N85-10007*# Boeing Commercial Airplane Co., Seattle, Wash.
DEVELOPMENT AND APPLICATIONS OF ALGORITHMS FOR CALCULATING THE TRANSONIC FLOW ABOUT HARMONICALLY OSCILLATING WINGS
F. E. EHLERS, W. H. WEATHERILL, and E. L. YIP Oct. 1984 152 p refs
(Contract NAS1-16297)
(NASA-CR-172376; NAS 1.26:172376) Avail: NTIS HC A08/MF A01 CSCL 01A

A finite difference method to solve the unsteady transonic flow about harmonically oscillating wings was investigated. The procedure is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady differential equation for small disturbances. The differential equation for the unsteady velocity potential is linear with spatially varying coefficients and with the time variable eliminated by assuming harmonic motion. An alternating direction implicit procedure was investigated, and a pilot program was developed for both two and three dimensional wings. This program provides a relatively efficient relaxation solution without previously encountered solution instability problems. Pressure distributions for two rectangular wings are calculated. Conjugate gradient techniques were developed for the asymmetric, indefinite problem. The conjugate gradient procedure is evaluated for applications to the unsteady transonic problem. Different equations for the alternating direction procedure are derived using a coordinate transformation for swept and tapered wing planforms. Pressure distributions for swept, untaped wings of vanishing thickness are correlated with linear results for sweep angles up to 45 degrees. E.A.K.

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AUTHORS

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A85-18511*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A VORTEX-LATTICE METHOD FOR GENERAL, UNSTEADY AERODYNAMICS
P. KONSTADINOPOULOS, D. F. THRASHER, D. T. MOOK, A. H NAYFEH, and L. WATSON (Virginia Polytechnic Institute and State University, Blacksburg, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Jan. 1985, p. 43-49. refs
(Contract N00014-79-C-0103; NSG-1262)

A general method of calculating unsteady, incompressible, inviscid, three-dimensional flows around arbitrary planforms has been developed. The method is an extension of the vortex-lattice technique. It is not limited by aspect ratio, camber, or angle of attack, as long as vortex breakdown does not occur above the surface of the wing and separation occurs only along sharp edges. As the wing performs arbitrary maneuvers, the position of the wake and the distribution of circulation on the wing and in the wake are obtained as functions of time. One desirable feature of the present method is its ability to treat steady lifting flows very efficiently. Several examples of steady and unsteady flows are presented. These include rectangular wings, with and without flaps, delta, and cropped delta wings. Author

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SEPTEMBER 1985

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AERONAUTICS (GENERAL)

A85-33396
AVIATION OF THE PRESENT AND FUTURE [AVIATSIIA NASTOIASHCHEGO I BUDUSHCHEGO]
A. N. PONOMAREV Moscow, Voenizdat, 1984, 256 p. In Russian. refs

The current status and future prospects of the design and development of military aircraft by the United States and Western Europe are examined. Consideration is given to the aerodynamic characteristics, powerplants, and navigation systems of tactical, strategic, and transport aircraft. B.J.

A85-35073
COMMISSION STACKER - INCORPORATION IN A TOTAL LOGISTIC CONCEPT [KOMMISSIONIERSTAPLER - EINBINDUNG IN EIN LOGISTISCHES GESAMTKONZEPT]
P. ORLOWSKI (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) Dortmunder Gespraeche '84 - Flexible Automatisierung von Flurfoerderzeugsystemen, Dortmund, West Germany, Mar. 28, 29, 1984, Paper. 5 p. In German.
(MBB-UT-36-84-OE)

The increase in Airbus production rates and the necessity to improve the cost efficiency of production has led to changes in the structure of the manufacturing plants of a West German aerospace company. An important factor, in addition to the employment of new technologies and installations, was the economic solution of problems of integration. Concepts of logistics for use throughout the plant organization were developed, and, in part, already implemented. The storage of parts and devices needed in subsequent manufacturing and assembly operations is considered, taking into account the 'commissioning' or assignment of items required for a specific operation. The commissioning or assignment of items required for a specific operation. The commissioning was considered as a problem for which an optimal solution had to be obtained. It was found that the utilization of a 'commission stacker' was an important factor in a procedure providing such an optimal solution. Another important element in the envisaged procedure involves the employment of data processing techniques and a closed informational chain of logistics. G.R.

A85-35254
PROPERTIES OF GLASS AND CARBON FIBER FABRICS USED IN HELICOPTER ROTORS
W. WEISS and P. AUER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984, Paper. 21 p.
(MBB-UD-424-84-OE)

A method to produce thick laminates out of fiber reinforced composites is described. Physical, mechanical and fatigue properties of quasi-isotropic glass and carbon fiber reinforced composites (GFC and CFC) are given. The mechanical properties of CFC are better than the properties of GFC. The optimal curing cycle shows the best values regarding the ease of fabrication. Samples manufactured with an optimized curing cycle have a higher fatigue strength than samples cut out of a rotor plate. Author

A85-36143
AIRCRAFT CORROSION AND DETECTION METHODS
D. J. HAGEMAIER, A. H. WENDELBO, JR., and Y. BAR-COHEN (Douglas Aircraft Co., Long Beach, CA) Materials Evaluation (ISSN 0025-5327), vol. 43, March 1985, p. 426-437.

Nondestructive inspection (NDI) techniques for the detection of corrosion damage in Al and steel aircraft structures are surveyed and illustrated with diagrams, graphs, drawings, and photographs. The effects of material selection, heat treatment, geographical location, and contamination on corrosion control are reviewed; surface, pitting, intergranular, exfoliation, galvanic, stress, microbial, filiform, and thermogalvanic types of corrosion are characterized; conventional NDT methods (X-rays, thermal-neutron radiography, ultrasonic testing, eddy-current testing, and acoustic-emission testing) and their limitations are discussed; and a number of specific examples of NDI corrosion detection are provided. It is pointed out that systematic NDI is initiated in the vast majority of cases only after corrosion has been detected by visual inspection or component failure. T.K.

A85-36421
V-22 OSPREY DEVELOPMENT CONTRACT TESTS NEW PROCUREMENT POLICY
D. E. FINK Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, June 3, 1985, p. 220, 223-225, 227.

Details of the contractual commitments being entered into by Bell Helicopters and Boeing Vertol to deliver 913 V-22 aircraft to the defense program are outlined. The contract was won as a result of competitive bidding and is now in final approval review. The V-22 is to ascend like a helicopter, transition to turbo-prop horizontal flight, then land like a helicopter. The companies won the contract largely on the basis of their experience with the XV-15 aircraft. The two companies have established a joint design team and separated tasks such as the designs of he engine and tilt packages and the fuselage. The engines have not yet been chosen. A pilot run of 18 aircraft due by 1989 is expected to be built by identical production facilities one owned by each contractor. The full production order will be manufactured in 10 lots. The engineering and design processes are automated and fuly accessed by personnel of both companies. M.S.K.

N85-25168# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
US ARMY AVIATION ENGINEERING FLIGHT ACTIVITY (USAAEFA) REPORT BIBLIOGRAPHY UPDATE 1983 - 1984
K. R. FERRELL Jan. 1985 10 p
(AD-A151381; USAAEFA-84-90) Avail: NTIS HC A02/MF A01 CSCL 01C

This mission of the US Army Aviation Engineering Flight activity (USAAEFA) is to conduct airworthiness qualification flight tests of air vehicles developed and/or procured as integrated systems and airworthiness evaluations of those vehicles proposed or considered for Army application or which incorporate advanced concepts having potential military application; produce test data on basic air vehicle performance, handling qualities, system/subsystem interface, and integrated system performance; and conduct a test pilot orientation course to prepare Army aviators for attendance at US Naval Test Pilot School. The bibliography is listed by both project number and aircraft type tested or involved in the test of the equipment or procedures. The project listing is in chronological order from 1983 through 1984. Missing numbers in the sequential project listing occur because of cancellations or restructuring of programs. The aircraft listing contains project numbers as well as all other information and allows the user an alternate method for obtaining necessary project information. Appendix A provides a quick reference list of the aircraft by contractor. Bibliography holders of record will automatically receive yearly supplemental listings. GRA

N85-25169# RAND Corp., Santa Monica, Calif.
MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB (PLANNING, PROGRAMMING AND BUDGETING) AND RELATED PROCESSES. TECHNICAL VOLUME Interim Report
J. BIGELOW Jun. 1984 390 p
(Contract MDA903-81-C-0381)
(AD-A152014; RAND/R-3094-MIL) Avail: NTIS HC A17/MF A01 CSCL 05A

This report describes a methodology called ORACLE--Oversight of Resources and Capability for Logistics Effectiveness. ORACLE's purpose is to assess the effects of varying certain resource levels on the peacetime materiel readiness and wartime sustainability of U.S. Air Forces, so that resource requirements can be better estimated and justified. It is intended primarily for use in the Planning, Programming, and Budgeting (PPB) process, but it can also be useful during execution. The author concludes that by itself, ORACLE should have significant value for resource planning. In conjunction with an improved forecasting capability and an execution tracking and control system, ORACLE's value will only be enhanced. GRA

N85-25170*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MISSIONS AND VEHICLE CONCEPTS FOR MODERN, PROPELLED, LIGHTER-THAN-AIR VEHICLES
M. D. ARDEMA and A. D. YOUNG, ed. (Queen Mary Coll., London) Feb. 1985 52 p refs
(NASA-TM-87461; NAS 1.15:87461; AGARD-R-724; ISBN-92-835-1492-0; AD-A153278) Avail: NTIS HC A04/MF A01 CSCL 01B

Missions and vehicle concepts for modern propelled lighter-than-air vehicles were assessed. Utilization of these vehicles for patrol and surveillance, vertical heavy-lift, high altitude platforms and transportation missions are reported. E.A.K.

N85-25171# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TRANSONIC UNSTEADY AERODYNAMICS AND ITS AEROELASTIC APPLICATIONS
Loughton, England Jan. 1985 318 p refs In ENGLISH and FRENCH Conf. held in Toulouse, 2-7 Sep. 1984
(AGARD-CP-374; ISBN-92-835-0371-6) Avail: NTIS HC A14/MF A01

Theoretical, numerical, and experimental techniques in transonic unsteady aerodynamics and their application to aeroelastic problems of aircraft loads, stability, and flutter are discussed. Supercritical, rectangular, and swept wing configurations are considered.

N85-25188# Advisory Group for Aerospace Research and Development, Paris (France).
SPECIAL COURSE ON V/STOL AERODYNAMICS: AN ASSESSMENT OF EUROPEAN JET LIFT AIRCRAFT
R. S. WILLIAMS (British Aerospace PLC, Surrey) Feb. 1985 25 p refs
(AGARD-R-710-ADDENDUM) Avail: NTIS HC A02/MF A01

The European jet lift V/STOL was examined in order to illustrate the extent to which the power plant has affected aircraft layout and consequently the aerodynamic design. Direct comparisons of V/STOL with contemporary conventional layouts are made. The successful Harrier's aerodynamic progress is highlighted. Promised engine performance advances are shown to offer more aerodynamic freedoms to V/STOL design. Author

N85-25189# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
3 May 1985 89 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-85-008) Avail: NTIS HC A05

Activities in civil aviation are reported as well as advances in transportation by motor vehicles and rail systems, and on waterways. Port and transshipment centers are also covered.

N85-25192# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
31 May 1984 49 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-015) Avail: NTIS HC A03

Improvements in air traffic control, international flights under the Civil Air Code, the need for the better storage batteries, and a numerical coding system for freight cars are discussed. Port operations and management are also considered.

N85-25196# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
13 Jun. 1984 65 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-017) Avail: NTIS HC A04/MF A01

Various topics on transportation with U.S.S.R. are discussed. Civil aviation, fuel shortages, rail transportation, aircraft lightning hazards, ship maintenance, and energy conservation are among the topics covered. R.J.F.

N85-25197# Joint Publications Research Service, Arlington, Va.
AVIATION WORKERS PLENUM REVIEWS FUEL CONSERVATION PROGRESS
A. ZUYEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-017) p 1-11 13 Jun. 1984 Transl. into ENGLISH of Vozdushnyy Transport (Moscow), 7 Apr. 1984 p 1-2
Avail: NTIS HC A04/MF A01

The Sixth Plenum of the Aviation Workers Trade Union Central Committee was held in Moscow on 4 April. The plenum examined the tasks of aviation workers trade union organizations to intensify economy of fuel and power and other material resources in light of the decisions of the February (1984) plenum of the CPSU Central Committee. Productivity, incentives, and management techniques are discussed. R.J.F.

N85-25616# Joint Publications Research Service, Arlington, Va.
MBB COST-REDUCTION PLAN FOR AIRBUS CONSTRUCTION DESCRIBED
K. WIBORG *In its* West Europe Rept.: Sci. and Technol. (JPRS-WST-84-027) p 18-20 17 Aug. 1984 Transl. into ENGLISH from Franfurter Allgem. Zeitung (Frankfurt am Main), 8 Jun. 1984 p 18
Avail: NTIS HC A04/MF A01

The economics of designing and producing a competitive major passenger aircraft is explored. Factors involved are producing an aircraft at economically acceptable cost and keeping pace with competition in terms of quality as well as manufacturing hours and manufacturing cost. The economics of manufacturing a plane in one or two plant site as opposed to several plant sites is examined. E.R.

N85-25638# Joint Publications Research Service, Arlington, Va.
FRG JOURNAL ANALYZES STATE, PROSPECTS OF AIRBUS PROGRAMS: GENERAL ANALYSIS
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-84-003) p 10-16 16 Jan. 1984 Transl. into ENGLISH from Handelsblatt (Dusseldorf), 25/26 Nov. 1983 p 25
Avail: NTIS HC A04/MF A01

Despite lagging sales and increased production cost of the the A300 and A310, airbus partners are urging the governments in Bonn, Paris, and London to subsidize a smaller model, the A320 with about 150 passenger seats. Management and organizational deficiencies in Airbus Industrie are becoming apparent in the current critical phase by a lack of timely adaptation to changing market conditions. Federal loans approved by the Bonn government, the British controversy over lending 500 million pounds, and the market potential for the A320 following McDonnell Douglas' decision to terminate development of two civil aircraft types are discussed. A.R.H.

N85-26610*# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Engineering and Technical Systems.
ACTIVITIES OF THE AERONAUTICS AND SPACE ENGINEERING BOARD Summary Report, 1 Jan. - 31 Mar. 1985
Apr. 1985 13 p
(Contract NASW-4003; NASW-3455)
(NASA-CR-175825; NAS 1.26:175825) Avail: NTIS HC A02/MF A01 CSCL 01B

A summary of activities of the Aeronautics and Space Engineering Board for the period January 1, 1985 to March 31, 1985 is given. Information is given on Space Technology Research activities. R.J.F.

N85-26611# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS
1983 216 p refs In JAPANESE and ENGLISH Symp. held in Tokyo, 30 Jun. - 1 Jul. 1983
(NAL-SP-1; ISSN-0289-260X) Avail: NTIS HC A10/MF A01

Papers from the National Aerospace Laboratory Symposium proceedings on Aircraft computational aerodynamics are presented. New advances in computer techniques in this area are highlighted. Numerical methods best suited for solving aircraft computational problems involving potential flow, cascade flow, separated flow and inviscid flow are discussed, in detail.

N85-26633# Naval Postgraduate School, Monterey, Calif.
GRAPHIC SIMULATION OF A MACHINE-REPAIRMAN MODEL M.S. Thesis
R. E. NELSEN Sep. 1984 88 p
(AD-A151761) Avail: NTIS HC A05/MF A01 CSCL 09B

A discrete-event simulation of a stochastic process, a machine-repairman model, has been programmed on the IBM Personal Computer. The model consists of three helicopters, of which two are in service and one is in cold standby, with an option of one or two repairmen. The program output is a graphics display containing a system state-versus-time graph, a table of statistics, and animated figures that illustrate the current state of the system. The program user can directly observe the dynamics of the model as the fixed-increment, simulation clock advances. The user has the option of changing the following model parameters: helicopter failure rate, repairman service rate, and the number of repairmen to employ. GRA

N85-26634# Naval Postgraduate School, Monterey, Calif.
A PRELIMINARY ANALYSIS OF C-12 AIRCRAFT USAGE BY THE NAVY AIR LOGISTICS SYSTEM M.S. Thesis
R. L. GILSON Sep. 1984 100 p
(AD-A151921) Avail: NTIS HC A05/MF A01 CSCL 01C

Exploratory data analysis techniques are utilized in this thesis in an attempt to understand the operation of the Navy Air Logistics System as a prerequisite to determining potential locations for additional C-12 aircraft already in the pipeline. Graphical analyses of flight data from Fiscal Year 1983 are combined with interviews of commands responsible for scheduling the aircraft to determine a measure of relative efficiency between the 23 bases currently supporting the aircraft. Glenview and Jacksonville are the recommended sites for the first two new C-12's. Several opportunities for further study and analysis are suggested. GRA

N85-26636# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN NUMBER 1984-3, 220/MAY-JUNE
C. SEVESTRE, ed. Paris ESA Dec. 1984 83 p refs Transl. into ENGLISH of La Rech. Aerospatiale Bull. Bimensuel (Paris), No. 1984-3, 220/May-Jun. 1984
(ESA-TT-882) Avail: NTIS HC A05/MF A01; print copy in ENGLISH available at ONERA, Paris FF 60; original report in FRENCH available at ONERA FR 60

A method for calculating turbulent three dimensional flows in diffusers; a model for quantitative X-ray microanalysis; a method for computing infrared transmission through the atmosphere; transient compressible fluid structure interaction; computation of unsteady aerodynamic pressure coefficients in a transonic straight cascade; calculation of streamlines from wall pressures on a fusiform body; and noise generated by a subsonic jet are discussed. Author (ESA)

N85-26637# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN, NUMBER 1984-4, 221/JULY-AUGUST
C. SEVESTRE, ed. Paris ESA Dec. 1984 67 p refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimensuel (Paris), No. 1984-4, 221/Jul.-Aug. 1984
(ESA-TT-884) Avail: NTIS HC A04/MF A01; print copy in ENGLISH available at ONERA, Paris FF 60; original report in FRENCH at ONERA, Paris FF 60

Optical signal processing; numerical modeling of a vortex breakdown in a laminar flow of revolution; hydrodynamic visualization of the flow around a streamlined cylinder with suction (Cousteau-Malavard turbine sail model); transition phenomena on an infinite swept wing; unsteady flow around a buffeting wing; and application of laser velocimetry to electrostatic precipitators are discussed. Author (ESA)

N85-26638# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
COST EFFECTIVE AND AFFORDABLE GUIDANCE AND CONTROL SYSTEMS
Loughton, England Feb. 1985 290 p refs In ENGLISH and FRENCH Proc. of the 39th symp., Izmir, Turkey, 16-19 Oct. 1984
(AGARD-CP-360; ISBN-92-835-0373-2) Avail: NTIS HC A13/MFA01

This volume contains the Technical Evaluation Report, the Keynote address and 24 out of the 26 papers presented at the Guidance and Control Panel 39th Symposium. The papers covered the following topics: (1) cost effectiveness models/systems configuration and design tools; (2) low cost, high reliability guidance and control sensors; (3) computational techniques and data processing; (4) reduction of development and support costs; and (5) examples of cost-effective accomplishments and approaches.

02

AERODYNAMICS

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

A85-33469* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIRLOADS ON BLUFF BODIES, WITH APPLICATION TO THE ROTOR-INDUCED DOWNLOADS ON TILT-ROTOR AIRCRAFT
W. J. MCCROSKEY, PH. SPALART, G. H. LAUB, M. D. MAISEL (NASA, Ames Research Center; U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), and B. MASKEW (Analytical Methods, Inc., Bellevue, WA) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 1, 1985, p. 1-11. Previously announced in STAR as N84-11142. refs
The aerodynamic characteristics of airfoils with several flap configurations were studied theoretically and experimentally in environments that simulate a wing immersed in the downwash of a hovering rotor. Special techniques were developed for correcting and validating the wind tunnel data for large blockage effects, and the test results were used to evaluate two modern blockage effects, and the test results were used to evaluate two modern computational aerodynamics codes. The combined computed and measured results show that improved flap and leading-edge configurations can be designed which will achieve large reductions in the downloads of tilt-rotor aircraft, and thereby improve their hover efficiency. Author

A85-33473* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTOR/BODY AERODYNAMIC INTERACTIONS
M. D. BETZINA, C. A. SMITH (NASA, Ames Research Center, Moffett Field, CA), and P. SHINODA (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 1, 1985, p. 65-81. Previously announced in STAR as N84-11143. refs
A wind tunnel investigation was conducted in which independent, steady state aerodynamic forces and moments were measured on a 2.24 m diam. two bladed helicopter rotor and on several different bodies. The mutual interaction effects for variations in velocity, thrust, tip-path-plane angle of attack, body angle of attack, rotor/body position, and body geometry were determined. The results show that the body longitudinal aerodynamic characteristics are significantly affected by the presence of a rotor and hub, and that the hub interference may be a major part of such interaction. The effects of the body on the rotor performance are presented. J.M.S.

A85-33593
A NUMERICAL CALCULATION OF NONEQUILIBRIUM FLOW PAST A WING IN THE APPROXIMATION OF A THIN SHOCK LAYER [CHISLENNYI RASCHET NERAVNOVESNOGO OBTEKANIIA KRYLA V PRIBLIZHENII TONKOGO UDARNOGO SLOIA]
V. N. GOLUBKIN and V. V. NEGODA Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 25, April 1985, p. 599-608. In Russian. refs
An efficient method is presented for solving nonlinear equations for a thin nonequilibrium shock layer on a low-aspect-ratio wing in hypersonic gas flow. The effect of the nonequilibrium of three-dimensional flow on the shape of the shock wave attached to the leading edge, pressure distribution, and the force and moment characteristics of the wing is discussed. Results of numerical calculations are presented. V.L.

A85-34011#
REYNOLDS NUMBER AND FAN/INLET COUPLING EFFECTS ON SUBSONIC TRANSPORT INLET DISTORTION
D. L. MOTYCKA (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 229-234. Previously cited in issue, 03, p. 3, Accession no. A85-13562.

A85-34012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION OF ROTATING STALL BY THE VORTEX METHOD
P. R. SPALART (NASA, Ames Research Center, Computational Fluid Dynamics Branch, Moffett Field, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 235-241. refs
The vortex method, coupled to a boundary-layer solver, is applied to the numerical simulation of high Reynolds number incompressible flow in two-dimensional cascades. Periodic conditions are imposed along the plane of the cascade, with several blades per period. Good agreement is found with two finite-difference methods for a single-blade case. When a staggered cascade is treated with five independent blades, the simulation predicts rotating stall, for a range of angles of attack and stagger, and the essential features of the flow are correct. The stall cell steadily propagates along the cascade. The sensitivity of this phenomenon to two parameters is studied, and the stall boundary is found. Quantitative results and visualizations are presented. Author

A85-34273
NONLINEAR CONICAL FLOW
B. M. BULAKH (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) Delft, Netherlands, Delft University Press, 1985, 337 p. Translation. refs
The present book provides an impressively complete description of the analytical techniques which could be used to understand and to study nonlinear flows of compressible fluids past conical bodies. General properties and some particular types of conical flow are discussed, taking into account spherical coordinates, Cartesian coordinates, generalized spherical coordinates, irrotational flows, hodograph transformation, the characteristic equations for conical flows, shock waves, the axially symmetric flow around a circular cone, transonic flow around cones, axisymmetric conical flows, flow around pyramidal bodies, conical simple waves, and singular points in solutions of the equations for conical flow. Subjects related to supersonic conical gas flows are explored, giving attention to flow around conical bodies, lying completely inside the Mach cone of the undisturbed flow, and to flows around conical bodies, lying outside the Mach cone of the undisturbed flow. Hypersonic conical flows of a gas are also considered. G.R.

A85-34379
CONFIGURATION OF A SHOCK WAVE INTERACTING WITH A CENTERED COMPRESSION FAN
A. S. VOINOVSKII and V. I. KIREEV (Moskovskii Aviatsionnyi Institut, Moscow, USSR) (Pis'ma v Zhurnal Tekhnicheskoi Fiziki, vol. 10, July 12, 1984, p. 796-799) Soviet Technical Physics Letters (ISSN 0360-120X), vol. 10, July 1984, p. 334, 335. Translation. refs
A classical mathematical model of a steady-state flow is used to examine the interaction of a shock wave (alpha) with a compression fan (beta) in the field of a planar supersonic flow of an ideal gas. The intensity of the resultant wave as a function of the intensities of alpha and beta appears to be a power law at a fixed intensity of alpha. With increasing Mach number of the incoming unperturbed flow the exponent of the dependence approaches one. L.T.

A85-34707

A METHOD FOR PREDICTING UNSTEADY POTENTIAL FLOW ABOUT AN AEROFOIL

M. VEZZA and R. A. MCD. GALBRAITH (Glasgow University, Glasgow, Scotland) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, April 1985, p. 347-356. Sponsorship: Science and Engineering Research Council. refs (Contract SERC-82801965)

It has been recognized that unsteady flow over lifting bodies can produce beneficial effects, such as stall delay. Theoretical and experimental studies have, therefore, been conducted with the objective of improving the performance of turbomachinery, helicopter rotors, and wind turbines. In the present investigation, a method is developed for calcualting the unsteady, incompressible potential flow around an arbitrary airfoil. The method employs a linear distribution of panel vorticity on the airfoil surface and a new procedure of shedding the necessary vorticity into the free stream in the form of discrete vortices. The considered model is based on the steady flow algorithm reported by Leishman and Galbraith (1981). The method predicts fully attached potential flow about an airfoil, but it is inappropriate in cases in which significant viscous effects, e.g., marked Reynolds number dependence and separation, are present. G.R.

A85-34735

COMPUTATION OF STEADY SUPERSONIC FLOWS BY A FLUX-DIFFERENCE/SPLITTING METHOD

M. PANDOLFI (Torino, Politecnico, Turin, Italy) Computers and Fluids (ISSN 0045-7930), vol. 13, no. 1, 1985, p. 37-46. Research supported by the Ministero della Pubblica Istruzione of Italy. refs

A 'flux-difference splitting' method has been conceived for the numerical solution of hyperbolic problems and successfully implemented for unsteady flows. It aims to describe the propagation of waves and to respect the domains of dependence. Shock waves are captured numerically very neatly. Here an extension is proposed for the prediction of two-dimensional or axisymmetric steady supersonic flows. Numerical examples are shown to validate the capabilities of the method. Author

A85-34998

THE EFFECT OF FREESTREAM TURBULENCE ON PRESSURE FLUCTUATIONS IN TRANSONIC FLOW

S. RAGHUNATHAN (Belfast, Queens University, Belfast, Northern Ireland) and R. J. W. MCADAM (Short Brothers, Ltd., Belfast, Northern Ireland) Aeronautical Journal (ISSN 0001-9240), vol. 89, March 1985, p. 87-92. refs

Pressure fluctuation measurements were made on an 18-percent thick biconvex aerofoil in the region of shock boundary layer interaction at various levels of free stream flow unsteadiness. Experiments were performed with free transition and transition-fixed models at a shock Mach number of 1.44 and blade chord Reynolds number of 160,000. The transition-free model with a laminar boundary layer showed the presence of periodic flows at low turbulence levels, which disappeared with the increase in turbulence levels. The general effect of free stream turbulence on the transition-fixed model is one of broad band amplification of pressure fluctuation levels in the region of shock interactions. Author

A85-35000

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

D. I. A. POLL (Cranfield Institute of Technology, Cranfield, Beds., England) and D. J. PAISLEY (Canadair, Ltd., St. Laurent, Montreal, Canada; Cranfield Institute of Technology, Cranfield, Beds., England) Aeronautical Journal (ISSN 0001-9240), vol. 89, March 1985, p. 109-117. Research supported by the Ministry of Defence of England. refs

An experimental study has been made of the conditions necessary to produce transition in a swept attachment-line boundary layer which is subjected to disturbances from trip wires of various sizes. The boundary layer considered is that formed on a long, untwisted, tapered wing which has been tested in both the backward swept and forward swept configurations. Results from these tests are compared with previous work on an untapered model. Some important similarities and some puzzling differences have been found. Finally consideration is given to the practical implications of this work. It is suggested that a forward swept wing may be capable of supporting a laminar attachment-line flow at a much higher free-stream Reynolds number than a corresponding swept-back wing. Author

A85-35126#

CALCULATION OF NONLINEAR SUBSONIC CHARACTERISTICS OF WINGS WITH THICKNESS AND CAMBER AT HIGH INCIDENCE

R. GORDON and J. ROM (Technion - Israel Institute of Technology, Haifa, Israel) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 817-825. refs (Contract DA-ERO-78-G-119; AF-AFOSR-80-0064)

A new vortex lattice model for the calculation of the flow over delta-shaped wing planforms at high angles of attack in subsonic flow is presented. This model enables the prediction of the aerodynamic coefficients and the pressure distributions for a wide range of wing planforms, in particular for delta-shaped wings with and without camber. The new vortex lattice model is combined with the panel source singularity for the calculation of the aerodynamic characteristics of thick wings having sharp leading edges. The calculated aerodynamic characteristics are in very good agreement with experimental data, while reasonable agreement is obtained in the evaluation of the pressure distributions. A parametric study of the numerical model and some numerical considerations which enable considerable reduction in computer time are also discussed. Author

A85-35127#

KNUDSEN LAYER CHARACTERISTICS FOR A HIGHLY COOLED BLUNT BODY IN HYPERSONIC RAREFIED FLOW

G. T. CHRUSCIEL and L. A. POOL (Lockheed Missiles and Space Co., Inc., Aerothermodynamics Dept., Sunnyvale, CA) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 826, 827. Abridged. Previously cited in issue 14, p. 1970, Accession no. A83-32703. refs

A85-35129#

COMPARISON OF INVISCID AND VISCOUS COMPUTATIONS WITH AN INTERFEROMETRICALLY MEASURED TRANSONIC FLOW

P. J. BRYANSTON-CROSS and W. N. DAWES (Cambridge University, Central Electricity Generating Board, Whittle Laboratory, Cambridge, England) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 834-839. Research supported by the Ministry of Defence (Procurement Executive). refs

In order to provide an experimental test case for use with the computer simulation of transonic flowfields, the transonic flow around a wedge profile in a wind tunnel has been measured using holographic interferometry. The quantitative detail provided by the interferogram is compared with the numerical predictions of a two dimensional inviscid time-marching method and a two dimensional Navier-Stokes solver. The a priori Navier-Stokes solution is in agreement with the experimental data. The predictions of the inviscid method can be made to agree with the measurements if the geometrical data used for the computations are modified to represent the presence of the large separated region observed experimentally. Author

A85-35130*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF A SHOCK WAVE IMPINGEMENT ON A CYLINDER

A. BROSH, M. I. KUSSOY, and C. M. HUNG (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 840-846. Previously cited in issue 17, p. 2446, Accession no. A83-37230. refs

A85-35132#
A GENERALIZED DISCRETE-VORTEX METHOD FOR SHARP-EDGED CYLINDERS
P. K. STANSBY (Manchester, Victoria University, Manchester, England) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 856-861. refs

An improved scheme for introducing vortex sheets from the sharp edges of a cylinder represented in an inviscid calculation by the panel method is described. Three edge conditions are satisfied directly through an efficient iterative formulation, while a fourth is satisfied approximately. The cylinder surface is represented only by a vortex sheet and nascent vorticity is also treated as elements of vortex sheet. Vorticity in the wake is handled by the vortex-in-cell method with overlapping meshes for good definition. The method is tested with various shapes which incorporate two shedding edges (an equilateral triangle and a range of rectangles). Author

A85-35135*# Lockheed-California Co., Burbank.
AN AERODYNAMIC THEORY BASED ON TIME-DOMAIN AEROACOUSTICS
L. N. LONG (Lockheed-California Co., Burbank, CA) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 875-882. Previously cited in issue 17, p. 2455, Accession no. A83-38653. refs
(Contract NCC1-14)

A85-35146#
EFFECT OF AMBIENT PRESSURE ON NOZZLE CENTERLINE FLOW PROPERTIES
A. B. BAILEY, L. L. PRICE, and J. G. PIPES (Calspan Field Services, Inc., Space Projects Branch, Arnold Air Force Station, TN) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 953, 954.

It is sometimes assumed, in connection with the expansion of a nozzle flow into a vacuum, that the static pressure across the exit plane is constant at the centerline value. It is presently noted that, for significant reductions in background pressure below the exit plane centerline value, nozzle centerline flow properties are affected. Codes for predicting the expansion characteristics of the nozzle boundary layer into the backflow region of the nozzle should be able to account for ambient pressure nozzle boundary layer interaction effects. O.C.

A85-35148#
THE POSITION OF LAMINAR SEPARATION LINES ON SMOOTH INCLINED BODIES
H. PORTNOY (Rafael Armament Development Authority, Haifa, Israel; Maryland, University, College Park, MD) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 956-958. refs
(Contract N60921-80-C-0154)

The present method for the calculation of laminar separation lines on general, smooth aerodynamic bodies is based on an adaptation of an existing slender body method. Attention is given to the hypothesis that, if a vortex-filament iterative technique is used with the correct separation conditions, and sufficient filaments and segments in each filament are used, the final, iterated filament shapes will lie close to vortex lines of the sheet that the filaments are replacing. O.C.

A85-35149#
TRANSONIC SMALL-DISTURBANCE THEORY FOR DUSTY GASES
F. J. ZEIGLER (Sandia National Laboratory, Albuquerque, NM) and D. A. DREW (Rensselaer Polytechnic Institute, Troy, NY) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 958-960.
(Contract DAAG29-80-C-0041)

Marble (1970) derived a model for the flow of gases containing small dust particles in which the gas and dust exchange heat and momentum. This model is presently applied to transonic small disturbance theory. It is shown that the effect of the dust is to modify the flow in such a way that it is equivalent to the flow of a clear gas at different freestream speed around an airfoil of a different thickness. O.C.

A85-35150#
THE DISCRETE VORTICES FROM A DELTA WING
M. GAD-EL-HAK (Flow Research Co., Kent, WA) and R. F. BLACKWELDER (Southern California, University, Los Angeles, CA; Flow Research Co., Kent, WA) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 961, 962.
(Contract F49620-82-C-0020)

Two large bound vortices generated by leading edge flow separation dominate the flow over delta wings at an angle of attack. The present experimental investigation gives attention to two delta wings with 45- and 60-deg leading edge sweeps that were towed through a deep water channel for flow visualization tests. Attention is given to the leading edge shear layer structure. It is found that the classical large vortices on delta wings originate as a series of smaller vortices shed from the leading edges; these rotate round each other and form larger vortices while moving downstream. O.C.

A85-35152#
PERTURBATIONS OF A TRANSONIC FLOW WITH VANISHING SHOCK WAVES
D. NIXON and G. D. KERLICK (Nielsen Engineering and Research, Inc., Mountain View, CA) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 965-967. refs
(Contract F49620-79-C-0054)

An investigation is conducted into the behavior of transonic perturbation theory for the case where shock waves vanish, so that a 'piece-wise' application of the perturbation theory is made necessary by the discontinuity of the equation set. It is noted that, if the incompressible solutions and one transonic solution are known, the range of transonic solutions can be constructed. O.C.

A85-35153#
UPSTREAM INFLUENCE IN CONICALLY SYMMETRIC FLOW
D. S. DOLLING (Texas, University, Austin, TX) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 967-969. refs
(Contract F49620-81-K-0018)

Experimental upstream influence data in the conically symmetric regime of sharp fin-induced shock wave/turbulent boundary layer interaction are examined, for the cases of adiabatic wall supersonic flows and cold wall, moderately hypersonic flows. The results obtained show that the growth of upstream influence with distance along the shock wave can be expressed as a linear function of the shock wave angle, supporting the idea that such interactions are primarily governed by inviscid mechanisms. O.C.

A85-35155#
MEAN VELOCITY AND STATIC PRESSURE DISTRIBUTIONS IN A THREE-DIMENSIONAL TURBULENT FREE JET
W. R. QUINN (Saint Francis Xavier University, Antigonish Nova Scotia, Canada), A. POLLARD (Queen's University, Kingston, Ontario, Canada), and G. F. MARSTERS (Transport Canada, Ottawa, Canada) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 971-973. Sponsorship: Natural Sciences and Engineering Research Council of Canada. Previously cited in issue 17, p. 2444, Accession no. A83-37185. refs
(Contract NSERC-A-4310)

A85-35202
AERO-OPTICAL TURBULENT BOUNDARY LAYER/SHEAR LAYER EXPERIMENT ON THE KC-135 AIRCRAFT REVISITED
J. E. CRAIG (Spectron Development Laboratories, Inc., Costa Mesa, CA) and C. ALLEN (USAF, Weapons Laboratory, Kirtland AFB, NM) Optical Engineering (ISSN 0091-3286), vol. 24, May-June 1985, p. 446-454. USAF-supported research. refs

Aberrations occurring as a result of the distortion of optical wavefronts are causing severe degradation to airborne astronomical observations, radiation sensing images, and laser beam propagation from aircraft. Studies have been conducted to explore the feasibility of eliminating or alleviating degradation by means of appropriate approaches. Thus, Gilbert (1980) has conducted KC-135 aero-optical turbulent boundary layer/shear layer experiments, while Craig et al. (1984) have examined propagation diagnostic techniques for turbulent transonic flow. The present investigation is concerned with a full-scale experiment which expands on previous wind tunnel and airborne experiments. One of the objectives of the experiment is related to a more accurate quantification of the boundary layer and artificial shear layer effects on optical propagation. Another objective is the comparison and correlation of aerodynamic measurement techniques with an optical diagnostic measurement technique. Experimental data are compared with theoretical relations for varying optical apertures. G.R.

A85-35260
DETERMINATION OF FORWARD EDGE EDDIES IN DELTA WINGS [BERECHNUNG VON VORDERKANTENWIRBELN AN DELTAFLUEGELN]
P.-M. HARTWICH Aachen, Rheinisch-Westfaelische Technische Hochschule, Fakultaet fuer Maschinenwesen, Dr.-Ing. Dissertation, 1983, 76 p. In German. Sponsorship: Deutsche Forschungsgemeinschaft. refs
(Contract DFG-SFB-25)

The incompressible flow around delta wings is studied by numerical integration of the full Navier-Stokes and Euler equations using finite volume technique. A square domain of integration surrounding the flat, infinitesimally thin wings is used for the flow field and is described by Cartesian coordinates attached to the wings. The equations of conservation are given in nonconservative form for primitive variables, and the equation of continuity is formulated as a compatibility condition. With increasing Reynolds number, numerical instabilities occur which can be eliminated by the inclusion of damping factors. The effect of such artificial damping on the differential solution is extensively discussed using the Burger equation as an example. The behavior of the differential solution of the Euler equations in the region of singularity is examined. The results show that the eddy formation at a sharp forward edge in laminar flow can be numerically simulated. C.D.

A85-35500
AN EXPERIMENTAL INVESTIGATION OF THE AERODYNAMICS OF NOZZLE FLOW IN A RECTANGULAR PASSAGE [EKSPERIMENTAL'NOE ISSLEDOVANIE AERODINAMIKI POTOKA V SOPLAKH, RASPOLOZHENNYKH V PRIAMOUGOL'NOM KANALE]
A. A. KHALATOV, V. N. VELICHKO, and V. S. TSVIKLIS (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian, SSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 7, no. 2, 1985, p. 13-15. In Russian.

The rates of airflow inside two two-dimensional converging nozzles in the rectangular passage of an aerodynamic tube have been determined experimentally. A complete list of the flow rates is given. It is shown that flow characteristics inside the nozzles (maximum flow cross section, flow density) were related to concurrent flow characteristics. I.H.

A85-35577#
THRUST REVERSER EFFECTS ON FIGHTER AIRCRAFT AERODYNAMICS
A. GLEZER, R. V. HUGHES, and B. L. HUNT (Northrop Corp., Aircraft Div., Hawthorne, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 455-461. Research supported by the Northrop Independent Research and Development Program. Previously cited in issue 17, p. 2457, Accession no. A84-38687. refs

A85-35579#
GRID GENERATION FOR WING-TAIL-FUSELAGE CONFIGURATIONS
A. SHMILOVICH (Douglas Aircraft Co., Long Beach, CA; Cornell University, Ithaca, NY) and D. A. CAUGHEY (Cornell University, Ithaca, NY) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 467-472. refs
(Contract N00014-77-C-0033)

An efficient procedure for generating boundary-conforming coordinate systems for three-dimensional wing-tail-body combinations is presented. A sequence of conformal and shearing transformations is employed to yield a slotted and nearly orthogonal computational domain and the resultant grid is nearly orthogonal almost everywhere. Computational grids for several realistic configurations are shown to illustrate the capability of the mesh generation procedure. The method is computationally more efficient than a number of other grid generation techniques, i.e., numerical methods or algebraic procedures; it allows for the control of orthogonality and requires less computational effort than one sweep of a transonic potential flow solver. Author

A85-35580*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ASSESSMENT OF PRELIMINARY PREDICTION TECHNIQUES FOR WING LEADING-EDGE VORTEX FLOWS AT SUPERSONIC SPEEDS
R. M. WOOD and D. S. MILLER (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 473-478. refs

A theoretical investigation of the aerodynamics of sharp leading-edge delta wings at supersonic speeds has been conducted. The primary objective of this was to determine the applicability of existing theoretical methods to predict wing leading-edge separated-flow characteristics at conditions conductive to high-lift supersonic flight. Predicted results from two modified linear-theory methods (LTSTAR and VORCAM) are compared with experimental data. Comparison of the two methods for uncambered wings revealed that the LTSTAR code is in much better agreement with experimentally measured vortex strength, vortex position, and total lifting characteristics than the VORCAM code. Selected analysis was also performed with an Euler code, SWINT. The results of this study indicated that the SWINT code was not well suited to the analysis of wings with separated flow at high lift and low supersonic speeds. Author

A85-35581*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FUNDAMENTAL AERODYNAMIC CHARACTERISTICS OF DELTA WINGS WITH LEADING-EDGE VORTEX FLOWS
R. M. WOOD and D. S. MILLER (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 479-485. refs

An investigation of the aerodynamics of sharp leading-edge delta wings at supersonic speeds has been conducted. The supporting experimental data for this investigation were taken from published force, pressure, and flow-visualization data in which the Mach number normal to the wing leading edge is always less than 1.0. The individual upper- and lower-surface nonlinear characteristics for uncambered delta wings are determined and presented in three charts. The upper-surface data show that both the normal-force coefficient and minimum pressure coefficient increase nonlinearly with a decreasing slope with increasing angle of attack. The lower-surface normal-force coefficient was shown to be independent of Mach number and to increase nonlinearly, with an increasing slope, with increasing angle of attack. These charts are then used to define a wing-design space for sharp leading-edge delta wings. Author

A85-35582*# Texas A&M Univ., College Station.
DESIGN PARAMETERS FOR FLOW ENERGIZERS
D. T. WARD and R. S. BINFORD (Texas A & M University, College Station, TX) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 486-489. Research supported by Texas A & M University. Previously cited in issue 03, p. 3, Accession no. A85-13570. refs
(Contract NAG1-344)

A85-35583*# Vigyan Research Associates, Inc., Hampton, Va.
AN INVESTIGATION OF THE TABBED VORTEX FLAP
K. D. HOFFLER and D. M. RAO (Vigyan Research Associates, Inc., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 490-497. NASA-supported research. Previously cited in issue 21, p. 2988, Accession no. A84-44197. refs

A85-35584#
TRANSONIC SHOCK INTERACTION WITH A TANGENTIALLY INJECTED TURBULENT BOUNDARY LAYER
G. R. INGER (Iowa State University of Science and Technology, Ames, IA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 498-502. Previously cited in issue 06, p. 704, Accession no. A84-17877. refs
(Contract NR PROJECT 061-274)

A85-35586#
APPLICATION OF THE SINGLE-CYCLE OPTIMIZATION APPROACH TO AERODYNAMIC DESIGN
M. H. RIZK (Flow Industries, Inc., Research and Technology Div., Kent, WA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 509-515. Research supported by Flow Industries, Inc. Previously cited in issue 21, p. 2988, Accession no. A84-44193. refs

A85-35587*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AXISYMMETRIC BLUFF-BODY DRAG REDUCTION THROUGH GEOMETRICAL MODIFICATION
F. G. HOWARD and W. L. GOODMAN (NASA, Langley Research Center, High-Speed Aerospace Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 516-522. refs

The effect of shoulder radiusing and grooving (longitudinally and circumferentially) the afterbodies of bluff bodies to reduce the base drag at low speeds is investigated experimentally. Shoulder radii as large as 2.75 body diameters are examined. Reynolds number (ReD) based on body diameter varied from 20,000 to 200,000. Results indicate that increasing the shoulder radius to 2.00 body diameters can reduce the drag levels to those of a streamline body having 67 percent greater fineness ratio. For the relatively sharp shoulder case, body drag reductions as large as 50 and 33 percent are obtained using circumferential or longitudinal grooves, respectively. Author

A85-35590*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SCALE-MODEL TESTS OF AIRFOILS IN SIMULATED HEAVY RAIN
E. C. HASTINGS, JR. and G. S. MANUEL (NASA, Langley Research Center, Low-Speed Aerodynamics Div., Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 536-540. Previously cited in issue 07, p. 1859, Accession no. A85-19618. refs

A85-35591#
AN INVERSE BOUNDARY ELEMENT METHOD FOR SINGLE COMPONENT AIRFOIL DESIGN
E. SAINNE (Saab-Scania Aerospace Co., Linkoping, Sweden; Helsinki University of Technology, Espoo, Finland) and S. LAINE (Helsinki University of Technology, Espoo, Finland) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 541-543. Research supported by the Academy of Finland. refs

The design problem posed by the determination of an airfoil contour that corresponds to a prescribed velocity distribution is presently considered for the case of single component airfoils in inviscid incompressible flow. In the stream function method employed, an integral equation is formed for the stream function describing the flow. A straight line element with linearly varying vortex density is used, with control points being placed exactly on the airfoil contour. O.C.

A85-35742#
A FAST ALGORITHM OF THE FINITE DIFFERENCE METHOD FOR COMPUTATION OF THE TRANSONIC FLOW PAST AN ARBITRARY AIRFOIL WITH THE CONSERVATIVE FULL-POTENTIAL EQUATION
H. MINGKE (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 19-24. In Chinese, with abstract in English. refs

Based on the methods developed by Jameson and Holst, a computer program has been developed for computation of the transonic flow past an arbitrary airfoil by the finite difference method. A conformal mapping is applied to map the exterior of the airfoil onto the interior of a circle. By a radial transformation reducing the effects of the singularity at the center of the circle, the use of the perturbation velocity potential is avoided. The governing equation simpler than those used by Jameson and Holst is approximated by a finite difference equation, which is then solved by AF2 iteration scheme in computing plane. The computations of the pressure distribution over the airfoil of NACA 0012 for subcritical and supercritical cases show the results in excellent agreement with those by Holst's method. Author

A85-35743#
A MIXED FINITE DIFFERENCE ANALYSIS OF THE INTERNAL AND EXTERNAL TRANSONIC FLOW FIELDS OF INLETS WITH CENTERBODY
S. LUO, H. SHEN, M. JI, Z. XING (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China), S. DONG, and A. HAN (Ministry of Astronautics Industry, 31st Institute, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 25-34. In Chinese, with abstract in English. refs

A mixed finite difference method for calculating the external and internal flow fields around an inlet with a centerbody is presented. The velocity potential equation with a small disturbance in the transverse direction is solved using Cartesian mesh, and irrotational schemes and exact body surface boundary conditions are treated in order to obtain a basic field solution including the shape and location of the shock and the sonic line. Then, the full potential equation is used to improve the accuracy of the computed value of the field variables. The use of multilayer line relaxations along radial lines is effective for an inlet with centerbody, more relaxation sweeps being carried out inside the inlet than outside. Computations have been performed for axisymmetric inlets with different freestream Mach numbers. The results show that the method is promising. C.D.

A85-35747#
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO BLUFF CYLINDERS AND CONES IN HYPERSONIC RAREFIED GAS FLOW
W. HUA Acta Aerodynamica Sinica, no. 2, 1984, p. 61-65. In Chinese, with abstract in English. refs

The report presents an experimental investigation of heat transfer to bluff cylinders and a sharp 10-deg half-angle cone at an angle of attack of 0 deg. The study was conducted in a low-density, hypersonic wind tunnel. Stagnation point and surface heat transfer data are obtained over a range of test conditions: Mach numbers at 12 and 24, unit Reynolds numbers from 1000 to 7000 per centimeter. The approximation formulas of the heat transfer are set up in rarefied transitional regimes. Comparisons are made to previously published experimental results and calculations from these approximation formulas. Author

A85-35749#

AN ITERATION PANEL METHOD FOR PREDICTING THREE DIMENSIONAL SURFACE PRESSURE DISTRIBUTION OF A WING WITH THICKNESS IN THE SUBCRITICAL STEADY TRANSONIC FLOW

B. TONG, L. ZHUANG (University of Science and Technology of China, Hefei, People's Republic of China), and X. LI (Institute of Space Technology of China, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 73-77. In Chinese, with abstract in English. refs

An Iteration Panel Method for solving the nonlinear small-disturbance potential equation in subcritical near-sonic flow past any 3-D symmetrical wing with thickness is presented. Here the local linearization assumption reduces the nonlinear problem to a local linear one, and then the iteration procedure based on the panel method gives approaching values of surface local Mach number and pressure distributions with good accuracy. A pressure modification factor based on the ratio of Karman-Tsien formulae and Prandtl-Glauert formulae has been introduced to accelerate the iteration process. Author

A85-35751#

A METHOD FOR THE ESTIMATION OF JET INTERFERENCES

G. HUANG (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 83-86. In Chinese, with abstract in English. refs

An engineering estimation method is presented and used to calculate jet effects on subsonic afterbody drag. In the method, a line distribution of sinks is used to represent jet entrainments, and a line distribution of sources is used to represent plume effects. Overestimations of plume effects may have to be corrected for in a semiempirical way. This is done by first deducing the correlation between jet solidity and jet-to-free stream velocity ratio using image theory in an incompressible flow. The correlation is then used to correct the plume effects. C.D.

A85-35755#

A LOCALLY LINEARIZED PANEL METHOD FOR TRANSUBSONIC FLOW PAST AN OSCILLATING WING

B. TONG, L. ZHUANG (University of Science and Technology of China, Hefei, People's Republic of China), and X. LI (Ministry of Aerospace Industry, Computation Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 20-27. In Chinese, with abstract in English. refs

The local linearization concept is employed to formulate the downwash integral equation for a small-perturbation transonic potential flow past an oscillating wing. A method is described for calculating the transonic and subsonic kernel functions; a generalized doublet-lattice method is then used to determine the unsteady pressure on an oscillating rectangular wing for both the transonic and subsonic flows. Graphs are included for $M = 0.7$ and 0.8. The analysis demonstrates the accuracy of the locally linearized panel method to be superior to that of the conventional linearized methods. L.T.

A85-35756#

TRANSONIC PRESSURE DISTRIBUTION COMPUTATIONS OF A FLEXIBLE WING

K. SHEN and X. ZHANG (Shanghai Aviation Industry Corp., Shanghai, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 28-33. In Chinese, with abstract in English. refs

An iteration method is used for computing the transonic pressure distribution on a flexible wing. The aerodynamic force is solved with the second order approximation method for transonic small disturbance potential flow. The structural deflection is computed using the one-dimensional simple beam theory or a two-dimensional flexibility matrix method. The typical computations for M6 flexible wing indicate that the iteration number for flexible wing computation is only slightly more than that for rigid one, and that the influences of the structural deflection on the airload and shock strength are important. Author

A85-35757#

ON RELAXATION OF TRANSONIC FLOWS AROUND ZERO-LIFT AIRFOIL AND CONVERGENCE OF SELF-CORRECTING WIND TUNNELS

X. LIU and S. LUO (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 34-41. In Chinese, with abstract in English.

With the assumption of small transverse velocity components, the steady transonic potential flow around a symmetric airfoil at a zero angle of attack is computed by the mixed difference method. After some numerical experiments on the stability of various possible schemes of iteration in the relaxation, a stable scheme is found and is used to verify the convergence of two kinds of transonic self-correcting wind tunnels which are based on the pressure distributions along two control surfaces, and one control surface and the airfoil. Author

A85-35762#

A CALCULATION METHOD OF GROUND EFFECTS FOR THE AIRCRAFT

Z. CHEN (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 92-97. In Chinese, with abstract in English.

The influence of ground proximity on the aerodynamic characteristics of a low-flying aircraft are investigated using the finite element analysis for linear and nonlinear boundary conditions. The analysis covers the cases of two-dimensional and three-dimensional wing and the wing-body-tail combinations and takes into consideration flap and elevator deflections. The results agree well with experimental data and previous theoretical results. It is concluded that errors, introduced if linear boundary conditions are used in the lifting line theory, can be eliminated by using nonlinear boundary conditions and the lifting surface theory. L.T.

A85-35763#

ON DETACHED SHOCK WAVE OF SPHERE MOVING WITH TRANSONIC VELOCITIES

Z. ZHENG (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 98-103. In Chinese, with abstract in English. refs

Based on experimental data an expression for the shock wave profiles of a sphere moving at transonic velocities is presented; the polar form of the equation describes the dimensionless value of shock detachment distance in terms of the freestream Mach number. It is also noted that the equation can be extended to calculate profiles of of shock wave for the case of a hemisphere-cylinder and cones blunted spherically at a half-angle of less than 8 deg. In addition, the results can be applied to studies of wall disturbances and of the flow field in the test section of a transonic wind tunnel. L.T.

A85-35764#

FINITE DIFFERENCE COMPUTATION OF THE FLOW AROUND AIRFOILS IN TWO-DIMENSIONAL TRANSONIC SLOTTED WALL WIND TUNNEL

N. ZHANG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 104-109. In Chinese, with abstract in English. refs

On the basis of a two-dimensional small-disturbance velocity potential equation, the transonic flow around NACA 0012 and RAE 104 airfoils in a slotted wall transonic wind tunnel is computed using the finite difference method. The parameters determined include the solid blockage interference at a zero angle of attack, pressure distributions on the airfoil surface and on the wall slotted in the streamwise direction, and the additional lift coefficient due to an asymmetrical setup of the model in the tunnel test section. Good agreement with available experimental results is noted to exist. L.T.

A85-35765#
ADVANCES IN THE STUDY OF SEPARATED FLOWS
F. ZHUANG (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) and H. ZHANG (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 1-9. In Chinese, with abstract in English. refs

The numerical simulation of separated flows is reviewed and problems needing further study are indicated on the basis of a Navier-Stokes model. An application of differential topology to qualitative analysis of flow fields is described. The connection between three-dimensional separation and vortex production is discussed. Author

A85-35766#
SOME PROBLEMS IN DISCRETE VORTEX NUMERICAL MODELLING ON VORTEX MOTION BEHIND A CIRCULAR CYLINDER
G. LING (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 10-14. In Chinese, with abstract in English. refs

A review of some aspects in discrete vortex numerical modelling on unsteady flow and vortex motion behind a circular cylinder is presented. Consideration is given to (1) the discrete method and the stability of the motion of the vortex sheet, (2) boundary layer separation and the nascent discrete vortices' positions, (3) the secondary vortices problem, and (4) the reduction of circulation of vortices in the wake. Some further works are also indicated. Author

A85-35767#
NONLINEAR WAVES THEORIES IN VORTEX FLOW
H. MA (University of Science and Technology of China, Hefei, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 15-20. In Chinese, with abstract in English. refs

The current development of nonlinear waves theories in vortex flow is briefly reviewed. The self-induced motion of a single vortex line, the axisymmetric long-wave model of vortex breakdown and the propagation of a non-axisymmetric disturbance along the vortex core are discussed. Author

A85-35768#
A CALCULATION OF SLENDER DELTA WING WITH LEADING-EDGE SEPARATION BY QUASI-VORTEX-LATTICE METHOD
S. XIONG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 21-26. In Chinese, with abstract in English. refs

The Quasi-Vortex-Lattice method (QVLM) which was used calculating the thin wing without separation has been exended to calculate the slender delta wing with leading-edge separation. The advantage of this method is that the leading-edge boundary condition can be exactly satisfied. It can be used to predict aerodynamic characteristics of wings having partial leading-edge separation. A calculation has been made here for a slender delta wing with complete leading-edge separation and the results are compared with the experimental data. The comparison shows that QVLM can give satisfactory or reasonable results. Author

A85-35769#
CALCULATION OF THE FLOW AROUND THICK WINGS WITH SEPARATION VORTICES
P. ZHU (Chinese Academy of Sciences, Institute of Computer Technology, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 27-33. In Chinese, with abstract in English. refs

A panel method predicting the nonlinear aerodynamic loads on thick wings with separation vortices is developed. The model employed is simple and visual. The method can be used for arbitrary planform wings with different profiles. A planar quadrilateral panel and a panel that consists of a parallelogram and four triangles are used. In order to obtain a high accuracy, the wing is represented by piecewise continuous quadratic doublet sheet distributions. The aerodynamic loads on a rectangular wing and on a sweepback wing are computed, and are found to agree well with experimental tests and other theories. Author

A85-35771#
THE SPLIT-COEFFICIENT MATRIX METHOD FOR SUPERSONIC THREE DIMENSIONAL FLOW
L. ZHANG and X. SHAN (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 41-47. In Chinese, with abstract in English.

The split coefficient matrix (SCM) finite-difference method for solving an inviscid steady supersonic flow over a nonsymmetrical body is presented. This method is based on the mathematical theory of characteristics. In the SCM approach, the coefficients are split according to the sign of the characteristic slopes. Forward differences are associated with negative characteristic slopes, while backward differences are associated with positive slope values. A numerical example of the blunt sphere-cones has been worked out to demonstrate good accuracy of SCM in rare mesh. Author

A85-35773#
AN EXPERIMENTAL INVESTIGATION OF FLAP TURBULENT HEAT TRANSFER AND PRESSURE CHARACTERISTICS IN HYPERSONIC FLOW
R. GAO (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 56-60. In Chinese, with abstract in English.

Experimental results of flap heat transfer and pressure characteristics on a blunt cone in a shock tunnel are presented. Effects of flap deflection angle, angle of attack, Mach number, and unit Reynolds number are discussed. Results have shown that the flap deflection angle and Mach number are decisive factors, which considerably affect the flap heating, pressure characteristics, and control effectiveness. A correlation between peak heating and peak pressure, and an empirical formula for estimating peak heating are given. Author

A85-35774#
LDA MEASUREMENTS FOR LEADING EDGE VORTEX CORE OF A STRAKE-WING
Z. LU (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) and Y. CHENG (Aviation Ministry, Institute No. 304, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 61-65. In Chinese, with abstract in English. refs

The axial velocity distribution along the leading edge vortex core of a strake-wing were measured by means of two-dimensional LDA and a hydrogen bubble technique in a water tunnel. The trajectories of the vortex core and the vortex breakdown point which vary with angles of attack are presented. It is shown that axial velocity distribution at different angles of attack can be fitted with a nondimensional curve, but this is not true downstream of the vortex breakdown point because of a dramatic change of the velocity. Author

A85-35775#
AN EXPERIMENT RESEARCH OF BOUNDARY LAYER CONTROL TECHNIQUE FOR MULTI-COMPONENT AIRFOILS
J. WANG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 66-69. In Chinese, with abstract in English.

Some research results of boundary-layer control on the wall of a two-dimensional low-speed wind tunnel with a blowing system are described. In the experimental research the airfoil models with single and double slotted trailing edge flaps were adopted. The boundary-layer control is a very effective method to prevent the premature flow separation in the junction corner between the tunnel wall and the airfoil model, and to get rid of the three-dimensional effect for single or multi-component airfoil research. Some of the contrast research results are given by figures, and the selection of the blowing quantity and the disposition of the blowing slots are described. Author

A85-35777#

NUMERICAL CALCULATION OF SEPARATION FLOW OVER SEVERELY INDENTED BLUNT BODY

S. GAO and G. GU (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 75-78. In Chinese, with abstract in English. refs

A time-dependent space-factored implicit numerical procedure solving simplified Navier-Stokes equations is used to calculate an axisymmetric hypersonic viscous flow over a severely indented blunt body. A simple algebraic turbulent model is adopted. The results are compared with another numerical solution by Kutler et al. (1978). A good agreement is found for the wall pressure and heating distribution, although there is some discrepancy for the flow structure. A secondary separation bubble is seen clearly in laminar numerical results, and high-frequency oscillation phenomena are found to be the same as that in the turbulent calculation by Rakich et al. (1978). Author

A85-35778#

AN IMPLICIT TECHNIQUE FOR COMPUTATION OF BASE FLOWFIELD

C. DONG (Beijing Institute of Information and Control, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 79-83. In Chinese, with abstract in English. refs

A new noniterative implicit scheme for computation of the base flowfields are presented. The new implicit scheme for solution of Navier-Stokes equations, based on the SCM technique, is developed by Steger and Warming (1980), for the solution of Euler equations and some properties of the algorithm analogous to the MacCormack algorithm (1981). Unlike usual implicit schemes, the present algorithm does not require the solution of a block tridiagonal system, because it leads to block bidiagonal systems. Numerical results indicate improvement in accuracy for the circulation-region. Furthermore, the computer time required to obtain a converged solution is reduced. Author

A85-35782#

A NUMERICAL STUDY OF THE SEPARATION FLOW BY NAVIER-STOKES EQUATION PAST A CIRCULAR CYLINDER AND SPHERE

D. DU and J. LI (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 98-101. In Chinese, with abstract in English.

The numerical solution of the steady incompressible viscous flow by a Navier-Stokes equation is discussed. In the case of a circular cylinder, the finite-difference method and the over-relaxation technique are used to solve the problem by iteration. As for a sphere, the Galerkin method is used. Quantities of interest, such as the separation angle and the wake length, are computed. Author

A85-35783#

THE SEPARATION CRITERIA AND FLOW BEHAVIOR FOR THREE-DIMENSIONAL STEADY SEPARATED FLOW

H. ZHANG (China Aerodynamic Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 1-12. In Chinese, with abstract in English. refs

In this paper, the separation criterion and the flow behavior near the separation line are explored for steady three-dimensional viscous flows. The separation (or attachment) criterion is presented. It is proved that the separation line (or attachment line) is a limiting streamline on the wall, the neighboring limiting streamlines are convergent to separation line (or are divergent to attachment line), and that the separation line is not the envelope of limiting streamlines for the flows described by NS equations. In addition, the forms for flow separation, the behavior of the singularity points on the separation line, and problems of deciding separation line are discussed. Author

A85-35784#

THE AERODYNAMICAL CALCULATION OF THE WING SECTION WITH SEPARATION

Z. ZHU, B. CHEN, and B. ZHANG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 13-21. In Chinese, with abstract in English. refs

A computational method of the flow around the wing section with separation is presented in this paper. The vortex sheet is used to simulate the separation wake. The strength of the vortex sheet is rationally selected. A 'equivalent body' is formed by this vortex sheet with the attached flow region of the wing section. An iterative solution of the viscous/inviscid interaction is used for this 'equivalent body'. The position of the separation point and the shape of the separation wake are simultaneously determined in the iterative procedure. Two typical wing sections have been calculated. The agreement of the computational results with the experimental data is fairly good. Author

A85-35787#

AN EXPERIMENTAL STUDY OF THE BEHAVIOR OF 3D-TURBULENT BOUNDARY LAYER IN AND OUT OF THE SEPARATION REGION AT WING-PLATE JUNCTION

D. XIN and X. DENG (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 39-48. In Chinese, with abstract in English. refs

An experimental study of the behavior of 3D-turbulent boundary layer in and out of the separation region at wing-plate junction has been carried out at low and subsonic speeds. The measurements at ten stations located on two lines for the low speed tests and at two stations with one in and the other outside the separation region for the subsonic speed tests were arranged in order to get some fuller information about the distributions of three mean velocities and six turbulent stresses normal to the flat plate. The results show that the skew-induced 'horse-shoe' vortex formed in the separation region plays an important role in influencing the turbulent behavior there. The method for processing data and the analysis of the experimental results including the effects of pressure gradient and curvature of streamline are also discussed. Author

A85-35788#

THE EFFECT OF WINGLET ON THE SPATIAL VORTEX OF SLENDER BODY AT HIGH ANGLE OF ATTACK

Z. WANG and G. WU (Nanjing Aeronautical Institute, Nanjing, Jiangsu, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 49-53. In Chinese, with abstract in English. refs

An experimental investigation of the effect of winglet on the spatial vortex of a slender body at high angle of attack is presented. This investigation clearly shows the circulation of the body vortex is minimized by the winglet and the vortex position is lower than that without winglet, so that the asymmetric problem can be solved. The method of fluorescent minituft has been used. Author

A85-35791#

THE STUDY ON THE WING LEADING EDGE VORTEX BREAKDOWN

B. LIN (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 68-74. In Chinese, with abstract in English. refs

Experimental results on vortex breakdown types, the construction of the breakdown region, and vortex breakdown over wings are discussed. Vortex breakdown phenomena since 1957 visualized in a tube and over wings are summarized. The difference in breakdown construction between tube vortex and the separated vortex of wings is examined, and complex factors affecting the wing leading edge vortex breakdown are pointed out. Current breakdown theory is studied in terms of its three branches: finite transition theory, hydrodynamic instability theory, and vortex core mode. Some interesting problems are posed, and a calculative result for slender delta-wing breakdown is presented. C.D.

A85-35792#
NUMERICAL ANALYSIS OF A 3-D SEPARATED FLOW
Y. MA (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 75-79. In Chinese, with abstract in English.

A one-step difference scheme approximating Navier-Stokes equations was previously used to solve three dimensional shock wave and boundary layer interaction problem. In this paper the computed results are analyzed. Details of the results are depicted. The flow is separated with M = 2.94 over flat plate with 10 deg half-angle wedge standing vertically on the plate. The computed results show that the profile, the projection of the velocity vector in the shock plane in the direction parallel to the bottom wall, as a function of y possesses break or departure form. This is because of spiral motion in the interaction region and progressively thinner boundary layer thickness in the higher pressure region behind the shock. Author

A85-35795#
A METHOD COMPUTING VISCOUS/INVISCID INTERACTION WITH LAMINAR SEPARATION
J. M. WU (Tennessee, University, Knoxville, TN) and Z. CHEN (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 89-95. In Chinese, with abstract in English. refs

Based on the viscous/inviscid interacting model and the integral boundary layer equations, equations for two and three dimensional incompressible laminar viscous/inviscid interaction are formulated which can be used for mild separation and reattachment cases. The computation method and examples are given. The two dimensional solutions agree with available computational and experimental results. The simplicity in formulation and rapidity of calculation make the present method very attractive in dealing with practical problems. Author

A85-35810
FUNDAMENTALS OF TRANSONIC FLOW
T. H. MOULDEN (Tennessee, University, Tullahoma, TN) New York, Wiley-Interscience, 1984, 346 p. refs

Flow phenomena in transonic aerodynamics are largely dominated by viscous forces, are time-dependent to various degrees, and in virtue of admitting shock waves must be described by nonlinear equations even under the small disturbance assumption. After an overview of gas dynamics, attention is given to small disturbance theory in recognition of the fundamental insights afforded into the transonic regime by it; the influence of viscous forces is then considered, together with the stochastic processes relating to turbulence and shock wave-turbulence interactions. O.C.

A85-35881
AERODYNAMIC HYSTERESIS IN STATIONARY SEPARATED FLOW PAST ELONGATED BODIES [AERODINAMICHESKII GISTEREZIS PRI STATSIONARNOM OTRYVNOM OBTEKANII UDLINENNYKH TEL]
M. G. GOMAN, S. B. ZAKHAROV, and A. N. KHRABROV (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovski, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 282, no. 1, 1985, p. 28-31. In Russian. refs

Separated flow past a conical combination of a delta wing and a fuselage is investigated theoretically assuming the fixed nature of separation lines at the sharp edges of the wing, the absence of separations at the fuselage, the stationary character and the conicity of the separated flow, and the nonviscous global nature of the flow. By using this formulation, symmetrical and nonsymmetrical solutions are obtained for the separated flow problem, and the stability of the solutions is analyzed. Based on the solutions obtained, an explanation is proposed for the effect of aerodynamic hysteresis. V.L.

A85-36335
FINITE ELEMENT SOLUTION OF NON-VISCOUS FLOWS IN CASCADES OF BLADES
M. FEISTAUER (Karlova Universita, Prague, Czechoslovakia) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 191-T 194.

Irrotational incompressible and subsonic compressible flows through cascades of profiles in a layer of variable thickness are studied numerically on the basis of a stream function formulation under trailing conditions, more suitable for practical applications than the previously considered circulation of velocity. The approach is applied to a cascade of ellipses, with the inlet angle of 45 deg and triangulation formed by 690 vertices and 1232 triangles. L.T.

A85-36339
VISCOUS INFLUENCE IN AXISYMMETRIC LAMINAR SUPERSONIC FLOW OVER BLUNT BODIES
B. MUELLER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Theoretische Stroemungsmechanik, Goettingen, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschfift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 216-T 218. Research supported by the Deutsche Forschungsgeminschaft. refs

A comparison is made between numerical steady-state solutions of Euler and Navier-Stokes equations in the thin-layer approximation of sphere-cone and hemisphere-cylinder shape in order to study viscous effects in an axisymmetric laminar supersonic flow over blunt bodies. The analysis covers freestream Mach numbers between 1.2 and 20.3 and freestream Reynolds numbers of O(100,000). It is found that at supersonic Mach numbers and high Reynolds numbers, the viscous effects on the shape of the shock, on the sonic line location, and on the surface pressure are small, increasing with the viscous interaction parameter for hypersonic flows. The influence of the separation bubble behind the transition from the hemisphere to the cylinder is also investigated. L.T.

A85-36340
THEORETICAL DETERMINATION OF PRESSURE COEFFICIENT CP ON DOUBLE WEDGED DELTA WING AND ITS AGREEMENT WITH EXPERIMENTAL RESULTS
A. NASTASE, A. BOZINIS, and R. BERTING (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 220-T 222. refs

The pressure, lift, and pitching moment coefficients of a double-wedged delta wing are determined using the solution of a three-dimensional linearized boundary problem for the dimensionless axial disturbance velocity. The solution satisfies boundary conditions on the wing, at the infinity (forward), and on the characteristic Mach cone of the apex of the wing. To find the presure coefficients on the rear region of the wing, a smoothed approximation of the wing surface was introduced. The theoretical predictions are compared with experimentally obtained data and are noted to show good agreement. L.T.

A85-36341
VALIDITY OF SOLUTION OF THREE-DIMENSIONAL LINEARISED BOUNDARY VALUE PROBLEM FOR AXIAL DISTURBANCE VELOCITY U, IN TRANSONIC-SUPERSONIC FLOW
A. NASTASE (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 222-T 225. refs
The validity of the solution of three-dimensional linearized boundary value problem for the dimensionless axial disturbance velocity is verified. The solution satisfies boundary conditions on the wing, at the infinity (forward), and at the characteristic Mach cone at the apex of the wing. The analysis is applied to a delta wing fitted to a central fuselage; dimensionless downwashes of thin and thick symmetrical wing components are given consideration. Experimental data were obtained to verify theoretical results for a wedged delta wing, double-wedged delta wing, fully optimized delta wing, and wedged and cambered rectangular wings for angles of attack ranging from -7 to 7 deg and Mach numbers from 1.25 to 2.2. L.T.

A85-36342
NEAR-SONIC SUBSONIC FLOW AROUND A PROFILE - IN PARTICULAR: THE FOOT-POINT STRUCTURE OF A SHOCK AND THE FLOW-REVERSE THEOREM [SCHALLNAHE UNTERSCHALLSTROEMUNG UM PROFILE OHNE ANSTELLUNG INSBESONDERE: FUSSPUNKTLAGE DES STOSSES UND FLOW-REVERSE-THEOREM]
G. SCHNERR and J. ZIEREP (Karlsruhe, Universitaet, Karlsurhe, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 240-T 243. In German. refs
In a blocked transonic wind tunnel, the maximum value of the Mach number of the oncoming flow attains its maximum value for one-dimensional flow. Experiments on two-dimensional flows have produced blocking Mach numbers surpassing this value. This is due to strong accelerations in transonic profiles reducing the boundary layer thickness and increasing the effective cross-section, which reduces the wall interference. In this paper, experimental studies on the reduction of wall interference conducted on five circular arc lune test sections with thickness parameters between 0.06 and 0.14 are reported. The results are compared with theoretical solutions and the near-sonic similarity solution. C.D.

A85-36344
DESIGN OF A TRANSONIC FLOW WITH COMPRESSION SHOCK [ENTWURF EINER TRANSSONISCHEN STROEMUNG MIT VERDICHTUNGSSTOSS]
H. SOBIECZKY and P. NIEDERDRENK (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 248, T 249. In German.
The 'fictive gas' method of Sobieczky, Yu, Fung, and Seebass (1979) for designing shock-free transonic configurations has been used to design shocked flows. The expansion of the shock is demonstrated using a simple example. The flow and shock fields resulting from the calculations are graphically shown. C.D.

A85-36404
MULTIGRID ACCELERATION OF AN ITERATIVE METHOD WITH APPLICATION TO TRANSONIC POTENTIAL FLOW
Z. NOWAK (Warszawa, Politechnika, Warsaw, Poland) and P. WESSELING (Delft, Technicshe Hogeschool, Delft, Netherlands) IN: Computing methods in applied sciences and engineering, VI; Proceedings of the Sixth International Symposium, Versailles, France, December 12-16, 1983 . Amsterdam and New York, North-Holland, 1984, p. 199-217. Research sponsored by the Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek. refs
The full transonic potential equation is solved numerically with the aid of a multigrid method. The multigrid part of the method is completely divorced from the handling of the nonlinearity, which makes the method relatively simple. A brief outline is given of algebraic aspects of multigrid acceleration of iterative methods for linear problems. The potential equation is discretized with the finite volume technique, using the retarded density concept. The physical domain is mapped numerically onto a rectangle. Results are presented for flows around the NACA 0012 airfoil. Author

A85-36415
NUMERICAL METHODS FOR THE TIME DEPENDENT COMPRESSIBLE NAVIER-STOKES EQUATIONS
M. O. BRISTEAU (Institut National de Recherche en Informatique et en Automatique, Rocquencourt, Yvelines, France), R. GLOWINSKI (Paris VI, Universite, Paris, France), B. MANTEL, J. PERIAUX, and P. PERRIER (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) IN: Computing methods in applied sciences and engineering, VI; Proceedings of the Sixth International Symposium, Versailles, France, December 12-16, 1983 . Amsterdam and New York, North-Holland, 1984, p. 565-583. Sponsorship: Direction des Recherches, Etudes et Techniques. refs
(Contract DRET-80-321)
In this paper the numerical solution of the time dependent Navier-Stokes equations for compressible viscous fluids is discussed. Using a finite difference method for the time discretization the solution of the original problem is reduced to that of a sequence of nonlinear steady problems. These problems can be solved by least squares and conjugate gradient methods, once an appropriate space discretization by finite element has been defined. Numerical results which concern flows past airfoils are presented. Author

A85-36675
LARGE CYBER 205 MODEL OF THE EULER EQUATIONS FOR VORTEX-STRETCHED TURBULENT FLOW AROUND DELTA WINGS
A. RIZZI (Flygtekniska Forsoksanstalten, Bromma, Sweden) and C. J. PURCELL (ETA Systems, Inc., St. Paul, MN) Engineering Computations (ISSN 0264-4401), vol. 2, March 1985, p. 63-70. refs
The large-scale numerical simulation of fluid flow is described as a discipline within the field of software engineering. As an example of such work, a vortex flowfield is analyzed for its essential physical flow features, an appropriate mathematical description is presented (the Euler equations with an artificial viscosity model), a numerical algorithm to solve the mathematical equations is described, and the programming methodology which allows us to attain a very high degree of vectorization on the CYBER 205 is discussed. Four simulated flowfields with vorticity shed from wing edges are computed with up to as many as one million grid points and verify the realism of the simulation model. The computed solutions show all the qualitative features that are expected in these flows. The twisted cranked- and-cropped delta case is one where the leading-edge vortex is highly stretched and unstable, displaying ultimately inviscid large-scale turbulent-like phenomena. Author

N85-25173# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.
TRANSONIC PRESSURE DISTRIBUTIONS ON A TWO-DIMENSIONAL 0012 AND SUPERCRITICAL MBB-A3 PROFILE OSCILLATING IN HEAVE AND PITCH
H. TIEBSTEIN and R. VOSS *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 24 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

Steady and unsteady aerodynamic data were measured on 2-d rectangular wings with a NACA 0012 and a supercritical MBB-A3 profile. The tests were performed in the DFVLR Transonic Wind Tunnel in Gottingen. Both wings were oscillated in pitch about the c/4 axis, the wing with the MBB-A3 profile was also oscillated in heave to generate the unsteady aerodynamic pressure data. The purpose of the wind tunnel tests was primarily to measure data for use in the development and assessment of transonic analytical codes. Systematic measurements were performed with respect to Mach number, reduced frequency, incidence and amplitude of oscillation. The test results show clearly the peculiar unsteady behavior of transonic flow, particularly the strong nonlinearities associated with shock and higher incidences. Emphasis is also placed on the higher harmonic parts of unsteady pressure induced by the occurrence of shock. The measured data serve well as a basis for comparison with corresponding theoretical results. Comparisons between measurements and numerical results from the finite difference code LTRAN2 and the field panel code PTRAN2 show fairly good agreement. Most of the results in this presentation were obtained from MBB-A3 profile. M.G.

N85-25174# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL STUDIES OF UNSTEADY TRANSONIC FLOW OVER OSCILLATING AIRFOIL
W. J. CHYU and S. S. DAVIS *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 22 p Jan. 1985 refs Document previously announced as N83-12316
Avail: NTIS HC A14/MF A01 CSCL 01A

A finite difference solution to the Navier-Stokes equations combined with a time varying grid generation technique was used to compute unsteady transonic flow over an oscillating airfoil. These computations were compared with experimental data (obtained at Ames Research Center) which form part of the AGARD standard configuration for aeroelastic analysis. A variety of approximations to the full Navier-Stokes equations was used to determine the effect of frequency, shock wave motion, flow separation, and airfoil geometry on unsteady pressures and overall air loads. Good agreement is shown between experiment and theory with the limiting factor being the lack of a reliable turbulence model for high Reynolds number, unsteady transonic flows. Author

N85-25175# National Aerospace Lab., Amsterdam (Netherlands).
ANALYSIS OF TRANSONIC AERODYNAMIC CHARACTERISTICS FOR A SUPERCRITICAL AIRFOIL OSCILLATING IN HEAVE, PITCH AND WITH OSCILLATING FLAP
R. C. DENBOER and R. HOUWINK *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 15 p Jan. 1985 refs Sponsored in part by Netherlands Agency for Aerospace Programs
Avail: NTIS HC A14/MF A01

An analysis is given of the unsteady aerodynamic characteristics of an oscillating supercritical airfoil with a thickness of 12% chord. Experimental data were obtained in the National Aerospace Laboratory (NLR) pilot tunnel for pitching, heaving and flap rotation, with Mach number, mean incidence, frequency and amplitude as parameters. The influence of these parameters is discussed in physical terms, with special emphasis on flow conditions with shock induced separation and aerodynamic resonance. Both for attached and separated flow, examples are presented of the use of experimental unsteady airloads in flutter computations for a wind tunnel model of a supercritical wing, and in correlation with results of viscous transonic flow computations. M.G.

N85-25176*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Unsteady Aerodynamics Branch.
EXPERIENCE WITH TRANSONIC UNSTEADY AERODYNAMIC CALCULATIONS
J. W. EDWARDS, S. R. BLAND, and D. A. SEIDEL *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 21 p Jan. 1985 refs Document previously announced as N84-32353
Avail: NTIS HC A14/MF A01 CSCL 01A

Comparisons of calculated and experimental transonic unsteady pressures and airloads for four of the AGARD Two Dimensional Aeroelastic Configurations and for a rectangular supercritical wing are presented. The two dimensional computer code, XTRAN2L, implementing the transonic small perturbation equation was used to obtain results for: (1) pitching oscillations of the NACA 64A010A; NLR 7301 and NACA 0012 airfoils; (2) flap oscillations for the NACA 64A006 and NRL 7301 airfoils; and (3) transient ramping motions for the NACA 0012 airfoils. Results from the three dimensional code XTRAN3S are compared with data from a rectangular supercritical wing oscillating in pitch. These cases illustrate the conditions under which the transonic inviscid small perturbation equation provides reasonable predictions. Author

N85-25177# Royal Aircraft Establishment, Farnborough (England).
CALCULATION OF HARMONIC AERODYNAMIC FORCES OF AEROFOILS AND WINGS FROM THE EULER EQUATIONS
D. J. SALMOND *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 17 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

A method developed to solve the Euler equations to obtain transonic aerodynamic forces on oscillating and wings is described. It is an extension of the implicit, finite difference method used by Pulliam and Steger to solve the Euler equations for the steady, transonic flow past an airfoil. Results in the form of steady pressure distributions and unsteady first harmonic, unsteady pressure coefficients are presented. Comparisons with the experimental results of Davis and Malcolm for the NACA 64A010 (Ames model) airfoil and those of Mabey for the AGARD tailplane are included. M.G.

N85-25178# Office National d'Etudes et de Recherches Aerospatiales, Leclerc (France).
CALCULATION OF UNSTEADY TRANSONIC SEPARATED FLOWS BY VISCOUS-INVISCID INTERACTION
P. GIRODROUX-LAVIGNE and J. C. LEBALLEUR *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 18 p Jan. 1985 refs In FRENCH; ENGLISH summary Original document previously announced as A85-12621
Avail: NTIS HC A14/MF A01

A technique based on viscid-inviscid flow interaction is used to describe separated and unseparated unsteady transonic flows over airfoils. A semi-implicit and time-consistent numerical formulation with semi-implicit relaxation provides strong coupling, and a local mesh clustering expresses the shock wave-boundary layer interaction. Direct and inverse mode solutions are defined for the boundary layer and wake defect integrals. The integral equations are closed by using instantaneous boundary layer profiles and defining a set of transport equations for turbulence. A small perturbation equation accounts for the inviscid flow. Sample results are calculated for flows over a NLG 7301 airfoil, a NACA 64 A 010 airfoil with shock-induced separation, and an oscillating RA 16 SC1 airfoil with a spoiler. M.S.K. (IAA)

N85-25179# British Aerospace Aircraft Group, Woodford (England).
A SEMI-EMPIRICAL UNSTEADY TRANSONIC METHOD WITH SUPERSONIC FREE STREAM
M. J. GREEN and D. LAMBERT *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 16 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

Garner's semi-empirical method for predicting oscillatory transonic aerodynamic characteristics on wings was extended to Mach numbers greater than unity. The object is to provide an economical means of carrying out transonic flutter calculations at a time when more sophisticated and costly methods are not available for routine use. To predict the unsteady transonic behavior, the method combines steady transonic pressures, obtainable from theory or experiment, with unsteady velocity potentials provided by linearized supersonic theory. Experimental quasisteady data obtained from a series of wind tunnel tests carried out at RAE Bedford on a low aspect ratio wing were used to predict the unsteady pressures at non-zero frequencies. These results were compared with the corresponding unsteady measurements. The method was found to be inadequate near the wing tip and an alternative approach is proposed. Preliminary results show a marked improvement in this region. M.G.

N85-25180# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATUS AND PROSPECTS OF COMPUTATIONAL FLUID DYNAMICS FOR UNSTEADY TRANSONIC FLOW
W. J. MCCROSKEY (Army Aeromechanics Lab.), P. KUTLER, and J. C. BRIDGMAN *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 24 p Jan. 1985 refs Document previously announced as N85-12037
Avail: NTIS HC A14/MF A01 CSCL 20D

Applications of computational aerodynamics to aeronautical research, design, and analysis have increased rapidly over the past decade, and these applications offer significant benefits to aeroelasticians. The past developments are traced by means of a number of specific examples, and the trends are projected over the next several years. The crucial factors that limit the present capabilities for unsteady analyses are identified; they include computer speed and memory, algorithm and solution methods, grid generation, turbulence modeling, vortex modeling, data processing, and coupling of the aerodynamic and structural dynamic analyses. The prospects for overcoming these limitations are presented, and many improvements appear to be readily attainable. If so, a complete and reliable numerical simulation of the unsteady, transonic viscous flow around a realistic fighter aircraft configuration could become possible within the next decade. The possibilities of using artificial intelligence concepts to hasten the achievement of this goal are also discussed. Author

N85-25181# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IMPROVEMENT AND EXTENSION OF A NUMERICAL PROCEDURE FOR THE THREE DIMENSIONAL UNSTEADY TRANSONIC FLOWS
P. MULAK and J. J. ANGELINI *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 12 p Jan. 1985 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A14/MF A01

A numerical procedure was developed at ONERA to solve the unsteady transonic flow problems under potential flow and small disturbance approximations, in the case of rectangular or simple swept wings. The use of an alternating direction implicid procedure (ADI) and a functional approach for potential flow allowed a very little computer time consummation and a correct approximation for the small disturbance equation with consistent boundary conditions. The purpose is to extend the method to most general planform wings, including highly swept wings, and to insure correct swept shock jump conditions in any case. Calculations will be compared with experiments made on supercritical wings. Author

N85-25183# Lockheed-Georgia Co., Marietta.
COMPUTATION OF UNSTEADY TRANSONIC FLOWS ABOUT TWO-DIMENSIONAL AND THREE-DIMENSIONAL AGARD STANDARD CONFIGURATIONS
J. B. MALONE, S. Y. RUO, and N. L. SANKAR (Georgia Inst. of Tech.) *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 14 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

Three state-of-the-art, finite-difference computer programs which were developed for the prediction of unsteady transonic flows about airfoil and wing configurations are examined. Descriptions of each computational procedure are given. Numerical results are compared to experimental data for several 2D and 3D AGARD standard configurations. In addition, computational results are presented for a low aspect-ratio wing planform for which a large, experimental data-base is available. Author

N85-25184# Dassault-Breguet Aviation, St. Cloud (France).
CALCULATION OF UNSTEADY TRANSONIC FLOW AROUND A HIGH SWEPT WING
A. LAURENT *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 24 p Jan. 1985 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A14/MF A01

The calculation of the unsteady transonic flow around a highly swept wing has led to development of a three-dimensional fully conservative code from the two-dimensional ideas of Murman and Cole using a finite difference scheme and an alternating direction implicit method. Extension to the three dimensional-problem of the transonic small disturbance method (the NLR equation) requires the investigation of the direction and type of flow locally. This approach allows the calculation in the physical plan (i.e., without any space transformation). Results on a NACA0012 thirty degrees swept wing, at a flying point, show the co-existence, along the span, of the three kinds of shock motion, as TIDJEMAN found in two-dimensional flows. Some calculations correlated with the experiment on the clean MIRAGE F1 wing tested by ONERA in 1982 will be shown as well as a few test cases of the NORA wing. In view of the aeroelastic implications, attention will be paid to the non-linearities of the phenomena encountered. Author

N85-25185*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UNSTEADY TRANSONIC AERODYNAMIC AND AEROELASTIC CALCULATIONS ABOUT AIRFOILS AND WINGS
P. M. GOORJIAN and G. P. GURUSWAMY (Informatics General Corp., Palo Alto, Calif.) *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 31 p Jan. 1985 refs Document previously announced as N84-31092
Avail: NTIS HC A14/MF A01 CSCL 20D

The development and application of transonic small disturbance codes for computing two dimensional flows, using the code ATRAN2, and for computing three dimensional flows, using the code ATRAN3S, are described. Calculated and experimental results are compared for unsteady flows about airfoils and wings, including several of the cases from the AGARD Standard Aeroelastic Configurations. In two dimensions, the results include AGARD priority cases for the NACA 54A006, NACA 64A010, NACA 0012, and MBB-A3 airfoils. In three dimensions, the results include flow about the F-5 wing, a typical wing, and the AGARD rectangular wings. Viscous corrections are included in some calculations, including those for the AGARD rectangular wing. For several cases, the aerodynamic and aeroelastic calculations are compared with experimental results. M.A.C.

N85-25187# National Aerospace Lab., Tokyo (Japan).
THE DEVELOPMENT OF UNSTEADY TRANSONIC 3-D FULL POTENTIAL CODE AND ITS AEROELASTIC APPLICATIONS
K. ISOGAI *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 25 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

The unsteady transonic 3-D full potential code (USTF3), which is based on a two-step semi-implicit time-marching finite difference technique, is outlined. To validate the code the unsteady pressure distributions on the oscillating horizontal tail model (NORA WING) and on the RAE swept tapered wing with oscillating part-span control surface are calculated and compared with the experimental results. The results of the aeroelastic applications of the code, including the static and dynamic aeroelastic response calculations of a high-aspect-ratio transport wing and the time domain numerical simulation of an active control system for a supercritical wing, are presented. Author

N85-25200 North Carolina State Univ., Raleigh.
A NEW IMPLICIT PLUS MINUS SPLITTING METHOD FOR THE SOLUTION OF THE EULER EQUATIONS IN THE TRANSONIC FLOW REGIME Ph.D. Thesis
C. M. SEAFORD 1984 100 p
Avail: Univ. Microfilms Order No. DA8429010

A plus minus flux vector splitting formulation of the two-dimensional time dependent Euler equations in strong conservation law form for a system of generalized body conforming curvilinear coordinates was developed and is based on the mathematical property of hyperbolic equations and the well-established theory of characteristics. The spatial flux vectors of the conservation law equations are split in terms of the sign of the characteristic speeds of the coefficient matrices. One-sided difference operators are then applied to each split flux vector. The conservation of energy equation is satisfied by the statement that the flow is adiabatic. Hence, the number of governing equations is reduced from 4 to 3. The finite difference equations are solved by means of a relaxation method based on the Peaceman-Rachford scheme. Such a procedure, conjunction with the implementation of implicit boundary conditions, yields a robust code and improved convergence history. Results obtained for flows over various airfoils and a full circular cylinder with similar results obtained from existing Euler codes are compared. Several solutions of a symmetrical NACA 0012 at various Mach numbers and angles of attack are compared and the solution of the flow field of a cambered NACA 64A410 is presented. Dissert. Abstr.

N85-25201*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Mechanical Engineering.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF FAN FLOW INTERACTION WITH DOWNSTREAM STRUTS Interim Report, 16 Jun. 1984 - 15 Mar. 1985
T. L. OLSEN, W. F. NG, and W. F. OBRIEN, JR. Apr. 1985 42 p refs
(Contract NAG1-486)
(NASA-CR-175756; NAS 1.26:175756; IR-1) Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation which was designed to provide insight into the fundamental aspects of fan rotor-downstream strut interaction was undertaken. High response, miniature pressure transducers were embedded in the rotor blades of an experimental fan rig. Five downstream struts were placed at several downstream locations in the discharge flow annulus of the single-stage machine. Significant interaction of the rotor blade surface pressures with the flow disturbance produced by the downstream struts was measured. Several numerical procedures for calculating the quasi-steady rotor response due to downstream flow obstructions were developed. A preliminary comparison of experimental and calculated fluctuating blade pressures on the rotor blades shows general agreement between the experimental and calculated values. G.L.C.

N85-25202*# Analytical Methods, Inc., Redmond, Wash.
UNSTEADY ANALYSIS OF ROTOR BLADE TIP FLOW Final Report
B. MASKEY and B. M. RAO Washington NASA May 1985 57 p refs
(Contract NAS1-15472)
(NASA-CR-3868; NAS 1.26:3868; AMI-8412) Avail: NTIS HC A04/MF A01 CSCL 01A

The development of the VSAERO-TS and VSAERO-H computer programs for calculating the unsteady aerodynamic characteristics of arbitrarily shaped wings oscillating in pitch is presented. The effect of several wake parameters on chordwise pressure distribution in VSAERO-TS is given and the convergence characteristics of both programs are discussed. In the program, the influence coefficient for each panel is formulated for a planar surface and so a skewed panel is represented by a projected flat quadrilateral lying in the mean plane. Since panels in the extreme roll-up region of the tip vortex are highly skewed the program was modified to treat each highly skewed panel as a pair of triangles. The programs are validated by comparing the chordwise pressure distribution of several blade tip planforms with experimental data. The comparison, for the most part, is good. The triangular panel representation improved the chordwise pressure distribution near the tip region for higher mean angle of attack. A.R.H.

N85-25203*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF A VARIABLE SWEEP WING
P. M. GOORJIAN, G. P. GURUSWAMY (Informatics General Corp., Palo Alto, Calif.), H. IDE, and G. MILLER (Rockwell International, Los Angeles, Calif.) Feb. 1985 18 p refs
(NASA-TM-86677; A-85119; NAS 1.15:86677) Avail: NTIS HC A02/MF A01 CSCL 01A

The flow over the B-1 wing is studied computationally, including the aeroelastic response of the wing. Computed results are compared with results from wind tunnel and flight tests for both low-sweep and high-sweep cases, at 25.0 deg. and 67.5 deg., respectively, for selected transonic Mach numbers. The aerodynamic and aeroelastic computations are made by using the transonic unsteady code ATRAN3S. Steady aerodynamic computations compare well with wind tunnel results for the 25.0 deg. sweep case and also for small angles of attack at the 67.5 deg. sweep case. The aeroelastic response results show that the wing is stable at the low sweep angle for the calculation at the Mach number at which there is a shock wave. In the higher sweep case, for the higher angle of attack at which oscillations were observed in the flight and wind tunnel tests, the calculations do not show any shock waves. Their absence lends support to the hypothesis that the observed oscillations are due to the presence of leading edge separation vortices and are not due to shock wave motion as was previously proposed. Author

N85-25204*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PREDICTION OF VORTEX-INDUCED LOADS ON WIND-TUNNEL TURNING VANES
J. C. ROSS Mar. 1985 28 p refs
(NASA-TM-86678; A-85123; NAS 1.15:86678) Avail: NTIS HC A03/MF A01 CSCL 01A

Models tested in the National Full-Scale Aerodynamic Complex at NASA Ames Research Center can generate strong wake vortices which in turn can induce large increases in the local loads on the turning vanes located downstream from the two test sections. A 3-D panel method which models wake roll up (VSAERO) was used to estimate the magnitude of these loads. In the simulation a rectangular wing at angle of attack sheds a wake which is allowed to roll up and interact with a smaller chord, high-aspect ratio wing which represents a single vane. Results agree well with experimental data and are consistent with previously reported results. A method is given for correcting the panel code results for the effects of vane set solidity and of the vortex passage through a diffuser before it interacts with the vane set. Estimates of the induced vortex loads on the vane sets downstream from the 40- by 80- and 80- by 120-foot test sections indicate that the induced local loads on a van can, in some cases, be more than 50% of the steady-state turning loads of an individual vane. Author

N85-25205*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPROXIMATE NEUTRAL POINT OF A SUBSONIC CANARD AIRCRAFT
J. D. PHILLIPS Apr. 1985 12 p refs
(NASA-TM-86694; A-85151; NAS 1.15:86694) Avail: NTIS HC A02/MF A01 CSCL 01A

An approximate formula is derived for the position of the neutral point in canard aircraft. This formula accounts for the aerodynamic interference between the wing (rear wing) and the canard (forward wing). Topics covered include determination of the canard downwash derivative, determination of the canard and wing liftslopes including the aerodynamic interference, and calculation of the neutral point position. A.R.H.

N85-25206*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NONLINEAR PROBLEMS IN FLIGHT DYNAMICS INVOLVING AERODYNAMIC BIFURCATIONS
M. TOBAK and G. T. CHAPMAN Mar. 1985 18 p refs
Presented at the AGARD Symp. on Unsteady Aerodyn. Fundamentals and Appl. to Aircraft Dyn., Goettingen, West Germany, 6-9 May 1985
(NASA-TM-86706; A-85179; NAS 1.15:86706) Avail: NTIS HC A02/MF A01 CSCL 01A

Aerodynamic bifurcation is defined as the replacement of an unstable equilibrium flow by a new stable equilibrium flow at a critical value of a parameter. A mathematical model of the aerodynamic contribution to the aircraft's equations of motion is amended to accommodate aerodynamic bifurcations. Important bifurcations such as, the onset of large-scale vortex-shedding are defined. The amended mathematical model is capable of incorporating various forms of aerodynamic responses, including those associated with dynamic stall of airfoils. E.A.K.

N85-25208*# North Carolina State Univ., Raleigh. Mechanical and Aerospace Engineering Dept.
AN EXPLORATORY STUDY OF APEX FENCE FLAPS ON A 74 DEG DELTA WING
R. A. WAHLS and R. J. VESS May 1985 30 p refs
(Contract NCC1-46)
(NASA-CR-172463; NAS 1.26:172463) Avail: NTIS HC A03/MF A01 CSCL 01A

An exploratory wind tunnel investigation was performed to observe the flow field effects produced by vertically deployed apex fences on a planar 74 degree delta wing. The delta shaped fences, each comprising approximately 3.375 percent of the wing area, were affixed along the first 25 percent of the wing leading edge in symmetric as well as asymmetric (i.e., fence on one side only) arrangements. The vortex flow field was visualized at angles of attack from 0 to 20 degrees using helium bubble and oil flow techniques; upper surface pressures were also measured along spanwise rows. The results were used to construct a preliminary description of the vortex patterns and induced pressures associated with vertical apex fence deployment. The objective was to obtain an initial evaluation of the potential of apex fences as vortex devices for subsonic lift modulation as well as lateral directional control of delta wing aircraft. Author

N85-25209*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF THE VORTEX TAB M.S. Thesis
K. D. HOFFLER May 1985 79 p refs
(Contract NCC1-46)
(NASA-CR-172586; NAS 1.26:172586) Avail: NTIS HC A05/MF A01 CSCL 01A

An investigation was made into the drag reduction capability of vortex tabs on delta wing vortex flaps. The vortex tab is an up-deflected leading edge portion of the vortex flap. Tab deflection augments vortex suction on the flap, thus improving its thrust, but the tab itself is drag producing. Whether a net improvement in the drag reduction can be obtained with vortex tabs, in comparison with plane vortex flaps of the same total area, was the objective of this investigation. Wind tunnel tests were conducted on two models, and analytical studies were performed on one of them using a free vortex sheet theory. Author

N85-25210*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
STUDIES ON THE INTERFERENCE OF WINGS AND PROPELLER SLIPSTREAMS Final Report
R. K. PRABHU and S. N. TIWARI May 1985 113 p refs
(Contract NCC1-65)
(NASA-CR-175753; NAS 1.26:175753) Avail: NTIS HC A06/MF A01 CSCL 01A

The small disturbance potential flow theory is applied to determine the lift of an airfoil in a nonuniform parallel stream. The given stream is replaced by an equivalent stream with a certain number of velocity discontinuities, and the influence of these discontinuities is obtained by the method of images. Next, this method is extended to the problem of an airfoil in a nonuniform stream of smooth velocity profile. This model allows perturbation velocity potential in a rotational undisturbed stream. A comparison of these results with numerical solutions of Euler equations indicates that, although approximate, the present method provides useful information about the interaction problem while avoiding the need to solve the Euler equations. G.L.C.

N85-25212*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ANALYSIS OF SELECTED PROBLEMS INVOLVING VORTICAL FLOWS
L. ROBERTS, D. J. LEE, and N. J. MOURTOS Apr. 1985 80 p refs
(Contract NCC2-149)
(NASA-CR-177347; NAS 1.26:177347) Avail: NTIS HC A05/MF A01 CSCL 01A

Three selected problems involving vortical flows are analyzed and discussed including: the trailing vortex behind a wing; rotor blade-vortex interaction; and the leading edge vortex on a flat plate.

N85-25213*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ON THE STRUCTURE OF THE TURBULENT VORTEX
L. ROBERTS *In its* Anal. of Selected Probl. Involving Vortical Flows p 6-17 Apr. 1985 refs Previously announced as N84-12102
Avail: NTIS HC A05/MF A01 CSCL 01A

The trailing vortex generated by a lifting surface, the structure of its turbulent core and the influence of axial flow within the vortex on its initial persistence and on its subsequent decay are described. Similarity solutions of the turbulent diffusion equation are given in closed form and results are expressed in sufficiently simple terms that the influence of the lifting surface parameters on the length of persistence and the rate of decay of the vortex can be evaluated. E.A.K.

N85-25214*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
INTERACTION OF A TURBULENT VORTEX WITH A LIFTING SURFACE
D. J. LEE and L. ROBERTS *In its* Anal. of Selected Probl. Involving Vortical Flows p 18-28 Apr. 1985 refs Previously announced in IAA as A84-19452
Avail: NTIS HC A05/MF A01 CSCL 01A

The impulsive noise due to blade-vortex-interaction is analyzing in the time domain for the extreme case when the blade cuts through the center of the vortex core with the assumptions of no distortion of the vortex path or of the vortex core. An analytical turbulent vortex core model, described in terms of the tip aerodynamic parameters, is used and its effects on the unsteady loading and maximum acoustic pressure during the interaction are determined. Author

N85-25215*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
FLOW PAST A FLAT PLAT WITH A VORTEX/SINK COMBINATION
N. J. MOURTOS *In its* Anal. of Selected Probl. Involving Vortical Flows p 29-77 Apr. 1985 refs
(JIAA-TR-58) Avail: NTIS HC A05/MF A01 CSCL 01A

An attempt was made to model the so called leading edge vortex which forms over the leading edge of delta wings at high angles of attack. A simplified model was considered, namely that of a two-dimensional, inviscid, incompressible steady flow around a flat plate at an angle of attack with a stationary vortex detached on top, as well as a sink to simulate the strong spanwise flow. The results appear to agree qualitatively with experiments. A comparison was also made between the lift and the drag of this model and the corresponding results for two classical solutions: (1) that of totally attached flow over the plate with the Kutta condition satisfied at the trailing edge only; and (2) the Helmholtz solution of totally separated flow over the plate. M.G.

N85-25218# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
UNSTEADY GAS DYNAMICS PROBLEMS RELATED TO FLIGHT VEHICLES Final Report, 1 Apr. 1979 - 31 Mar. 1984
H. ASHLEY May 1984 10 p
(Contract AF-AFOSR-0061-79)
(AD-A151187; AFOSR-85-0166TR) Avail: NTIS HC A02/MF A01 CSCL 20D

This report summarizes research efforts in unsteady aerodynamics and aeroelasticity. GRA

N85-25219# Naval Postgraduate School, Monterey, Calif.
DESIGN OF APPARATUS FOR THE DETERMINATION OF AERODYNAMIC DRAG COEFFICIENTS OF AUTOMOBILES M.S. Thesis
B. R. GRITTE Jun. 1984 80 p
(AD-A151842) Avail: NTIS HC A05/MF A01 CSCL 20D

There are three major components of the total resistance to motion of road vehicles: aerodynamic drag, rolling resistance in the form of tire friction on road surfaces and mechanical resistance in the form of bearing friction. Apparatus constructed at the naval Postgraduate School, Monterey, CA, employs the measurement of total drag (aerodynamic drag + rolling resistance drag + mechanical drag) by means of coastdown testing and the measurement of rolling resistance and mechanical drag in an aerodynamic shielding trailer to determine the aerodynamic drag. Data acquisition and reduction is carried out with a portable dedicated minicomputer system. The apparatus is designed to yield drag coefficients with an estimated uncertainty of about one percent. GRA

N85-26613# National Aerospace Lab., Tokyo (Japan).
COMPUTER SOFTWARE FOR AERODYNAMIC DESIGN OF AIRCRAFT DEVELOPED WITHIN THE NATIONAL AEROSPACE LABORATORY
H. ENDO *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 7-16 1983 refs In JAPANESE
Avail: NTIS HC A10/MF A01

A computer was first introduced to the National Aerospace Laboratory in 1960. Subsequent introduction of increasingly more sophisticated models played important roles in the active research conducted by the laboratory. Acquisition of FACOM 230-75AP, the first vector computer in Japan, resulted in the start of software designing for full utilization of a large, ultra-high speed computer. The analytical programs developed by the laboratory include FLOW, PNCCP, TSFOIL, AFMESH, NSFOIL, SPWING, and AFPWING, while notable design programs are TSFD, INVERSE, SPWD, and BLAY. In designing these softwares, the laboratory is aware of importance of organizing joint projects to avoid unnecessary expenditures and waste of manpower, confirmation of reliability of each program, systematization of data bases, and publication of these programs for the general interest. A computer specially designed for statistical simulation of a wind tunnel is described. With the completion of the next generation numerical simulator, such a computer wind tunnel system is expected to play an important role in aircraft technology in Japan. Transl. by B.G.

N85-26623# National Aerospace Lab., Tokyo (Japan).
NUMERICAL EXAMPLE OF THREE-DIMENSIONAL FLYING OBJECT IN SHOCKLESS TRANSONIC FLOW
M. NAKAMURA *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 101-107 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

A quasi-aircraft was numerically simulated in a physical space to design a shockless aircraft in a transonic flow. A three-dimensional artificial flow method was used for obtaining aircraft configurations in shockless transonic flows. This method is an extension of the artificial flow method used with two-dimensional flows. An original quasiaircraft is composed of a body, a sweptback wing and a tail unit, and it has no lift. Under the design conditions of a free stream Mach number of 0.87, and an angle of attack of 0 deg, the original quasiaircraft is partially modified and a shockless transonic quasiaircraft is obtained numerically. The potential flow is applied and the flow model has the effects of walls of a wind tunnel. E.A.K.

N85-26624# National Aerospace Lab., Tokyo (Japan).
NAVIER-STOKES SOLUTION OF HYPERSONIC BLUNT-NOSED BODY FLOWFIELDS
Y. YAMAMOTO *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 109-122 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

Numerical algorithm to solve the unsteady thin-layer Navier-Stokes equations in a strong conservative form was used to compute the flow around capsule-type bodies in a hypersonic free stream. When these vehicles enter the atmosphere, aerodynamic heating becomes so severe that exact numerical viscous flow predictions are needed for the design of thermal protection systems. Body configurations consist of two segments: the nose and shoulder radii R(1), R(2), respectively. Shoulder radius R(2) is varied from 1.0 to 0.05, nondimensionalized by the nose radius r(2). Free stream conditions are set at the same conditions as in the hypersonic wind tunnel to compare numerical results with experimental data: a free stream Mach number of 7.0 with a Reynolds number of 4.5 x 100,000 based on the nose radius R(1). The capability of the present numerical procedure for computing such three-dimensional viscous flowfields is demonstrated. E.A.K.

N85-26626# Kyoto Technical Univ. (Japan).
RECENT PROGRESS IN COMPUTATIONAL AERODYNAMICS
N. SATOFUKA *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 130-139 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

Recent developments in computational aerodynamics are surveyed. Methods for numerical grid generation techniques are reported. Techniques which have already been used successfully on practical problems or appear to have such potential are emphasized. Approaches for acceleration of convergence, i.e., the pseudounsteady methods and the multigrid methods are reviewed. A new explicit method is devised for solving the Navier-Stokes equations for unsteady compressible viscous flow. The method is shown to be very accurate and efficient when compared with the implicit methods. E.A.K.

N85-26628# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
COMPARISON OF COMPUTATIONAL RESULTS OF A FEW REPRESENTATIVE THREE-DIMENSIONAL TRANSONIC POTENTIAL FLOW ANALYSIS PROGRAMS
K. TANAKA and H. HIROSE *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 157-167 1983 refs In JAPANESE
Avail: NTIS HC A10/MF A01

Three-dimensional transonic potential flow analysis programs were applied to the designs of: (1) transonic transport; (2) small transonic aircraft; (3) the evaluation of area rule on the fuselage of a transport-type aircraft; and (4) in the use in the boundary layer computation. In (1), computation of the small disturbance potentials at the wing and fuselage sections are satisfactory. However, the interference by the fuselage and wing is minimum in a transport aircraft. In (2), the interference from the wing and the fuselage is much larger than that of the transport and the computation of the wing alone results in a large discrepancy from the actual figure. The computation of the wing and fuselage is accurate. In the evaluation of the effect of the area rule (3), the results of the computation correspond well with the data obtained from the wind tunnel test. The boundary layer computation (4) is included to add viscosity effect to most of the transonic potential air flow programs. This addition improves the accuracy of the localization and strength of the shock wave and recovery of the pressure following the shock. It is concluded that the following items are required in the future programs: analysis of the entire aircraft including interferences from each section, inclusion of viscosity and nonstationary flow in the program, generation of reliable data in a relatively short time period, and domestic origin of such programs. Transl. by B.G.

N85-26632# National Aerospace Lab., Tokyo (Japan).
THREE-DIMENSINAL WING BOUNDARY LAYER ANALYSIS PROGRAM BLAY AND ITS APPLICATION
K. MATSUNO and T. ISHIGURO *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 207-218 1983 refs In JAPANESE
Avail: NTIS HC A10/MF A01

The boundary layer calculation program (BLAY) is a program code which accurately analyzes the three-dimensional boundary layer of a wing with an undefined plane. In comparison with other preexisting programs, the BLAY is characterized by the following: (1) the time required for computation is shorter than any other; (2) the program is adaptable to a parallel processing computer; and (3) the program is associated with a secondary accuracy in the z-direction. As a boundary layer modification to transonic nonviscous flow analysis programs, it is used to adjust viscous and nonviscous interference problems repeatedly. Its efficiency is an important factor in cost reduction in aircraft designing. Transl. by B.G.

N85-26652# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
WIND MODELLING FOR INCREASED AIRCRAFT OPERATIONAL EFFICIENCY
W. LECHNER and R. ONKEN *In* AGARD Cost Effective and Affordable Guidance and Control Systems 12 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

Accurate knowledge of the wind in magnitude and direction as a function of airspace position and time is an essential part for navigation and for fuel efficiency and efficient planning and control of air traffic. The demand for wind data in four dimensional guidance was examined. The calculation of the three dimensional flight path command subject to time-of-arrival constraints (fourth dimension) requires wind prediction along the complete flight path the aircraft is going to track. Since the flight path is calculated and updated on line wind information has to be available at any time for the respective three dimensional airspace. The wind data, currently available are not sufficient when used as single source. An actual wind situation can extremely deviate from what the MET service announces. Complementary or even quite different techniques emrge for wind estimation, in particular using modern aircraft sensor and computer equipment. Airborne wind estimation techniques were developed and implemented in the automatic digital flight control system of the DFVLR's test aircraft HFB 320. The efficiency of these techniques, is demonstrated. E.A.K.

N85-26663 Aerazur C.A., Issy-les-Molineaux (France).
PARACHUTE EXTRACTION DEVICE FOR ULTRALIGHT GLIDERS Patent [DISPOSITIF D'EXTRACTION D'UN PARACHUTE POUR PLANEURS ULTRA-LEGERS ET PLANNEUR ULTRA-LEGER EQUIPE DU DISPOSITIF]
J. ROUSSEAU Bern Swiss Patent Office 15 Jun. 1984 5 p In FRENCH Filed 11 May 1981, Priority date 23 May 1980 FR 80 11565
(CH-643499-A5; REPT-3017/81; INTL-CL-B64D-17/64) Avail: Swiss Patent Office

The device includes a projectile propelled by elastic energy and attached to the parachute itself by elastic strings. The system is proposed as an auxiliary safety and aerodynamic braking means. The projectile ejected at up to 180 km/hr deploys the auxiliary parachute in 0.2 sec and the main parachute is then extracted by the force applied by the auxiliary parachute, which is of the order of hundreds of Newtons. Author (ESA)

N85-26664*# Amtec Engineering, Inc., Bellevue, Wash.
A METHOD FOR SIMULATING 3-D AIRCRAFT FLOW FIELDS WITH JET PLUME EFFECTS Monthly Technical Progress Reort, 1-31 Dec. 1984
1984 3 p refs
(Contract NAS2-11711)
(NASA-CR-175802; NAS 1.26:175802; MTPR-15) Avail: NTIS HC A02/MF A01 CSCL 01A

The objective is to develop, demonstrate, and document a coupled flow analysis procedure for computing 3D aircraft flow fields with deflected subsonic and supersonic jet exhaust plumes. The PNS plume code was transferred to the Ames computer facility for execution on the Cray computer. No problems were encountered when installing this code. The Bower's test case is currently being run. This case is being used to fine tune the procedure for coupling the plume code to PANAIR. B.G.

N85-26665*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
INVESTIGATION TO OPTIMIZE THE PASSIVE SHOCK WAVE/BOUNDARY LAYER CONTROL FOR SUPERCRITICAL AIRFOIL DRAG REDUCTION Final Report
H. T. NAGAMATSU and R. DYER Dec. 1984 33 p refs
(Contract NAG1-330)
(NASA-CR-175788; NAS 1.26:175788) Avail: NTIS HC A03/MF A01 CSCL 01A

The passive shock wave/boundary layer control for reducing the drag of 14%-thick supercritical airfoil was investigated in the 3 in. x 15.4 in. RPI Transonic Wind Tunnel with and without the top wall insert at transonic Mach numbers. Top wall insert was installed to increase the flow Mach number to 0.90 with the model mounted on the test section bottom wall. Various porous surfaces with a cavity underneath were positioned on the area of the airfoil where the shock wave occurs. The higher pressure behind the shock wave circulates flow through the cavity to the lower pressure ahead of the shock wave. The effects from this circulation prevent boundary layer separation and enthropy increase hrough the shock wave. The static pressure distributions over the airfoil, the wake impact pressure survey for determining the profile drag and the Schlieren photographs for porous surfaces are presented and compared with the results for solid surface airfoil. With a 2.8% uniform porosity the normal shock wave for the solid surface was changed to a lambda shock wave, and the wake impact pressure data indicate a drag coefficient reduction as much as 45% lower than for the solid surface airfoil at high transonic Mach numbers. E.A.K.

N85-26666# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
LOW REYNOLDS NUMBER VEHICLES
T. J. MUELLER (Notre Dame Univ.) and E. RESHOTKO, ed. (Case Western Reserve Univ.) Feb. 1985 77 p refs
(AGARD-AG-288; ISBN-92-835-1486-6) Avail: NTIS HC A05/MF A01

Recent interest in the subject of low Reynolds number configuration has entered on the design and evaluation of efficient airfoil sections at chord Reynolds numbers from about 100,000 to 1m. These configurations include remotely-piloted vehicles operating at high altitudes, sailplanes, ultra-ligh man-carrying/man-powered aircraft, wind turbines and propellers. Serious problems still exist with respect to boundary layer separations and transition below R(c)=500,000. Current design and analysis methods need improved criteria for laminar separation. Improved mathematical models for these complex phenomena require more experimental studies. For various reasons definitive experiments are difficult. The results of many experimental studies are presented to illustrate the type of difficulties encountered. Recommendations for future research are given. Author

N85-26667*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPLORATORY WIND-TUNNEL INVESTIGATION OF A WINGTIP-MOUNTED VORTEX TURBINE FOR VORTEX ENERGY RECOVERY
J. C. PATTERSON, JR. and S. G. FLECHNER Jun. 1985 24 p
(NASA-TP-2468; L-15795; NAS 1.60:2468) Avail: NTIS HC A02/MF A01 CSCL 01A

The Langley 8-foot transonic pressure tunnel was used for tests to determine the possibility of recovering, with a turbine-type device, part of the energy loss associated with the lift-induced vortex system. Tests were conducted on a semispan model with an unswept, untapered wing, with and without a wingtip-mounted vortex turbine. Three sets of turbine blades were tested to determine the effect of airfoil section shape and planform. The tests were conducted at a Mach number of 0.70 over an angle-of-attack range from 0 deg. to 4 deg. at a Reynolds number of 3.82 x 10 to the 6th power based on the wing reference chord of 13 in. Author

N85-26668*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
DEVELOPMENT OF A ROTOR WAKE-VORTEX MODEL, VOLUME 1 Final Technical Report
R. K. MAJJIGI and P. R. GLIEBE Jun. 1984 171 p refs
(Contract NAS3-23681)
(NASA-CR-174849; NAS 1.26:174849) Avail: NTIS HC A08/MF A01 CSCL 01A

Certain empirical rotor wake and turbulence relationships were developed using existing low speed rotor wave data. A tip vortex model was developed by replacing the annulus wall with a row of image vortices. An axisymmetric turbulence spectrum model, developed in the context of rotor inflow turbulence, was adapted to predicting the turbulence spectrum of the stator gust upwash. G.L.C.

N85-26669*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FINITE-DIFFERENCE COMPUTATIONS OF ROTOR LOADS
F. X. CARADONNA and C. TUNG Apr. 1985 19 p refs
Prepared in cooperation with Army Research and Technology Labs.
(NASA-TM-86682; REPT-85132; NAS 1.15:86682; USAAVSCOM-TR-85-A-3) Avail: NTIS HC A02/MF A01 CSCL 01A

The current and future potential of finite difference methods for solving real rotor problems which now rely largely on empiricism are demonstrated. The demonstration consists of a simple means of combining existing finite-difference, integral, and comprehensive loads codes to predict real transonic rotor flows. These computations are performed for hover and high-advanced-ratio flight. Comparisons are made with experimental pressure data. Author

N85-26670*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC DETUNING ANALYSIS OF AN UNSTALLED SUPERSONIC TURBOFAN CASCADE
D. HOYNIAK and S. FLEETER 21 Mar. 1985 25 p refs
Presented at the 30th Intern. Gas Turbine Conf. and Exhibit, Houston, Tex., 17-21 Mar. 1985; sponsored by ASME
(NASA-TM-87001; E-2546; NAS 1.15:87001) Avail: NTIS HC A02/MF A01 CSCL 01A

An approach to passive flutter control is aerodynamic detuning, defined as designed passage-to-passage differences in the unsteady aerodynamic flow field of a rotor blade row. Thus, aerodynamic detuning directly affects the fundamental driving mechanism for flutter. A model to demonstrate the enhanced supersonic aeroelastic stability associated with aerodynamic detuning is developed. The stability of an aerodynamically detuned cascade operating in a supersonic inlet flow field with a subsonic leading edge locus is analyzed, with the aerodynamic detuning accomplished by means of nonuniform circumferential spacing of adjacent rotor blades. The unsteady aerodynamic forces and moments on the blading are defined in terms of influence coefficients in a manner that permits the stability of both a conventional uniformally spaced rotor configuration as well as the detuned nonuniform circumferentially spaced rotor to be determined. With Verdon's uniformly spaced Cascade B as a baseline, this analysis is then utilized to demonstrate the potential enhanced aeroelastic stability associated with this particular type of aerodynamic detuning. Author

N85-26671*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF CFD TECHNIQUES TOWARD THE VALIDATION OF NONLINEAR AERODYNAMIC MODELS
L. B. SCHIFF and J. KATZ May 1985 18 p refs Presented at AGARD Fluid Dyn. Panel and Flight Mech. Panel Symp. on Unsteady Aerodyn.: Fundamentals and Appl. to Aircraft Dyn., Gottingen, West Germany, 6-9 May 1985
(Contract NAGW-218)
(NASA-TM-86715; REPT-85212; NAS 1.15:86715) Avail: NTIS HC A02/MF A01 CSCL 01A

Applications of Computational fluid dynamics (CFD) methods to determine the regimes of applicability of nonlinear models describing the unsteady aerodynamic responses to aircraft flight motions are described. The potential advantages of computational methods over experimental methods are discussed and the concepts underlying mathematical modeling are reviewed. The economic and conceptual advantages of the modeling procedure over coupled, simultaneous solutions of the gasdynamic equations and the vehicle's kinematic equations of motion are discussed. The modeling approach, when valid, eliminates the need for costly repetitive computation of flow field solutions. For the test cases considered, the aerodynamic modeling approach is shown to be valid. Author

N85-26673*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EXPERIMENTAL AND ANALYTICAL STUDY OF THE AERODYNAMIC INTERFERENCE EFFECTS BETWEEN TWO SEARS-HAACK BODIES AT MACH 2.7 M.S. Thesis - George Washington Univ.
J. W. BANTLE Apr. 1985 186 p refs
(NASA-TM-85729; NAS 1.15:85729) Avail: NTIS HC A09/MF A01 CSCL 01A

Aerodynamic interference effects were studied for two slender, streamlined bodies of revolution at Mach 2.7. A wind tunnel investigation produced force and moment data and measurements of pressure distributions on the bodies. As these bodies remained parallel with each other and with the freestream flow, their relative lateral and longitudinal spacing were varied. Results of theoretical methods were used in the analysis of results. The interference effects between the two bodies yielded less total drag than a single body of equal total volume and the same length. M.G.

N85-26674# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
DESCRIPTION OF A COMPUTER PROGRAM TREATING TRANSONIC STEADY STATE AEROELASTIC EFFECTS FOR A CANARD OR TAIL AIRPLANE
N. AGRELL Oct. 1983 28 p refs
(Contract FMV-F:INK-82223-80-001-21-001)
(FFA-TN-1983-23) Avail: NTIS HC A03/MF A01

A program to calculate the aerodynamic loading of supersonic airplanes, using the transonic small perturbation potential method is described. A version to allow for two wing surfaces with wakes was developed. The wing deformations are assumed to be linear functions of the load distributions. The iterative procedure used to solve the transonic small perturbation potential equation in finite difference form can treat the flow field around given wing shapes. As the shape of elastic wings is, a priori, not known temporary wing shapes must be determined. These depend on temporary load distributions and are quantified through the deformation matrix of the wing. When external aerodynamic loads are in equilibrium with internal elastic forces the final shape of the wing is obtained. Author (ESA)

N85-26675# Aeronautical Research Inst. of Sweden, Stockholm.
MEASUREMENTS OF THE SYMMETRIC AERODYNAMIC COEFFICIENTS FOR FLAT FACED CYLINDERS IN THE ANGLE OF ATTACK REGIME 0 TO 90 DEG FOR TRANSONIC AND SUPERSONIC SPEEDS Final Report; M.S. Thesis
H. BERGLUND Jan. 1984 224 p refs
(Contract FMV-FLYGFL-82223-80-001-21-001)
(FFA-TN-1984-04) Avail: NTIS HC A10/MF A01

Flat faced right circular cylinders with a length to diameter ratio of 1.5, 2, 4 and 6 were investigated in wind tunnels for 8 Mach numbers in the range 0.5 to 3.0. The cylinders were equipped with sharp edges. To investigate the influence of corner radius, test runs (M = 0.5, 0.7) with slightly rounded edges were performed. Angle of attack range was 0 to 90 deg. The cylinders with rounded edges behave more like streamlined bodies than the sharp edged cylinders. Normal force and pitching moment coefficients increase as fineness ratio increases, while the tangential force coefficient vanishes, slightly affected by fineness ratio. A maximum for all coefficients occurs at Mach 1.42. Author (ESA)

N85-26678# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
SYNTHESIS STUDY: VALIDATION OF A GUST GENERATOR IN THE PRESENCE OF A MODEL IN A WIND TUNNEL Final Report [ETUDE DE SYNTHESE. VALIDATION D'UN GENERATEUR DE RAFALE EN PRESENCE D'UNE MAQUETTE EN SOUFFLERIE]
C. BROTTE Jul. 1984 38 p refs In FRENCH
(Contract STPA-83/95013)
(ONERA-RT-16/5108-RY-051; ONERA-RT-16/5108-RY-053)
Avail: NTIS HC A03/MF A01

The comparison of local measurements of the fluctuations of wind incidence with and without model in wind tunnel tests, resulted in the conclusion that the gust characteristics are not affected by the presence of the model. The amplitude of the gust is half degree at Mach 0.5 up to 110 Hz. Author (ESA)

N85-26679# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
PRELIMINARY WIND TUNNEL STUDY OF THE INFLUENCE OF A JET ON THE UNSTEADY AERODYNAMICS OF A TURBOJET ENGINE Final Report [ETUDE PRELIMINAIRE EN SOUFFLERIE DE L'INFLUENCE D'UN JET SUR L'AERODYNAMIQUE INSTATIONNAIRE D'UN REACTEUR]
A. GRAVELLE May 1984 31 p refs In FRENCH
(Contract STPA-83/95030)
(ONERA-RT-12/5115-RY-230-R-231G) Avail: NTIS HC A03/MF A01

The unsteady forces produced by engine displacements were evaluated including the jet effect. A jet nacelle model, 1/20 scale, was tested in a wind tunnel. The nacelle was subjected to 10 and 20 Hz oscillations of 1 deg amplitude. The jet flow was variable. Another model with a double flow permeable wall was also tested. An important nonlinear effect related to the incidence angle of the nacelle is detected, showing the importance of the presence of the jet. Author (ESA)

N85-26680# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
CONICAL STAGNATION POINTS IN THE FLOW AROUND AN EXTERNAL CORNER
P. G. BAKKER and J. W. REYN Oct. 1983 34 p refs
(VTH-LR-396) Avail: NTIS HC A03/MF A01

The supersonic flow around configurations consisting of two plane delta wings, attached to each other along a common edge, forming an external corner is discussed on the basis of potential conical flow theory. The occurrence and character of conical stagnation points is studied as a bifurcation from the starlike node in the conical streamline pattern, which occurs at the corner point in a uniform flow. Various bifurcation modes are possible, including those where nodal points move away from the corner on which a saddle point is formed. Flow around a symmetrical external corner illustrates the use of the first bifurcation mode to obtain a better understanding of the flow field. The flow pattern with a saddle point at the corner flanked by two nodal points on the body surface is confirmed. Author (ESA)

N85-26681# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
A COMPUTER PROGRAM FOR THE DRAG PREDICTION OF SUBSONIC, TURBINE POWERED AIRCRAFT IN THE EN-ROUTE CONFIGURATION
E. TORENBEEK, C. VERMEULEN, and G. H. BERENSCHOT Dec. 1983 46 p refs
(VTH-LR-412) Avail: NTIS HC A03/MF A01

A computer program written in FORTRAN 77, for calculating drag polars of gas turbine powered aircraft in the en-route configuration is presented. The method includes a correction for compressibility effects. Applications to several civil aircraft (business and transport aircraft, turboprop and turbofan powered) are presented. They suggest that the low-speed polar is accurate within 10 to 15 counts, for normally used CL values. The drag polars with compressibility effects appear realistic for small angles of attack only. Author (ESA)

N85-26682# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
A CURVED TEST SECTION FOR RESEARCH ON TRANSONIC SHOCK WAVE-BOUNDARY LAYER INTERACTION
C. NEBBELING and W. J. BANNINK Jan. 1984 30 p refs
(VTH-LR-414) Avail: NTIS HC A03/MF A01

A nozzle with a curved test section for a blowdown wind tunnel was designed to generate a transonic flow to investigate shock wave-boundary layer interaction on a convex curved wall at the lower side of the test section. The Mach number at the lower wall just in front of the shock wave may be varied between 1.2 and 1.45. The Mach number at the concave upper wall is or = 0.85. Measurements show the usefulness of the application of a simple one-dimensional analysis to determine the cross-sectional area distribution of the nozzle, the Mach number, and pressure distribution in front of the shock wave, and the dimensions of the downstream choke area. Author (ESA)

N85-26683# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
NUMERICAL SOLUTION OF TRANSONIC NORMAL SHOCK WAVE-BOUNDARY LAYER INTERACTION USING THE BOHNING-ZIEROP MODEL
B. KOREN and W. J. BANNINK Jan. 1984 35 p refs
(VTH-LR-416) Avail: NTIS HC A03/MF A01

A numerical method for transonic shock wave-boundary layer interaction on a plane wall or on a convex wall, based on the Bohning-Zierep (BZ) model where a turbulent boundary layer is perturbed by a weak normal shock wave that exists in the external flow is described. The flow region along the wall is divided into a relatively thick upper layer, where the flow is considered to be inviscid and rotational, and a thin sublayer where the flow is viscous. The problem of the diffusion inside these layers of the jumps in flow quantities across the shock wave is solved without the practical disadvantages of the BZ method. Compared to experiments, good agreement is obtained if the Mach number in front of the shock wave does not exceed unity too much. Author (ESA)

N85-27059# Joint Publications Research Service, Arlington, Va.
FLOW AROUND ROTATING AND NONMOVING CIRCULAR CYLINDER NEAR FLAT SCREEN. REPORT 1: AERODYNAMIC FORCES IN CYLINDER Abstract Only
V. M. KOVALENKO, N. M. BYCHKOV, G. A. KISEL, and N. D. DIKOVSKAYA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-006) p 52-53 6 Aug. 1984 Transl. into ENGLISH from Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekhn. Nauk (Novosibirsk, USSR), ser. 3, no. 13, Oct. 1983 p 50-59
Avail: NTIS HC A05/MF A01

The major aerodynamic characteristics of a rotating and nonmoving circular cylinder near a flat screen, primarily in the area of critical Reynolds numbers were investigated. Tests were performed in a subsonic wind tunnel, the ITPM T-324 with a 1 x 1 m cross section and a length of 4 m. The lift and drag of rotating and nonrotating cylinders are computed. It is shown that the aerodynamic characteristics depend in a complex manner on the Reynolds number of the incident streams, relative speed of rotation of the cylinder and distance between cylinder and screen. The presence of this screen resulted in the appearance of a repulsive force between cylinder and screen in addition to the unsteady forces acting on the cylinder at greater distances from the screen. The influence of this screen is most notable at distances of about 0.1 d or less. Rotation of the cylinder changes not only the value and nature of the forces but in some cases even their sign, particularly at critical rotational speeds. Author

N85-27061# Joint Publications Research Service, Arlington, Va.
STUDY OF STRESSES ON SURFACE OF FLAT BARRIER IMMERSED IN UNDER EXPANDED JET OF RAREFIED GAS Abstract Only
B. F. PANOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-006) p 54 6 Aug. 1984 Transl. into ENGLISH from Vest. Leningradskogo Univ. (Leningrad), ser. 19, no. 4, Oct. 1983 p 78-83 Original document previously announced as A84-15763
Avail: NTIS HC A05/MF A01

An experimental study has been made of the pressure and tangential stresses on the surface of a plane obstacle in the path of a strongly underexpanded air jet issuing from a sonic nozzle. It is shown that the relationship between the maximum value in stress distribution and the degree of rarefaction, which varies both with the gas pressure in the precombustion chamber and with the distance between the nozzle and the obstacle, is determined by the Knudsen number. The latter is derived from the gas parameters behind the shock wave and its departure from the obstacle. Empirical formulas for calculating tangential and normal stress distributions at the obstacle surface are presented. V.L. (IAA)

N85-27063# Joint Publications Research Service, Arlington, Va.
HYPERSONIC NONEQUILIBRIUM GAS FLOW PAST ZERO-ASPECT WING Abstract Only
A. I. GOLUBINSKIY and V. N. GOLUBKIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-006) p 56 6 Aug. 1984 Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidkosti i Gaza (Moscow), no. 6, Jun. 1983 p 125-128
Avail: NTIS HC A05/MF A01

The hypersonic flow of a gas stream past a zero-aspect wing is analyzed, taking into acount the occurrence of physical and chemical nonequilibrium processes in the gas. The corresponding equations are formulated in the system of coordinates fixed to the wing. These equations are solved analytically for velocity, pressure and the density jump function by the approximate method of a thin shock layer, considering the conservation of longitudinal vorticity along a streamline characteristic of every nonequilibrium flow. A class of particular solutions is obtained, after transformation to the system of independent coordinates x,y,z and translation of the latter along the y-axis, with curvature of the wing cross section as parameter. The effect of nonequilibrium on the thickness of the shock layer is found to weaken as this curvature parameter increases. Author

N85-27725 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
NEW FLOW PHYSICAL ASPECTS IN AERODYNAMICS [NEUE STROEMUNGSPHYSIKALISCHE ASPEKTE IN DER AERODYNAMIK]
E. H. HIRSCHEL *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 11-21 1984 In GERMAN
(MBB-FE-122/S/PUB/133) Avail: Issuing Activity

Developments in flow physics are discussed. Separated flows, passive and active laminar control of boundary layers, and turbulence management are treated. Author (ESA)

03

AIR TRANSPORTATION AND SAFETY

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

A85-34259#
MOORING AIRSHIPS
I. REID (Airship Industries, Ltd., London, England) (Royal Aeronautical Society and Airship Association, Annual Symposium, 10th, London, England, Nov. 8, 1984) Airship (ISSN 0002-2853), no. 66, Dec. 1984, p. 12-16.

The basic method for airship mooring involves a low mast and a castering wheel undercarriage, in contact with the ground, that supports the bulk of the airship's weight. A number of different masts have been developed in the past, including those fixed at a given location, road-mobile ones, and transportable fixed ones. When an airship encounters a gust, the ship lifts off its undercarriage, weathervanes into the new direction, and sinks back to the ground. Attention is given to airship ground-handling procedures. O.C.

A85-34261#
THE ACQUISITION AND OPERATING COST OF AN ADVERTISING AIRSHIP
N. GREENWOOD (Airship Industries, Ltd., London, England) (Royal Aeronautical Society and Airship Association, Annual Symposium, 10th, London, England, Nov. 8, 1984) Airship (ISSN 0002-2853), no. 66, Dec. 1984, p. 19-27.

A85-35585*# Massachusetts Inst. of Tech., Cambridge.
DROPLET SIZE DISTRIBUTION EFFECTS ON AIRCRAFT ICE ACCRETION
R. J. HANSMAN, JR. (MIT, Cambridge, MA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 503-508. FAA-supported research. Previously cited in issue 06, p. 716, Accession no. A84-17886. refs
(Contract NAG1-100; NGL-22-009-640)

N85-25191# Joint Publications Research Service, Arlington, Va.
OFFICIAL ON SOVIET RESEARCH IN DEICING TECHNIQUES
In its USSR Rept.: Transportation (JPRS-UTR-85-008) p 22-24 3 May 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 19 Feb. 1985 p 3
Avail: NTIS HC A05

Technical solutions to the problem of deicing protection for aircraft are examined. Further study is needed of the forms, amounts, and conditions of icing on modern and prospective airplanes and helicopters. The parameters being standardized require more exact definition. In-flight experimentation under natural icing conditions is the most effective method of data acquisition. The deicing fluid Arktica must be improved with consideration to environment protection and toxicity. Coordination of efforts and a unified scientific approach to the problem is needed. A.R.H.

N85-25194# Joint Publications Reseafch Service, Arlington, Va.
CIVIL AIR CODE INTERNATIONAL FLIGHTS SECTION EXPLAINED
A. ZINEVICH *In its* USSR Rept.: Transportation (JPRS-UTR-84-015) p 5-9 31 May 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 3, Mar. 1984 p 32-33
Avail: NTIS HC A03

International flights are intimately connected with both the political and economic interests of the USSR. The growing volume of flights into and out of the country influenced the content and development of the eight articles of the civil air code recently promulgated. Apparent contradictions in provisions of the various articles of the code are resolved. The functions of the Ministry of Aviation, and regulations covering one-time special flights of foreign aircraft over Soviet territory, are examined as well as authorization for the use of other than established routes and takeoff and landing sites. Certification of airworthiness and measures to prevent air piracy are also covered. A.R.H.

N85-25199# Joint Publications Research Service, Arlington, Va.
EFFECTS OF LIGHTNING ON AIRCRAFT STUDIED AT SHEREMETYEVO
L. TSESARKIN and O. K. TRUNOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-017) p 16-18 13 Jun. 1984 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 31 Mar. 1984 p 4
Avail: NTIS HC A04/MF A01

The effects of lightning on aircraft are discussed. The by-passing of danger zones, lightning resistance, atmospheric electricity, and anti-lightning systems are covered. R.J.F.

N85-25220*# Operations Research, Inc., Rockville, Md.
INVESTIGATION OF TECHNOLOGY NEEDS FOR AVOIDING HELICOPTER PILOT ERROR RELATED ACCIDENTS Final Report
R. I. CHAIS and W. E. SIMPSON Washington NASA Jun. 1985 54 p
(Contract NASW-3554)
(NASA-CR-3895; NAS 1.26:3895; ORI-TR-2384) Avail: NTIS HC A04/MF A01 CSCL 01C

Pilot error which is cited as a cause or related factor in most rotorcraft accidents was examined. Pilot error related accidents in helicopters to identify areas in which new technology could reduce or eliminate the underlying causes of these human errors were investigated. The aircraft accident data base at the U.S. Army Safety Center was studied as the source of data on helicopter accidents. A randomly selected sample of 110 aircraft records were analyzed on a case-by-case basis to assess the nature of problems which need to be resolved and applicable technology implications. Six technology areas in which there appears to be a need for new or increased emphasis are identified. E.A.K.

N85-25221# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S), A-84-128 THROUGH -133
29 Nov. 1984 5 p
(REPT-3996C/41) Avail: NTIS HC A02/MF A01

On January 13, 1984, Pilgrim Airlines Flight 35, a Fokker F-27-100 (N148PM), crashed on runway 4-L at John F. Kennedy International Airport, Jamaica, New York, shortly after takeoff. Following takeoff, at about 100 feet above the ground, the No. 1 engine autofeathered followed within seconds by a loss of power in the No. 2 engine. The airplane rapidly lost altitude and crashed on the runway and slid about 1,200 feet before coming to rest. There was no fire. The flight attendant sustained a spinal fracture, and the captain and 13 passengers sustained minor injuries. The first officer and 8 passengers, including a 3-month-old infant and a 2 1/2-year-old-child were not injured. The National Transportation Safety Board's investigation of the accident identified several conditions which adversely affected the postcrash evacuation of the crew and passengers. It also found that information contained in the flight attendant's manual was imprecise, incomplete, or inappropriate. These safety hazards were not uncovered during the FAA airworthiness and operating certification inspections of this airplane in connection with the airplane being brought into U.S. registry. The Board believes that FAA operations and maintenance inspectors should increase their surveillance and review their procedures. A.R.H.

N85-25222# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S), A-84-123 AND -124
16 Nov. 1984 7 p refs
(REPT-3894B/93) Avail: NTIS HC A02/MF A01

On February 28, 1984, Scandinavian Airlines System (SAS) Flight 901, a McDonnell Douglas DC-10-30 of Norwegian Registry, was a regularly scheduled international passenger flight from Stockholm, Sweden, to John F. Kennedy International Airport (JFK), New York. Following a category 2 instrument landing system approach to runway 4 right at JFK, the airplane touched down long and fast after which it rolled off the end of the runway and came to rest with its nose partially submerged in a tidal waterway about 600 feet beyond the departure end of the runway. The 163 passengers and 14 crewmembers evacuated the airplane safely, but with some injuries. The Safety Board determined that the probable cause of this accident was the flightcrew's: (1) disregard for prescribed procedures for monitoring and controlling of airspeed during the final stages of the approach; (2) decision to continue the landing rather than to execute a missed approach; and (3) overreliance on the autothrottle speed control system which had a history of recent malfunctions. A.R.H.

N85-25223# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S), A-84-96
15 Aug. 1984 4 p refs
(REPT-3983A/217) Avail: NTIS HC A02/MF A01

About 0514 eastern standard time, on March 30, 1983, Central Airlines Flight 27, a Gates Learjet model 25, crashed during a landing attempt on runway 4 right at Newark International Airport, Newark, New Jersey. Flight 27 was operating as a nonscheduled cancelled bank check courier under 14 CFR Part 135. The airplane was destroyed on impact and the two pilots died as a result of the accident. Toxicological testing done on mucous membrane specimens of both pilots indicated that they had used or been exposed to marijuana within the past 24 hours. In addition, gas chromatography/mass spectrometry testing on the urine of the pilot in command revealed a delta-9-THC level comparable to marijuana use within the previous 24 to 48 hours. The National Transportation Safety Board determined that the probable cause of this accident was: (1) the loss of control following ground contact;

(2) an unstabilized approach; and (3) likely impairment of the flightcrew's judgment, decisionmaking, and flying abilities by a combination of physiological and psychological factors. G.L.C.

N85-25224# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S), A-84-76 THROUGH -78
12 Jul. 1984 4 p
(REPT-3751E) Avail: NTIS HC A02/MF A01

The National Transportation Safety Board has completed its investigation of the accident involving Air Canada Flight 797, which occurred on June 2, 1983, when an in-flight fire forced the flightcrew of the McDonnell Douglas DC-9 airplane to make an emergency landing at the Greater Cincinnati Airport. Upon landing, a flash fire occurred in the cabin. The five crewmembers and 18 passengers were able to evacuate the burning cabin; the remaining 23 passengers died in the fire. The Safety Board's investigation has determined that the fire propagated through the airplane's left rear lavatory, but was unable to identify positively the source of ignition. G.L.C.

N85-25225# Ametek, Santa Barbara, Calif. Offshore Research and Engineering Div.
AIRCRAFT SKIN PENETRATOR AND AGENT APPLICATOR. VOLUME 2: TEST AND EVALUATION Final Report, 17 Sep. 1982 - 15 Mar. 1983
R. H. CUTHBERTSON Tyndall AFB, Fla. Air Force Engineering and Services Center Nov. 1984 33 p
(Contract F08635-82-C-0472)
(AD-A151609; AFESC/ESL-TR-84-12-VOL-2) Avail: NTIS HC A03/MF A01 CSCL 13L

The need for development of the tool evolved from the fact that current USAF firefighting equipment does not provide rapid access to aircraft fires occurring in airframe voids where access ports are either limited or not provided. This report covers development and construction of an aircraft skin penetrator device to provide rapid penetration and allow placement of a suitable fire suppressing agent onto the base of an aircraft fire. Volume 1 discusses in detail the research conducted on the development of the proposed working model of the Aircraft Skin Penetrator/Agent Applicator. The report contains photographs of the different concepts considered. Volume 2 has detailed drawings showing the construction of the working model Penetrator and sketches which show how the Penetrator may be used to fight aircraft fires. GRA

N85-25226# Systems Research Labs., Inc., Dayton, Ohio.
PRELIMINARY DESIGN OF A LIMB RESTRAINT EVALUATOR Final Report
R. P. WHITE, JR., T. W. GUSTIN, and M. C. TYLER Dec. 1984 132 p
(Contract F33615-81-C-0500)
(AD-A151749; AFAMRL-TR-84-042) Avail: NTIS HC A07/MF A01 CSCL 06G

This report summarizes the results of mechanical and instrumentation design studies conducted to formulate the preliminary design of a system to measure the effectiveness of various limb restraint systems during wind tunnel, rocket sled, or laboratory tests. The system is to be integrated into an anthropometric test dummy designated the Limb Restraint Evaluator (LRE). Mechanical design considerations include anthropometry, joint articulation, structural strength, the usability of available commercial components, and sensor selection and placement. The instrumentation will have a total capability of 96 channels of data, including 52 LRE parameters involving limb joint rotation, knee joint loads, forces and moments developed at the neck and forearm, and torso accelerations. The system will also be capable of recording data from up to 26 transducers mounted on the ejection seat. The major conclusion is that a successful limb restraint evaluator can be designed and constructed, using current state-of-the-art techniques and many existing components from anthropomorphic dummies, to survive the extreme environmental conditions to which it will be exposed, and to accurately evaluate the effectiveness of various limb restraint devices in preventing limb flailing during aircraft ejections. GRA

N85-25229# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
25 May 1985 56 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-014) Avail: NTIS HC A04/MF A01

An overview of various aspects of the Soviet transportation industry are presented. Topics discussed include: (1) civil aviation; (2) motor vehicles and highways; (3) rail systems; (4) maritime and river fleets; and (5) intersector network development.

N85-25230# Joint Publications Research Service, Arlington, Va.
DESIGNER O. K. ANTONOV ON NEW AN-74 ARCTIC TRANSPORT
O. K. ANTONOV and T. KUZNETSOVA *In its* USSR Rept.: Transportation (JPRS-UTR-84-014) p 1-3 25 May 1985 Transl. into ENGLISH from Pravda Ukr. (Kiev), 22 Mar. 1984 p 4
Avail: NTIS HC A04/MF A01

A brief non-technical overview of the Antonov AN-74 aircraft is presented. The AN-74 is designed for operation in the Arctic and Antactic regions. G.L.C.

N85-25231# Joint Publications Research Service, Arlington, Va.
ILYUSHIN BUREAU DESIGNER ON FUEL CONSERVATION RESEARCH
G. NOVOZHILOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-014) p 4-5 25 May 1985 Transl. into ENGLISH from Vozdushnyy Transp. (Moscow), 5 Apr. 1984 p 2
Avail: NTIS HC A04/MF A01

Measures aimed at reducing the overall expenditure of aviation fuel by aeroflot were examined. Topics mentioned included: (1) economical flight profiles; (2) selection of rational take-off and landing course; (3) optimal plans for plane steering at airports; (4) utilization of straight plane routes; and (5) decreasing engine idle time while planes are on the ground. Part of the task was solved by a mathematical-economic model employing the use of a computer. G.L.C.

N85-26602*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIRCRAFT SAFETY IMPROVEMENT
G. KAO *In its* NASA Ames Summer High School Apprenticeship Res. Program p 69-74 Apr. 1985
Avail: NTIS HC A06/MF A01 CSCL 01C

Fabrication and testing of honeycomb sandwich aircraft panels are discussed. Also described is the use of the following instruments: thermogravimetric analyzer, differential scanning calorimeter, limiting oxygen index, and infrared spectrometer. B.G.

N85-26684 Department of the Navy, Washington, D. C.
TORSO RESTRAINT SYSTEM Patent
D. L. LORCH, inventor (to Navy) 18 Dec. 1984 7 p Supersedes AD-D010207
(AD-D011609; US-PATENT-4,488,691; US-PATENT-APPL-SN-453444; US-PATENT-CLASS-244-151)
Avail: US Patent and Trademark Office CSCL 01C

This patent discloses a harness system for releasably restraining the torso of a crewman in a set aboard an aircraft. The harness system includes an upper torso restraint adapted to engage the seat at points on either side thereof and wherein a pair of chest straps connected to either side of a backpad are slidingly routed through respective roller fittings in a criss-cross fashion across the crewman to permit upper torso rotation. A separate lower torso restraint is coupled to the upper torso restraint and adapted to engage the seat at the same points of engagement as the upper torso restraint. A single-action release mechanism, actuated manually or automatically by water immersion, disengages both the upper and lower restraints from the seat thereby divesting the crewman of the harness system. GRA

N85-26685# Committee on Public Works and Transportation (U. S. House).
THE IMPACT OF WEATHER ON AVIATION SAFETY
Washington GPO 1984 722 p Hearings before the Subcomm. on Invest. and Oversight of the Comm. on Public Works and Transportation, 98th Congr., 1st Sess., 24, 26 Mar., 19-20 May 1981 and 18 Aug., 6-7 Dec. 1983
(GPO-35-520) Avail: Subcommittee on Investigations and Oversight

Hearings were conducted and testimony heard on the role of weather as a casual or serious factor in air carrier accidents. Federal Aviation Administration and National Weather Service weather detection and reporting capabilities were examined. G.L.C.

N85-26686# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: UNITED AIRLINES FLIGHT 663, BOEING 727-222, N7647U, DENVER, COLORADO, MAY 31, 1984
21 Mar. 1985 78 p
(PB85-910405; NTSB/AAR-85/05) Avail: NTIS HC A05/MF A01

On May 31, 1984, at 1334 m.d.t., United Airlines Flight 663, a Boeing 727, struck the localizer antenna 1,074 feet beyond the departure end of runway 35L during takeoff at Stapleton International Airport, Denver, Colorado. There were no injuries, but the airplane sustained substantial airframe damage when it struck the antenna. The National Transportation Safety Board determines that the probable cause of the accident was an encounter with severe wind shear from microburst activity following the captain's decision to take off under meteorological conditions conducive to severe wind shear. Factors which influenced his decisionmaking include: (1) the limitations of the low level wind shear alert system to provide readily usable shear information, and the incorrect terminology used by the controller in reporting this information; (2) the captain's erroneous assessment of a wind shear report from a turboprop airplane and the fact that he did not receive a wind shear report from a departing airplane similar to his airplane because of congestion on the air traffic control radio frequency; (3) successful takeoffs made by several other air carrier airplanes in sequence; and (4) the captain's previous experience operating successfully at Denver under wind shear conditions. Author

N85-26687*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF WIND VELOCITY IN THUNDERSTORMS DETERMINED FROM MEASUREMENTS BY A GROUND-BASED DOPPLER RADAR AND AN F-106B AIRPLANE
J. W. USRY, R. E. DUNHAM, JR., and J. T. LEE (NOAA, Norman, Okla.) Apr. 1985 39 p refs
(NASA-TM-86348; L-15875; NAS 1.15:86348) Avail: NTIS HC A03/MF A01 CSCL 01C

As a part of the NASA Storm Hazards Program, the wind velocity in several thunderstorms was measured by an F-106B instrumented airplane and a ground-based Doppler radar. The results of five airplane penetrations of two storms in 1980 and six penetrations of one storm in 1981 are given. Comparisons were made between the radial wind velocity components measured by the radar and the airplane. The correlation coefficients for the 1980 data and part of the 1981 data were 0.88 and 0.78, respectively. It is suggested that larger values for these coefficients may be obtained by improving the experimental technique and in particular by slaving the radar to track the airplane during such tests. R.J.F.

N85-26688# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
IMPROVING INFLIGHT NEGATIVE GZ RESTRAINT FOR AIRCREWMEN Final Report
D. LORCH Aug. 1984 43 p
(AD-A151909; NADC-84114-60) Avail: NTIS HC A03/MF A01 CSCL 01C

Inadequate negative Gz restraint has been cited as a factor preventing pilots from recovering control of their aircraft after a departure from positive G maneuvers. Several prototype XV seat-mounted harnesses were designed and tested to determine if they might provide improved inflight restraint. Although they were able to improve restraint, none of them could meet the rigid and conflicting demands which were imposed. The restraint which met most of the requirements was the MA-2 Torso Harness with the addition of a seat-mounted Y shoulder strap. The Y strap reduced average head displacement to about one-third of its former value (from 6cm to 2cm for a 50% subject at -1Gz). No problems were uncovered during seat/man separation tests, and the Y strap did not restrict upper torso rotation. GRA

N85-26689# Oak Ridge National Lab., Tenn.
GENERALIZED ESCAPE SYSTEM SIMULATION: ITS PURPOSE, RECENT MODIFICATIONS AND POTENTIAL
G. E. LIEPINS and S. Y. OHR 1984 5 p Presented at the SAFE Association meeting, Las Vegas, Nev., 9 Dec. 1984
(Contract DE-AC05-84CR-21400)
(DE85-005571; CONF-841257-1) Avail: NTIS HC A02/MF A01

The Generalized Escape System Simulation (GESS) model and recent modifications expected to contribute to a more useful AAES/AISS in-service usage data analysis system are discussed. the GESS code was developed for CDC hardware from various precursor codes by the Naval Air Development Center (NADC), and was recently transcribed to IBM compatibility by Oak Ridge National Laboratory. The capabilities of the GESS code, the needs that are expected to be met by the transcribed IBM version, longer-range modifications, and the expected benefits resulting from the transcribed IBM version both to the Crew Systems Division, Naval Air Systems Command, and the AAES community in general are discussed. DOE

N85-26690# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de la Physique Generale.
LIGHTNING STRIKES ON AIRCRAFT. THE TRIP 82 EXPERIMENT AND 3-DIMENSIONAL ELECTROMAGNETIC INTERFEROMETRY Final Report [FOUDROIEMENT DES AERONEFS. EXPLOITATION TRIP 82. INTERFEROMETRIE ELECTROMAGNETIQUE A 3 DIMENSIONS]
P. LAROCHE, P. RICHARD, G. LABAUNE, S. LARIGALDIE, J. APPEL, F. DUNAND, J. MARCAULT, F. BROUTET, and J. L. BOULAY Sep. 1984 238 p refs In FRENCH
(Contract DRET-83/34.123)
(ONERA-RF-88/7154-PY) Avail: NTIS HC A11/MF A01

The electrical properties of triggered lightning and its effects on aircraft were studied using a hemispherical ended cylinder that simulated an aircraft fuselage when struck by lightning. The triggering system used the wire and rocket technique. Current, light emitted, magnetic fields and distant VHF radiation were measured. Triggered flashes, in particular flashes that deviate from the evaporated wire, exhibit a behavior close to that of naturally occuring upward initiated discharges. This makes triggering a powerful tool for all lightning studies. Author (ESA)

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A85-33755
THERMAL TEST AND ANALYSIS OF SEM FORMAT B INTEGRATED RACK AND APPLICATION TO SEM FORMAT C
V. CIRRITO and H. SCHNEIDER (Grumman Aerospace Corp., Bethpage, NY) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 14th, San Diego, CA, July 16-19, 1984. 12 p.
(SAE PAPER 840944)

The results of thermal modeling and analysis for a three-tier integrated rack, utilizing SEM Format B modules, are compared to thermal test data. Direct application of the analysis and test results to system design restraints such as maximum power per module, component junction temperature, environmental control system airflow, heat exchanger design parameters, pressure drop and module retainer requirements are presented for SEM Format B modules. Extrapolation of these results to various SEM Format C module configurations is presented defining changes in thermal design restraints. Author

A85-33763
DEVELOPMENT AND TESTING OF FORCED-AIR COOLED ENCLOSURES FOR HIGH DENSITY ELECTRONIC EQUIPMENT
R. C. ZENTNER and T. J. KRAMER (Boeing Aerospace Co., Seattle, WA) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 14th, San Diego, CA, July 16-19, 1984. 7 p.
(SAE PAPER 840952)

A family of standardized avionics enclosures has been designed, fabricated and tested. These enclosures accommodate Standard Avionics Module circuit cards which utilize aluminum base plates and are cooled by conduction to their mounting guiderails in the enclosure. The guiderails incorporate high performance module clamps and state-of-the-art brazed-fin heat exchange for air cooling. The enclosures are designed to be cooled by air delivered from an aircraft environmental control system. Cooling effectiveness and enclosure thermal performance have been determined by laboratory tests. Typically, the enclosures provide 85 C (185 F) module edge temperatures while operating with 27 C (80 F) cooling air in a 71 C (160 F) ambient environment. With an operating pressure loss of 374 Pa (1.5 inches of water), their outlet cooling air temperature approaches 71 C (160 F). This results in cooling effectiveness of about 22.7 g/s (3 lb/min) of cooling air per kW. This paper describes engineering analysis, enclosure thermal and airflow design features, and performance testing results. Author

A85-33774#
DESIGN OF A RADAR GUIDANCE MECHANISM USING MECSYN ANIMEC
A. MYKLEBUST, C. F. REINHOLTZ (Virginia Polytechnic Institute and State University, Blacksburg, VA), W. H. FRANCIS (Bendix Avionics Service Center, Ft. Lauderdale, FL), and M. J. KEIL (Motorola, Inc., Ft. Lauderdale, FL) American Society of Mechanical Engineers, Design Engineering Technical Conference, Cambridge, MA, Oct. 7-10, 1984. 6 p. refs
(ASME PAPER 84-DET-139)

To improve the scan angle for in-wing radar on small single engine aircraft, an RPRP mechanism was designed and patented. A revolute jointed linkage was subsequently designed using mechanism synthesis software. The resulting design did not strictly meet all design criteria. An extended design effort produced many similar solutions and one good but rare solution. Ease of use and rapid display of solutions by the design software contributed significantly to the satisfactory solution of the problem. Author

A85-33999#
EFFECT OF COUNTERPOISE ON VOR ANTENNA RADIATION PATTERNS
C. C. MOUBY, S. SURENDER, C. D. RAO, and S. S. KUMAR (V R Siddhartha Engineering College, Vijayawada, India) Institution of Engineers (India), Journal, Electronics and Telecommunication Engineering Division (ISSN 0020-3378), vol. 65, Aug. 1984, p. 11-13.

Quanatification of the effect of ground on the radiation pattern of the VOR antenna arrangement is discussed. Although the resulting minima may be probleematic in certain cases, it can be reduced by putting up a counterpoise between the VOR and the ground. The geometry is analyzed by using the method of images. The design considerations for the counterpoise are clarified. Comparison of the radiation pattern, with a counterpoise, with the case where no counterpoise is used reveals the efficacy of the counterpoise. M.D.

A85-34217
WIDESPREAD CIVIL USES ENVISIONED FOR SATELLITE NAVIGATION SYSTEM
B. A. SMITH Commercial Space (ISSN 8756-4831), vol. 1, Spring 1985, p. 27-29.

It is expected that the Defense Department's Navstar global positioning system (GPS) will be utilized by many civil users, taking into account trucks, emergency vehicles, pleasure boats, and commercial aircraft. An important factor regarding the realization of the expectations is the production of reliable and relatively low-cost receiver sets for the GPS signals. Some industry officials believe that the use of receivers will expand gradually during the next two to three years, and then accelerate rapidly once the satellite system has become operational. The largest civilian market for receivers is expected to be land-based users, while the second largest segment of the civilian market involves marine applications. Attention is given to a number of applications of the GPS signals and the devices which have been or are being developed for these applications. G.R.

A85-34490
SATELLITE COMMUNICATION PERFORMANCE EVALUATION MODEL FOR AIRCRAFT SYSTEMS
K. A. SADLER (Lockheed-California Co., Burbank, CA) IN: Milcom '83; Proceedings of the Military Communications Conference, Washington, DC, October 31-November 2, 1983. Volume 2 . New York, Institute of Electrical and Electronics Engineers, Inc., 1983, p. 428-432. refs

The model was developed to cost-effectively evaluate candidate antenna systems for Satellite Communications between the P-3C Orion Anti-Submarine aircraft and the Navy Anti-Submarine Warfare Operational Centers (ASWOC). Constituent elements of the model are discussed, data used by the model are described and a comparison to actual flight test results is made. Limitations in the model are indicated with possible improvements noted. The model was tailored to determine performance during P-3C ASW operations; however, it can be easily altered for other aircraft and tactical scenarios. Author

A85-36284
NAVIGATION AND SENSOR ORIENTATION SYSTEMS IN AERIAL PHOTOGRAPHY
F. L. J. H. CORTEN ITC Journal (ISSN 0303-2434), no. 4, 1984, p. 296-304.

The principles of such navigation approaches as deduced reckoning, position fixing, and inertial navigation are reviewed, centering on the potential improvements to their accuracy in aerial photography. The in-flight performance of several systems is discussed, including distance measuring equipment and VOR stations, airborne tellurometer or aerodist, microwave beacon systems, computer controlled photo navigation system, and Doppler radar for planimetric position determination; and laser altimeter, statoscope, hypsometer, and airborne profile recorders for altitude determination. Consideration is also given to the Global Positioning System Navstar, which consists of 18 orbiters (three satellites in each orbital plane) and is expected to provide an accuracy of + or - 3.5 m horizontally, 4.5 m vertically, and 0.05 m/s in speed. Finally, the applications of the systems and the economic aspects of their operation are detailed. L.T.

A85-36426
FLIGHT SYSTEMS OF FUTURE COMMERCIAL AIRCRAFT [LES SYSTEMES DE CONDUITE DU VOL DES FUTURS AVIONS COMMERCIAUX]
F. MUSZYNSKI (Compagnie Nationale Air France, Service du Developpement Technique, Paris, France) Navigation (Paris) (ISSN 0028-1530), vol. 33, April 1985, p. 155-164. In French.

The extension of digital techniques to the electronics of commercial aircraft, resulting in significant improvements in human engineering, flight management, and the effectiveness of on-board systems, is discussed. It is shown that most equipment that asssures flight control is regrouped or integrated in organized systems around one or more central computers, thus reducing the risk of total breakdown. The principal systems of future aircraft such as flight control systems, flight management systems, pilot instrument systems (global positioning system and NAVSAT) and communication systems are described. M.D.

A85-36429
ERRARE HUMANUM EST
J.-C. BUCK Navigation (Paris) (ISSN 0028-1530), vol. 33, April 1985, p. 194-199. In French.

The errors related to airborne navigation systems, which occur because the actual needs of the aircrews and the peculiarities of human behavior are not sufficiently accounted for, are discussed. Consideration is given to INS and Omega, and to the errors that occur with regard to initialization, programming, the use of electronic computers, and coupling to an automatic pilot. It is shown that the errors can be avoided or detected in time by a crew that is well-trained and very alert. Navigation errors can be due to the incorrect execution of commands by an overexhausted crew, to a poorly qualified crew, to falsely transmitted information received by the crew, and to visual illusions. It is found that the human factors of the flight are as important as the technical aspects and that better communication and cooperation is needed between the aircraft designers and pilots in order to avoid future errors. M.D.

A85-36430
MLS EXISTS - WE HAVE TESTED IT [LE MLS EXISTE - NOUS L'AVONS ESSAYE]
B. FRANCK Navigation (Paris) (ISSN 0028-1530), vol. 33, April 1985, p. 221-229. In French.

Flarescan, a hybrid system which combines two technologies, metric-wave ILS and MLS, is described. This system permits the exploration of the guidance possibilities offered by centimetric waves in the flare phase preceding landing. An outline of the tests performed on Flarescan in 1965-1966 and arranged by the Centre d'Exploitation Postal Metropolitain, is presented, the equipment involved is examined, and the results are summarized. DC-4s equiped with Flarescan participated in the flight tests. The aircraft which were manned and staffed by Air France flying and ground personnel, airlift domestic mail for the French postal service. M.D.

A85-36509
RANDOM AIR TRAFFIC GENERATION FOR COMPUTER MODELS
J. L. GOODWIN (International Computers, Ltd., London, England) and R. L. FORD (Royal Signals and Radar Establishment, Malvern, Worcs., England) Journal of Navigation (ISSN 0020-3009), vol. 38, May 1985, p. 218-233. Research supported by the Civil Aviation Authority.

Some of the problems of random air traffic generation for a computer model are discussed and two approaches are described. The first approach to the problem involves a two-dimensional model for a circular playing area and other convex shapes. The second approach which is based on a traffic flux concept is applied to two-dimensional and three-dimensional models, and allows the use of any convex volume of airspace made up of plane surfaces. An explanation of the effects on conflicts of the discontinuities at the boundaries of such models is given. M.D.

A85-36510
EFFECTS OF MEASUREMENT ERRORS IN ESTIMATING THE PROBABILITY OF VERTICAL OVERLAP
S. NAGAOKA (Electronic Navigation Research Institute, Mitaka, Tokyo, Japan) Journal of Navigation (ISSN 0020-3009), vol. 38, May 1985, p. 234-243. refs

Mathematical equations for the probability density function (PDF) of observed relative vertical distance are derived, under the assumption that the PDF of heightkeeping errors is either double-exponentially or double-double-exponentially distributed. Attention is given to numerical examples of the PDF of relative vertical distance, together with the overlap density function, in order to examine the effects of height measurement errors in estimating the probability of the vertical overlap from the distribution of relative vertical distance data. O.C.

N85-25193# Joint Publications Research Service, Arlington, Va.
ADMINISTRATION CHIEF ON AIR TRAFFIC CONTROL IMPROVEMENTS
A. KOLESNIKOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-015) p 1-4 31 May 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 3, Mar. 1984 p 30-31
Avail: NTIS HC A03

The implementation of a unified system of air traffic control in the Soviet Union, the introduction of automated air terminal and air routing systems, and the installation of unified air traffic controllers' consoles with modern radio and secondary radar equipment are discussed. The main link in the operation of the air traffic control system is the controller. Intense attention is being paid to raising the professional, ethical, and political level of these personnel through training at educational establishments, the use of special training equipment, and in-service training at aviation enterprises. More attention should be given to technical training and system work in the traffic control services themselves. The role of flight supervisors as the primary teachers for each shift is examined. A.R.H.

N85-25236# Systems Control Technology, Inc., West Palm Beach, Fla.
HELICOPTER USER SURVEY: TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) Final Report, Oct. 1983 - Feb. 1985
F. R. TAYLOR and R. J. ADAMS Apr. 1985 97 p refs
(Contract DTFA-80-C-10080)
(FAA-PM-85-6) Avail: NTIS HC A05/MF A01

The data collection methodology, and the results obtained from the Traffic Alert and Collision Avoidance System (TCAS) User Survey are described. Helicopter operator and pilot responses were examined in three particular areas of interest: (1) the nature of helicopter near mid-air collision encounters; (2) pilot display preferences; and (3) user price thresholds for a helicopter TCAS. The survey reveals that only a small percentage of near mid-air collisions involving helicopters are reported, although pilots assert tht mid-air collisions pose a significant hazard to flight safety. Significant characteristics of helicopter operations and their associated NMAC hazards which should be addressed in the design of a helicopter specific TCAS are broken down, according to operator group. A.R.H.

N85-25237*# Honeywell, Inc., St. Louis Park, Minn. Military Avionics Div.
ROTORCRAFT DIGITAL ADVANCED AVIONICS SYSTEM (RODAAS) FUNCTIONAL DESCRIPTION
E. M. PETERSON, J. BAILEY, and T. J. MCMANUS Jan. 1985 188 p
(Contract NAS2-11695)
(NASA-CR-166611; NAS 1.26:166611) Avail: NTIS HC A09/MF A01 CSCL 01D

A functional design of a rotorcraft digital advanced avionics system (RODAAS) to transfer the technology developed for general aviation in the Demonstration Advanced Avionics System (DAAS) program to rotorcraft operation was undertaken. The objective was to develop an integrated avionics system design that enhances rotorcraft single pilot IFR operations without increasing the required pilot training/experience by exploiting advanced technology in computers, busing, displays and integrated systems design. A key element of the avionics system is the functionally distributed architecture that has the potential for high reliability with low weight, power and cost. A functional description of the RODAAS hardware and software functions is presented. E.A.K.

N85-25238# Federal Aviation Administration, Washington, D.C.
NATIONAL AIRSPACE REVIEW. IMPLEMENTATION PLAN. REVISED
Jan. 1985 51 p
(AD-A151412) Avail: NTIS HC A04/MF A01 CSCL 17G

Since the summer of 1982, the Federal Aviation Administration (FAA) has been hosting task group working sessions of the National Airspace Review (NAR). The NAR is a cooperative venture by the aviation industry and government. The NAR is comprehensively reviewing current air traffic control procedures, flight regulations, and airspace for the purpose of validating the current system or identifying near-term changes which will promote greater efficiency. As a component of the National Airspace System Plan, the NAR will provide the operational framework for moving into the next generation National Airspace System. In the area of procedures, task groups have covered: terminal services, weather programs, traffic flow management, helicopter operations, separation standards and the national Flight Data System. In the regulations area, task groups have covered: regulated terminal airspace areas, and some aspects of airways and routes establishment and revocation. In the area of airspace task groups have covered: terminal and en route airspace configuration, routes, United States/Canada/Mexico interface, charts, Air Route Traffic Control Center infrastructure, and airspace reclassification. Study areas remaining to be reviewed are FAA Handbooks, several regulatory areas, and international airspace. Working sessions covering these areas will extend to the fall of 1984. GRA

N85-25241# Royal Signals and Radar Establishment, Malvern (England).
CALCULATION AND DISPLAY OF STACK DEPARTURE TIMES FOR AIRCRAFT INBOUND TO HEATHROW AIRPORT
J. O. COOK 31 Aug. 1984 17 p
(AD-A151991; RSRE-MEMO-3750; BR94334) Avail: NTIS HC A02/MF A01 CSCL 01E

The accurate calculation of delays to be absorbed by inbound aircraft is difficult in a manual Air Traffic Control environment. However, when flight plan information is computerized with adequate on-line data - transfer facilities, the problem may be solved. This memorandum suggests a way of automating and displaying to Air Traffic Controllers information about strategies for absorbing aircraft delays. Adoption of the proposed methods would have advantages for pilots, airline operators and Air Traffic Controllers. GRA

N85-26640# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).
COMBINATORIAL PERFORMANCE/COST ANALYSIS OF AN AUTONOMOUS NAVIGATION SYSTEM FOR AIRCRAFT [ANALYSE COMBINATOIRE PERFORMANCES/COUTS DUN SYSTEME AUTONOME DE NAVIGATION POUR AERONEFS]
P. LLORET and G. LAVOIPIERRE *In* AGARD Cost Effective and Affordable Guidance and Control Systems 12 p Feb. 1985 refs In FRENCH
Avail: NTIS HC A13/MF A01

A simple method is proposed for assisting the designer of autonomous navigation systems for aircraft in the choice of an optimal solution from the point of view of performance and cost. The proposed method is applied to a list of navigation system inertial navigation systems and on original rules uniting the price and the performance or the volume of the system considered. The combinatorial analysis proposed utilizes performance and cost data by comparing the cost of an inertial navigation system considered as a reference to the costs of solutions regarding a less effectively performing alternative inertial and one or more added sensors. The navigation of a combat helicopter is used to illustrate the method. Transl. by A.R.H.

N85-26641# Marconi Avionics Ltd., Rochester (England).
NAVIGATION: ACCOUNTING FOR COPY
D. J. HAMLIN *In* AGARD Cost Effective and Affordable Guidance and Control Systems 11 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The ideal navigation system, from the point of view of the supplier, is a saleable system. From the user's point of view, the ideal navigation system would support the operational functions of his vehicle with perfect precision at all times. That the matching of these aims has been challenging is evidenced by the staggering array of systems which have been marketed for the purpose since the 1940's, the range of principles employed, their characteristics and their costs. The contending technologies for the navigation element of various types of guidance and control applications are surveyed. The practical constraints on both supplier and user in attaining the ideals are illustrated. Examples are presented from both civil and military fields which are relevant to guidance and control, where improvements in cost effectiveness are being achieved. B.W.

N85-26650# Societe Crouzet, Valence (France).
THE USE OF A SELF-COMPENSATED MAGNETOMETER IN AN ECONOMICAL NAVIGATION SYSTEM FOR THE HELICOPTER [UTILISATION DUN MAGNETOMETRE AUTOCOMPENSE DANS UN SYSTEME DE NAVIGATION ECONOMIQUE POUR HELICOPTERE]
J. L. ROCH, J. C. GOUDON, and P. CHAIX *In* AGARD Cost Effective and Affordable Guidance and Control Systems 10 p Feb. 1985 refs In FRENCH
Avail: NTIS HC A13/MF A01

Analysis of a mission of a military helicopter show the need for installing a navigation system, since to assure its safety and avoid detection by enemy systems, the helicopter must follow the terrain at a height less than or equal to 50m, and at a varying speed. It is difficult to take bearings during the so-called tactical phases of flight. Various autonomous navigation systems are examined. The advantages of using a magnetometer, the choice of magnetic sensor, and the principles of compensation are discussed. Results obtained using a system with a three-axis static magnetometer on the PUMA SA 330 and the GAZELLE SA 342 helicopter aare summarized and conform to operational requirements of the French army for the GV76 and RDN 80 B. Transl. by A.R.H.

N85-26659# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
TERRAIN FOLLOWING WITHOUT USE OF FORWARD LOOKING SENSORS
H. F. SCHWEGLER and B. SCHREINER *In* AGARD Cost Effective and Affordable Guidance and Control Systems 3 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

A system is presented which allows an aircraft to follow a preplanned vertical profile along a planned route. Using a simple representation of the planned vertical profile instead of terrain data the computational tasks to be performed in the aircraft in real time are minimized. This system may ease some operational problems of todays military aircraft when flying in hostile environment until the advent of more sophisticated systems likely to be based on the intelligent combination of forward looking sensor data and stored map derived information G.L.C.

N85-26661# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
LOW COST TWO GIMBAL INERTIAL PLATFORM AND ITS SYSTEM INTEGRATION
R. N. PRIESTLEY and J. B. TOWLER *In* AGARD Cost Effective and Affordable Guidance and Control Systems 14 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The development of more accurate inertial systems has led to more expensive inertial instruments and complex electronics. Future navigation systems will require further improvements in accelerometer and gyro design in order to achieve the required performance. There are however doubts as to whether autonomous inertial systems will be sufficiently accurate. An alternative approach is to combine a second sensor with the inertial system to improve performance, for example doppler velocities or NAVSTAR/GPS positions and velocities. The inertial platform may then be simplified, retaining high accuracy only in the platform parameters having an impact on the integrated system performance. This simplification allows lower cost of ownership with an increase in reliability and a medium accuracy reversion capability. The inertial system computer may be programmed with the integration software so avoiding a separate dedicated integration computer with the consequent decrease in reliability. G.L.C.

N85-26691*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
NAVIGATION AND FLIGHT DIRECTOR GUIDANCE FOR THE NASA/FAA HELICOPTER MLS CURVED APPROACH FLIGHT TEST PROGRAM
A. V. PHATAK and M. G. LEE May 1985 133 p refs
(Contract NAS2-10850)
(NASA-CR-177350; NAS 1.26:177350) Avail: NTIS HC A07/MF A01 CSCL 17G

The navigation and flight director guidance systems implemented in the NASA/FAA helicopter microwave landing system (MLS) curved approach flight test program is described. Flight test were conducted at the U.S. Navy's Crows Landing facility, using the NASA Ames UH-IH helicopter equipped with the V/STOLAND avionics system. The purpose of these tests was to investigate the feasibility of flying complex, curved and descending approaches to a landing using MLS flight director guidance. A description of the navigation aids used, the avionics system, cockpit instrumentation and on-board navigation equipment used for the flight test is provided. Three generic reference flight paths were developed and flown during the test. They were as follows: U-Turn, S-turn and Straight-In flight profiles. These profiles and their geometries are described in detail. A 3-cue flight director was implemented on the helicopter. A description of the formulation and implementation of the flight director laws is also presented. Performance data and analysis is presented for one pilot conducting the flight director approaches. Author

N85-26692# Federal Aviation Administration, Washington, D.C.
NATIONAL AIRSPACE SYSTEM PLAN: FACILITIES, EQUIPMENT AND ASSOCIATED DEVELOPMENT
Apr. 1985 358 p
Avail: NTIS HC A16/MF A01

The National Airspace System (NAS), a mixture of equipment, techniques, and skills that evolved over 40 years is discussed. Improvements in the systems are outlined. The need to accommodate safely the increasing demand for aviation services, constrain costs, and solve the problems of aging facilities is emphasized. The specific improvements required long-term capabilities, and the planned system evolution remains essentially unchanged from previous editions. However, four new projects were added. The FAA has put in place a formal and disciplined management process to monitor and control schedules and costs of the NAS Plan. The NAS system requirements specification for the NAS and the system-level design are documented, baselined, and placed under configuration control. Risk areas in the program are identified, and SEI technical resources are applied to assist NAS projects in achieving milestone schedules. The new program management controls, SEI resources in place, and most of the major contracts awarded, the outlook is very favorable for the successful execution of the NAS Program Plan. E.A.K.

N85-26693# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AUTOFOCUS MOTION COMPENSATION FOR SYNTHETIC APERTURE RADAR AND ITS COMPATIBILITY WITH STRAPDOWN INERTIAL NAVIGATION SENSORS ON HIGHLY MANEUVERABLE AIRCRAFT M.S. Thesis
H. D. BAIRD, JR. Dec. 1984 56 p
(AD-A151940; AD-E751114; AFIT/GA/ENG/84D-1) Avail: NTIS HC A04/MF A01 CSCL 17I

This thesis investigated the feasibility of using state-of-the-art strapdown inertial navigation systems to motion compensate synthetic aperture radar aboard highly maneuverable aircraft. The applicable equations were first derived to obtain a comparison between inertial navigation system capabilities and synthetic aperture radar motion compensation requirements. Both turned gyro and laser gyro systems were investigated to determine the applicability for the task. The autofocus motion compensation technique was studied to determine if its range and squint angle boundaries could be improved by the use of highly accurate strap-down inertial navigation system measurements. It was determined that state-of-the-art strapdown inertial systems have the capability to motion compensate synthetic aperture radars in maneuvering aircraft and can improve the range and squint angle boundaries using the autofocus motion compensation technique. The results illustrate the ability of tactical aircraft to obtain high resolution imagery, as well as navigation and target information, while maintaining the low life-cycle cost of strapdown technology. GRA

N85-26694# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
GENERATION OF FLIGHT PATHS USING HEURISTIC SEARCH M.S. Thesis
C. S. LIZZA 1984 112 p
(AD-A151949; AFIT/CI/NR-85-17T) Avail: NTIS HC A06/MF A01 CSCL 12A

This thesis examines a solution to the problem of developing an effective, computer algorithm to route aircraft through hostile enemy defenses. The problem was proposed to assist in studies of the impact of varied, on-board countermeasures upon pre-planned aircraft routes. The quality of a route can be defined in terms of the cost of interaction between the aircraft and threats encountered along the path, and the length of the path. Current methods of automated routing are either inefficient or produce unsatisfactory results. Given a more general description of the problem, this thesis details a solution for developing routes by using the artificial intelligence technique of heuristic search in an A* algorithm. The algorithm uses heuristics based upon estimates of the degree of threat interactivity and distance from a point to

the goal. Due to the nature of the heuristic, the A* algorithm cannot guarantee development of a least-cost path. However, the heuristic may be adjusted to insure reasonably good results in most cases. Test cases confirm improvements in efficiency while maintaining solution quality comparable to previous methods. The flexibility of the algorithm allows applicability to the specific aircraft routing problem and to other route planning applications.
Author (GRA)

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-33437#
DESIGNING A V/STOL FIGHTER - MCDONNELL'S AV-8B HARRIER II
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, May 1985, p. 88-91.
The design innovations and performance gains obtained for the AV-8B 'Harrier II' V/STOL attack aircraft are discussed. In order to lower aircraft weight while increasing the strength required for enhanced payload carriage, an all-carbon fiber-reinforced composite wing primary structure was produced, together with a composite forward fuselage section and control surfaces. The greater thickness and planform area of this wing yield a 50 percent larger internal fuel volume, commensurately increasing range. Strakes have been appended beneath the fuselage to capture the down-vectored nozzles' flow during vertical operations. Attention is given to advanced design features that may be developed for a next-generation V/STOL fighter. O.C.

A85-33470
A DESCRIPTION OF HELIX AND FELIX, STANDARD FATIGUE LOADING SEQUENCES FOR HELICOPTERS, AND OF RELATED FATIGUE TESTS USED TO ASSESS THEM
P. R. EDWARDS (Royal Aircraft Establishment, Materials and Structures Dept., Farnborough, Hants., England) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 1, 1985, p. 13-33. refs
Helix and Felix are standard loading sequences which relate to the main rotors of helicopters with articulated and semi-rigid rotors respectively. The purpose of the loading standards is, first, to provide a convenient tool for providing fatigue data under realistic loading, which can immediately be compared with data obtained by other organizations. Second, loading standards can be used to provide design data. This paper outlines the form of Helix and Felix, summarizes their statistical content according to different counting methods and gives results of fatigue tests used to assess their usefulness. Author

A85-33471
A GENERAL MODEL OF HELICOPTER BLADE DYNAMICS
A. ROSEN and O. RAND (Technion - Israel Institute of Technology, Haifa, Israel) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 1, 1985, p. 35-50. refs
A general model describing the helicopter blade dynamics is presented. The model takes into consideration the case of planar curved blades, as well as straight blades, and accounts for structural nonlinearities for small strains and moderate elastic rotation; it is noted to be easily extendable to cases of higher nonlinearity. Furthermore, a model of the root dynamics is included which is capable of modeling a wide variety of the types of hubs and attachments of the blade to the hub, including elastomeric bearings and other flexible attachments. Calculations for the resultant moment and shear forces along the blade are performed through integration and include all nonlinear effects. Finally, several numerical examples are presented which demonstrate the model's flexibility. L.T.

A85-33752
THE CLOSED-LOOP AIR-CYCLE OPTION FOR EQUIPMENT COOLING ON AIRCRAFT
H. C. HOLLY (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 14th, San Diego, CA, July 16-19, 1984. 10 p.
(SAE PAPER 840940)
Cooling of electrical equipment often represents the largest cooling load on military aircraft environmental control systems. When this load is not accompanied by a similarly large fresh air ventilation demand, it is appropriate to consider closed-loop cooling systems so as to minimize power consumption. Vapor-cycle refrigeration generally is considered the most efficient. However, there are limitations on sink temperature which can make vapor-cycle refrigeration unusable in specific instances. Further, there are other applications where the available sink is marginal for known phase-change refrigerants. In such circumstances the efficiency or coefficient-of-performance of a closed-loop air-cycle refrigeration system can approach that of the vapor cycle. As the power advantage becomes smaller, the inherent maintenance or operational disadvantage of the vapor cycle tends to become an overriding consideration. Author

A85-33753
HELICOPTER COOLING, AIR CYCLE/VAPOR CYCLE TRADE-OFFS
R. D. BUCKINGHAM (Fairchild Control Systems Co., Manhattan Beach, CA) AIAA, SAE, ASME, AIChE, and ASMA, Intersociety Conference on Environmental Systems, 14th, San Diego, CA, July 16-19, 1984. 13 p.
(SAE PAPER A840942)
Lift and flight capabilities of high performance helicopters are severely impaired when engine bleed air is extracted for the environmental cooling system. Current high fuel costs have necessitated fuel consumption efficiency improvement. Passenger helicopter owners have expressed need of improved ground cooling and pulldown performance. State-of-the-art cooling systems (air cycle machines and vapor cycle systems) are compared as to: (1) cooling performance, (2) installed shift horsepower, (3) specific fuel consumption, (4) thermal diagrams, (5) psychometrics, and (6) coefficient of performance. These types are described by schematics, thermal diagrams and psychrometric plots. Since vapor cycle systems do not use engine bleed air, all helicopter performance is improved; flexibility of power source is also an advantage. Author

A85-33848
BOEING'S GROWN-UP BABY
Air International (ISSN 0306-5634), vol. 28, May 1985, p. 226-232, 248, 249.
After a brief development history of the 737 family of twin-engine airliners, attention is given to the design features and performance capabilities of the latest, 737-300 variant. The most prominent of the new features incorporated, and the most consequential in achieving the greater fuel economy sought in this design, is its reengining with the CFM 56-3B1 high bypass ratio turbofan of 20,000 lb thrust. The flight deck of the 737-300 has been remodeled in the wake of design experience gained with the 757/767 airliners. An assessment is made of orders received to date by the manufacturer, as well as general commercial prospects. O.C.

A85-33850
C-17 WILL FILL LONG-HAUL AIRLIFT GAP
Flight International (ISSN 0015-3710), vol. 127, April 27, 1985, p. 9-11.
An evaluation is made of the design features, performance capabilities, operational modes, and comparative economic and tactical advantages, of the projected C-17 long-haul military airlift aircraft, which has just begun engineering development, and will

make its maiden flight in 1989. Full deployment of a fleet of 210 C-17s is expected to be completed by 1998. In 1984 dollars, the $85 million unit cost of the C-17 compares with $141 million for the C-5B. Attention is given to cargo compartment accommodation schemes for trucks, tanks, armored personnel carriers, and helicopters. The C-17 is designed to serve in both airlift and paratroop drop operations. Design emphasis has been given to takeoff and landing in short/rough and foul weather airstrip conditions. O.C.

A85-33869
SYSTEMS FOR THE AIRBUS A320 - INNOVATION IN ALL DIRECTIONS
P. CONDOM Interavia (ISSN 0020-5168), vol. 40, April 1985, p. 353-355.

The Airbus A320 will be the first airliner to be equipped with digital flight controls, in association with side stick controllers, that are directly integrated with the aircraft flight management system. A built-in centralized test system for maintenance purposes and a full authority digital engine control system are also incorporated. The A320 flight deck will be almost entirely constituted of electronic visual displays. The degree of integration thus achieved among the various systems will yield a weight saving of up to several hundred kg. Flight time reductions obtainable through the digital engine controls and flight management system will also yield significant fuel savings. Attention is given to the electrical generation systems that will supply this all-electronic flight control system with the requisite degree of reliability. O.C.

A85-33870
HARRIER GR5, SECOND-GENERATION JUMP JET - EASIER RIDE, GREATER PUNCH
B. WANSTALL Interavia (ISSN 0020-5168), vol. 40, April 1985, p. 363-366.

An evaluation is made of the design features, performance capabilities, and fabrication method and weapons suite refinements, of the GR5/AV-8B second generation development of the Harrier VTOL fighter/attack aircraft. Among the prominent new features are a bubble canopy for improved visibility, a larger, supercritical airfoil section all-composite structure wing with high lift control surfaces, and redesigned cockpit display systems. The GR5 weapons complement is predicated on the primary use of this aircraft by the RAF in the Central European region; the AV-8B, by contrast, is intended for carrier operations in support of Marine Corps ground units. The GR5 incorporates the 'Zeus' integrated electronic countermeasures system. O.C.

A85-33871
JAPANESE AEROSPACE ADVANCES WITH XT-4 MILITARY TRAINER
P. J. RUBIN Interavia (ISSN 0020-5168), vol. 40, April 1985, p. 369-371.

A development history and current technological and economic status assessment are presented for the Japanese aerospace industry, with attention to the significance of its recent completion of design and construction for the XT-4 intermediate military trainer. The XT-4 is a tandem-seat, twin turbofan-engined subsonic aircraft employing fly-by-wire flight control and an onboard oxygen-generation system. It has been speculated that the XT-4 may be employed as a close-support fighter, but an entirely new design is anticipated as replacement for the Japanese Self Defense Air Force's current aircraft for this role, the FS-1. The XT-4 is noted to incorporate composite materials to the extent of 4.5 percent of total structural weight. O.C.

A85-34199
VERSATILE F/A-18 HORNET PERFORMS FIGHTER AND ATTACK MISSIONS
J. F. JUDGE Defense Electronics (ISSN 0278-3479), vol. 16, Dec. 1984, p. 71, 72, 74.

At the squadron level, an F-18 (fighter variant) can be converted to an A-18 (attack aircraft variant) in less than one hour, and vice versa. This offers a carrier group commander unprecedented air wing flexibility. Advanced digital technology furnished many added modes to the Hughes APG-65 radar that are not available in any current fighter, and is programmed to automatically counter most ECM threats. An HUD is the primary flight instrument, covering such data as airspeed, vertical speed, attitude, altitude, heading, Mach number, g-force, and delivery information for air-to-air and air-to-ground weapons. O.C.

A85-34260#
MANUFACTURE AND OPERATING COST APPRAISALS FOR MODERN AIRSHIPS
J. A. DEAN (Wren Skyships, Ltd., England) (Royal Aeronautical Society and Airship Association, Annual Symposium, 10th, London, England, Nov. 8, 1984) Airship (ISSN 0002-2853), no. 66, Dec. 1984, p. 16-19.

An evaluation is made of the economic viability of the manufacture and operation of a 1,600,000 cu ft metalclad airship using helium as its lifting gas. This project's basic philosophy is the restriction of research and development to the minimum; many of the airship's components will accordingly be directly comparable with those of established aircraft manufacturing practice, resulting in a construction cost estimate of 5.3 man-hours/lb of empty weight. Estimates are also undertaken for overhaul reserve, scheduled and line maintenance, crew costs, and fuel costs. O.C.

A85-34262
FLIGHT TEST PLANNING FROM THE BOTTOM UP - AN ALTERNATE APPROACH TO FLIGHT TESTING
W. G. SCHWEIKHARD (Kohlman Aviation Corp., Systems Research Div., Lawrence, KS) Cockpit (ISSN 0742-1508), Jan.-Mar. 1985, p. 5-14.

It is pointed out that flight testing has become so complex and so manpower intensive that it is almost impossible to do a simple program without massive amounts of support to install and maintain the data acquisition system and to analyze the data. The present investigation is concerned with the procedures used to gather, analyze, and report flight test results, taking into account possibilities for an employment of more efficient approaches. Attention is mainly given to small to moderate programs which can become unnecessarily large, and small, low priority projects which never get done because of the huge organizational structure that must be mobilized to get them under way. The conduction of the flight test in the past is considered along with the flight test today, aspects of top-down flight test planning, and bottom-up flight test planning. The advantages of a use of simpler data acquisition and analysis systems for many flight test investigations are pointed out. It is recommended to put the data system back in the hands of the investigator. G.R.

A85-34263
THE ROLE OF TESTING IN QUALIFICATION AND CERTIFICATION OF AIRCRAFT
C. C. CRAWFORD, JR. (USAF, Aviation and Surface Material Command, St. Louis, MO) Vertiflite (ISSN 0042-4455), vol. 31, May-June 1985, p. 64-68.

An assessment is made of helicopter manufacturers' experience with U.S. government agencies' involvement in flight tests, the detailed qualification requirements upon the awarding of a contract, the program management effects of design changes prompted by the discovery of flaws during flight testing, and the relative efficiencies of government and contractor-run test facilities. It is recommended that performance testing be conducted by government personnel exclusively, at a government rather than contractor facility. O.C.

A85-34581
TEST FLYING THE 146
M. GOODFELLOW (British Aerospace PLC, Hatfield, Herts., England) Aerospace (UK) (ISSN 0305-0831), vol. 12, May 1985, p. 5-24.

The configuration, characteristics, and results of flight tests of the BAe 146 jet-airliner are discussed, with detailed comparisons to the existing turboprops and turbojets of comparable size. Among the areas of comparison are the field performance, public, passenger, and pilot appeal, airworthiness, and design features. The aircraft is shown to have notably good stability, high lift-to-drag ratios in all configurations, lateral and directional control, and low noise. Due to its high lift/drag and thrust/weight ratios and simplicity the aircraft is noted to achieve a profitable blend of climb/cruise performance and low operating costs. L.T.

A85-34699
THE X-29 - IS IT COMING OR GOING?
G. KAPLAN IEEE Spectrum (ISSN 0018-9235), vol. 22, June 1985, p. 54-60.

An assessment is made of the development status, design features and performance capabilities of the X-29 forward swept-wing experimental aircraft, with emphasis on the dependency of its unstable flight control characteristics on a sophisticated system encompassing fly-by-wire actuator inputs and triply redundant digital and analog computers. Also noted are the advanced, aeroelastically tailored laminate composite wing structure design and manufacture techniques employed. The X-29 will reap maneuverability improvements from its relaxed static stability control dynamics, as well as aerodynamic efficiency (and mission range) improvements in virtue of its forward swept wing planform. O.C.

A85-35251
ASPECTS OF A SEE-SAW TAIL ROTOR BALANCING
V. KLOEPPEL and G. MARSCH (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984, Paper. 27 p. refs
(MBB-UD-423-84-OE)

A theoretical analysis of the impact of profile contour deviations on the aerodynamic properties of the helicopter tail rotor blades is performed. The unbalance factors under consideration include incorrect rotor hub mounting, pitch, track, and unsymmetric blade feathering moments. It is demonstrated that the main source of unbalance is the eccentric assembling of the tail rotor hub; such factors as manufacturing tolerances and the resulting aerodynamic unbalance and nonsymmetric blade feathering moment must also be taken into account. In the case of MBB tail rotors the anisotropy of the rotating components is determined to be low or nonexistent. Finally, it is noted that good balancing results can be obtained with the aid of linear theory. L.T.

A85-35253
BK 117 FOR DUAL PILOT IFR OPERATION
A. FAULKNER and H. KOENIG (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984, Paper. 18 p.
(MBB-UD-422-84-OE)

The instrumentation of the BK 117 rotorcraft, certified for dual-pilot IFR, is described. Cockpit instrumentation, and navigation and communication instruments are detailed, with consideration of both basic and alternative systems and displays. Particular attention is paid to the pitch, roll, and yaw control and stability augmentation system (CSAS); all three axes operate independently of each other, and may be operated on the single-axis basis under VFR. In addition, the trim and force feel system is described. Finally, flight test evaluation and its results are included, with consideration of the flight testing concept, the design optimization and stabilization parameters, and dynamic and static stability; testing has demonstrated a flexible flight envelope with a 45 KIAS V(min), a 1500-ft/min climb and descent, and a 9-deg steep approach. L.T.

A85-35350* Virginia Polytechnic Inst. and State Univ., Blacksburg.
ENERGY-MODELLED CLIMB AND CLIMB-DASH - THE KAISER TECHNIQUE
S. R. MERRITT, E. M. CLIFF, and H. J. KELLEY (Virginia Polytechnic Institute and State University, Blacksburg, VA) Automatica (ISSN 0005-1098), vol. 21, May 1985, p. 319-321. refs
(Contract NAG1-203)

F. Kaiser's germinal 1944 report on his 'resultant-height' concept, now known as energy modelling, is reviewed. The data base for the Me. 262 jet fighter is recreated via spline-lattice representation of specific excess power. Minimum-time and 'distance'-climb trajectories are generated in an attempt to check Kaiser's results. Agreement is good for the minimum-time calculations but only qualitative agreement is obtained for the mysterious 'distance climbs' whose documentation is fragmentary. The character of optimal climb-dash trajectories in energy approximation is examined and illustrated. Author

A85-35351
LHX - NOT JUST ANOTHER HELICOPTER
M. LAMBERT Interavia (ISSN 0020-5168), vol. 40, May 1985, p. 448-450.

An evaluation is made of the likely design features and capabilities of the U.S. Army's next-generation combat/utility helicopter system, the 'LHX', in view of the development status of the various technologies that will be integrated in its design. The decisive Army decision with respect to LHX configuration and level of technological innovation was the final stipulation of a 170-knot speed capability; this is well within the performance envelope intrinsic to conventional helicopter design practices. The single-pilot requirement, however, can be satisfied in a nap-of-the-earth mission aircraft like the LHX only through the incorporation of advanced pilot/control system integration methods, with cockpit avionics that may exceed the sophistication of those of the recent F-18 and F-20 single-seat fighter aircraft. Powerplant requirements have also been clarified. O.C.

A85-35352
X-WING HARRIER SPEED AND HELICOPTER HOVERING
M. LAMBERT Interavia (ISSN 0020-5168), vol. 40, May 1985, p. 501-504.

Attention is given to the projected design features and performance capabilities of an 'X-Wing' aircraft, whose operations would encompass efficient high subsonic forward flight and equally efficient hover and VTOL. Carbon fiber-reinforced composites and digital avionics are identified as essential technologies for X-Wing aircraft, in virtue of the severe and complex aerodynamic and structural loading experienced by the blades in both helicopter-like (rotating) and forward (fixed wing) flight regimes. A key element of the wing/rotor system is the use of Coanda-effect lift-generating slots in the leading and trailing edges of the airfoils, which are symmetrical about their central spar. Internally mounted compound engines turn compressors that will alternately drive rotor slot flow-generating of propulsion jets. An X-Wing system will be flight tested by the Rotor Systems Research Aircraft. O.C.

A85-35353
C-17 CLEARED FOR TAKE-OFF
P. TURK Interavia (ISSN 0020-5168), vol. 40, May 1985, p. 511, 512.

After noting the design features and development and production time tables envisaged for the U.S. Air Force's C-17 cargo airlift aircraft, attention is given to the comparative performance advantages expected over C-130, C-141 and C-5A/B capabilities in both intertheater and tactical operations. The C-17, despite extensive use of proven technology, will incorporate winglets and advanced flight control and cockpit display technologies. The C-17 structure will make comparatively little use of advanced composite materials. The four 37,000 lb-thrust turbofans are equipped with thrust reversers for short airfield operations, and the wings feature externally blown, double-slotted flaps for steep landing approaches and short field landings. O.C.

A85-35588#
EVALUATION OF INTERIOR NOISE CONTROL TREATMENTS FOR ADVANCED TURBOPROP AIRCRAFT
R. A. PRYDZ, J. D. REVELL, F. J. BALENA, and J. L. HAYWARD (Lockheed-California Co., Burbank, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 523-529. Previously cited in issue 10, p. 1375, Accession no. A83-25914. refs

A85-35748#
THE PERFECTION AND APPLICATION OF THE FLUTTER SUBCRITICAL RESPONSE ANALYTICAL METHOD
Q. LU, G. LU, and W. ZENG (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 66-72. In Chinese, with abstract in English.

The perfection and application of the random decrement/power spectrum subcritical response analytical method for use in wind tunnel model flutter tests are described. The establishment of the on-line analytical system and of the curve fitting method with exponential functions is shown, and the accuracy and application results of the method are discussed. Using the method, the effect of wind tunnel flow noise can be effectively eliminated, the running time is shorter, and the modes of closely spaced frequencies can be identified. The method's feasibility is good, and its practical application in tests of models A, B, C and of a 60 deg delta flat wind model shows that it can be applied to transonic, supersonic, and low-speed wind tunnel flutter tests. C.D.

A85-35818
AIRCRAFT FLIGHT STABILITY TESTING: DYNAMIC LOADING [LETNYE PROCHNOSTNYE ISPYTANIIA SAMOLETOV: DINAMICHESKIE NAGRUZKI]
M. D. KLIACHKO and E. V. ARNAUTOV Moscow, Izdatel'stvo Mashinostroenie, 1984, 120 p. In Russian. refs

Techniques used to evaluate the effects of vibrational and acoustic stresses on aircraft during flight are discussed. Consideration is given to both experimental and analytical methods. Practical applications of analytical methods of aircraft stability testing include: the selection of optimal performance criteria; identification of materials for aircraft structures; and the prediction of aircraft performance in flight tests. Consideration is also given to the major experimental techniques, including strain-gauge analysis, wind tunnel tests, and on board vibration measurements for in flight. The operating principles used in the design of instruments for flight stability testing are described. I.H.

A85-36147#
DESIGNING AIRCRAFT ON SMALL COMPUTERS
E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 23, June 1985, p. 70-73.

Several companies manufacturing small aircraft ranging from ultralights to business aircraft have developed aircraft design programs suitable for microcomputers. The programs each cover a specific design problem, e.g., aerodynamics, structural analysis, conversion of wind tunnel data to performance predictions, etc. The separate programs are claimed to offer greater ease of use than comprehensive packages on mainframes while being small enough to keep the designers in touch with the computations being performed. Turnaround time may actually be lower on microcomputers because a mainframe has hundreds of users, so feedback is slowed. The lack of iterative, fine-tuned accuracy in microcomputer designs leads to a reliance on flight testing, which then replaces numerous simulations. The standardization and book publication of many of the programs is regarded as a spur to a whole new generation of aircraft designers with no formal training - and no need for it - in aerodynamics. M.S.K.

A85-36149*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OBLIQUE WING READY FOR RESEARCH AIRCRAFT
T. GREGORY (NASA, Ames Research Center, Moffett Field, CA) Aerospace America (ISSN 0740-722X), vol. 23, June 1985, p. 78-81.

Performance features and possible design configurations for oblique wings which would lower the supersonic drag characteristics of fighter aircraft are described. The oblique shape reduces wave drag in proportion to the wing length, and can achieve reductions by factors of 4-16. Variable sweep would be accompanied by fuel pumping to maintain an acceptable center of gravity and tail loading. The lift forces remain balanced and thus remove fuselage loads considerations. Extra tail loading to handle longitudinal moments of center-of-lift shifts with variable sweep aircraft are also eliminated. However, oblique wings couple the roll, pitch and yaw axes and require digital controls to provide balancing forces. NASA has initiated a four phase design, construction and flight test program to examine the flight envelope of oblique wings on the F-8 aircraft. M.S.K.

A85-36150#
MILITARY MISSIONS CALL FOR OBLIQUE WING
Aerospace America (ISSN 0740-722X), vol. 23, June 1985, p. 82-84.

NASA is exporing designs leading to construction and flight tests of an oblique wing, variable sweep supersonic aircraft. The wing would be in normal position for cruise and loiter and be rotated to an oblique configuration for dashes and low level attack maneuvers. The obliqueness would lower drag 11-21 percent, compared to swept wings, and reduce supersonic wave drag by 26 percent. A 16 percent increase in payload is projected, implying a 20 percent larger mission radius for combat aircraft. Flight instabilities will be controlled digitally during test flights with an oblique wing on the NASA F-8 aircraft. The wing will have a GRE skin and Al frame. The flight tests will also examine the effects of wet wings, 90 deg pivoting of the wings for storage, and stores carriage, as well as innovative control circuitry such as fiber optics. M.S.K.

A85-36725
AEROSPACE TECHNOLOGY - PROJECTIONS TO THE YEAR 2000
J. H. BRAHNEY Aerospace Engineering (ISSN 0002-1458), vol. 5, Jan. 1985, p. 28-34.

A speculative assessment is made of the state-of-the-art of aeronautical technologies in the year 2000, in the wake of a study which encompassed contributions from industry, government, and academe. Attention is given to configurational possibilities which emerge from the integration of advancements in materials, aerodynamics, propulsion systems, control systems, and manufacturing processes. Also noted are the advantages of flight operations at supersonic, hypersonic, and near-orbital regimes. O.C.

N85-25242 Technische Geraete und Entwicklungsgesellschaft m.b.H., Klagenfurt (Austria).
FLYING OBJECTS Patent [FLUGKOERPER]
H. JORDAN Bern Swiss Patent Office 15 Feb. 1983 9 p In GERMAN Filed 23 Oct. 1978, Priority Dates 31 Oct. 1977 at AT 7749/77, 13 Jun. 1978 at AT 4309/78, 13 Jun. 1978 at AT 4310/78
(CH-634516-A5; INTL-CL.B64C-39/06; INTL-CL-A63H-27/02)
Avail: Swiss Patent Office

A flying object with especially good stability and economic properties and with the highest possible safety was developed. It is an axially symmetrical airship with, inside, a coaxial rotatable propulsion system supported on bearings. There is a control part and/or a cockpit to take a load. The airship is driven by the restoring torque produced by the propulsion system, in a direction opposite to that of the propulsion system. The control part and/or the cockpit are rotatably supported on bearings with respect to the airship and the propulsion system, and is stationary during the flight. Author (ESA)

N85-25243 Eidgenoessische Technische Hochschule, Grosshesselohe (West Germany).
AIRFOIL WING WITH FLAP Patent [TRAGFLUEGEL MIT KLAPPE]
B. GROB, E. GEGENHUBER, and E. BRETTING Bern Swiss Patent Office 28 Feb. 1983 7 p In GERMAN Filed 29 Jan. 1979, Priority Date 1 Feb. 1978 at DE 2804254
(CH-634787-A5; INTL-CL.B64C-3/50) Avail: Swiss Patent Office

An airfoil wing with a mobile flap on bearings was developed. On the upper side of the wing the outer cover of the plane reference area is connected to the outer cover of the flap via a thin flexible direct diaphragm. Cam slideways serve as bearings for the flap; they guide the point of support of the diaphragm at the flap approximately along a spiral trajectory around the point of support of the diaphragm at the plane reference area. By this measure stray flows unfavorably affecting the wing forces are avoided. Author (ESA)

N85-25244 Groupement d'Etudes et de Promotion pour Avions Legers, Paris (France).
AIRCRAFT STRUCTURE FOR APPLICATION TO TRAINING AIRCRAFT Patent [CELLULE D'AVION NOTAMMENT D'UN AVION D'ENTRAINEMENT]
R. RICHOUX, J. LEMACON, and J. R. PARMENTIER Bern Swiss Patent Office 31 Mar. 1983 15 p In FRENCH Filed 31 Mar. 1980, Priority Date 27 Mar. 1979 at FR 79 07587
(CH-635286-A5; REPT-2514/80; INTL-CL.B64C-1/00; INTL-CL.B64C-3/14) Avail: Swiss Patent Office

An aircraft structure designed using symmetrical elements, such that most of the left and right half wings are interchangeable is described. The design shows a cost advantage since the number of different elements required is about half. The design requires the utilization of symmetrical wing profiles such as NACA00 or a slight variation, the NACA23000 which can be obtained from the NACA00 by changing the leading edge. Author (ESA)

N85-25245 United Technologies Corp., East Hartford, Conn.
HELICOPTER ROTOR Patent [HUBSCHRAUBERROTOR]
D. L. FERRIS, W. L. NOEHREN, and P. C. OGLE Bern Swiss Patent Office 31 Aug. 1983 6 p In GERMAN Filed 9 Jul. 1979, Priority Date 12 Jul. 1978 at US 924110
(CH-637890-A5; INTL-CL.B64C-27/35) Avail: Swiss Patent Office

A helicopter rotor was developed. It has a flexible beam fixed to the rotor hub and extending radially opposite the hub. The beam carries a rotor blade at each end. A torque tube enclosing the beam extends radially inside from each rotor blade. There is an elastomer damper between the radial inner end of the torque tube and the beam. An inner plate of the damper is placed in a fixation part which is glued to the beam via an elastomer layer, in order that this damper can be simply replaced and remain connected to the beam during all blade motions. The fixation avoids motion of the inner plate in the transversal direction and radially outwards with respect to the beam, but allows a radial inward motion. An outer plate of the damper is fixed to the torque tube by a fast releasable and rebuildable screw joint. Author (ESA)

N85-25246 Kfoury (Elie Philippe), Cairo (Egypt).
AIRCRAFT Patent [FLUGZEUG]
E. P. KFOURY Bern Swiss Patent Office 30 Apr. 1984 6 p In GERMAN Filed 29 Feb. 1980
(CH-642598-A5; INTL-CL.B64C-29/00) Avail: Swiss Patent Office

A aircraft which is much easier to control than a helicopter was developed. The aircraft consists of parts arranged one after another and having about the same length and width. The front and back parts have the same average height; the middle part is higher and is designed as a cockpit with windows. The front and back parts are honeycombed from top to bottom by tubular channels in which driven lifting propellers are arranged which suck air from the top and blow it away at the bottom, producing drive. A thrust propeller with variable blade pitch produces a forward and backward thrust. Author (ESA)

N85-25247*# Sikorsky Aircraft, Stratford, Conn.
DESIGN, FABRICATION AND TEST OF COMPOSITE CURVED FRAMES FOR HELICOPTER FUSELAGE STRUCTURE
D. W. LOWRY, N. E. KREBS, and A. L. DOBYNS Oct. 1984 111 p refs
(Contract NAS1-16826)
(NASA-CR-172438; NAS 1.26:172438; SER-510145) Avail: NTIS HC A06/MF A01 CSCL 01C

Aspects of curved beam effects and their importance in designing composite frame structures are discussed. The curved beam effect induces radial flange loadings which in turn causes flange curling. This curling increases the axial flange stresses and induces transverse bending. These effects are more important in composite structures due to their general inability to redistribute stresses by general yielding, such as in metal structures. A detailed finite element analysis was conducted and used in the design of composite curved frame specimens. Five specimens were statically tested and compared with predicted and test strains. The curved frame effects must be accurately accounted for to avoid premature fracture; finite element methods can accurately predict most of the stresses and no elastic relief from curved beam effects occurred in the composite frames tested. Finite element studies are presented for comparative curved beam effects on composite and metal frames. E.A.K.

N85-25248*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT INVESTIGATION OF STALL, SPIN AND RECOVERY CHARACTERISTICS OF A LOW-WING, SINGLE-ENGINE, T-TAIL LIGHT AIRPLANE
H. P. STOUGH, III, D. J. DICARLO, and J. M. PATTON, JR. May 1985 98 p refs
(NASA-TP-2427; L-15868; NAS 1.60:2427) Avail: NTIS HC A05/MF A01 CSCL 01C

Flight tests were performed to investigate the stall, spin, and recovery characteristics of a four-place, low-wing, single-engine, T-tail, general aviation research airplane at an aft center-of-gravity position. Most stalls resulted in roll-offs. Spins were oscillatory in roll and pitch at 43 deg angle of attack; the magnitude of the oscillations was determined by aileron position. Power, flap deflection, and landing gear position did not affect the angle of attack to the spin. Antispin rudder followed by forward wheel with ailerons neutral produced the fastest and most consistent recoveries but the initial application of recovery controls did not always stop a spin. E.A.K.

N85-25250*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMULATOR STUDY OF THE STALL DEPARTURE CHARACTERISTICS OF A LIGHT GENERAL AVIATION AIRPLANE WITH AND WITHOUT A WING-LEADING-EDGE MODIFICATION
D. R. RILEY May 1985 86 p refs
(NASA-TM-86309; L-15792; NAS 1.15:86309) Avail: NTIS HC A05/MF A01 CSCL 01C

A six-degree-of-freedom nonlinear simulation was developed for a two-place, single-engine, low-wing general aviation airplane for the stall and initial departure regions of flight. Two configurations, one with and one without an outboard wing-leading-edge modification, were modeled. The math models developed are presented simulation predictions and flight-test data for validation purposes and simulation results for the two configurations for various maneuvers and power settings are compared to show the beneficial influence of adding the wing-leading-edge modification. E.A.K.

N85-25251# McDonnell Aircraft Co., St. Louis, Mo.
FIBER OPTICS APPLICATIONS FOR MIL-STD-1760 Final Report, 15 May 1983 - 13 Aug. 1984
G. L. WEINSTOCK and R. POPPITZ Wright-Patterson AFB, Ohio AFWAL Oct. 1984 180 p
(Contract F33615-83-C-1004)
(AD-A151113; AFWAL-TR-84-1162) Avail: NTIS HC A09/MF A01 CSCL 01C

Fiber optics offers attractive design options for information transfer systems with its advances of wide bandwidth and electromagnetic noise immunity. The DOD has recognized these potential benefits by allocating positions in the MIL-STD-1760 Primary Interface Signal Set connector for two future fiber optic bus lines. For several years, users and several connector manufacturers have been interested in a set of fiber optics contacts interchangeable with size 16 electrical contacts for the MIL-C-38999 connector. Preliminary prototype testing had been sufficiently successful to define a program of full scale qualification for aircraft applications. The result was this contract sponsored by the U.S. Air Force ASD/ENASA with the objective to identify and qualify a set of fiber optics interconnect components which would meet MIL-STD-1760 performance and environmental tests requirements. The program has been successful. A MIL-STD-1760 fiber optics interconnect set has been identified and qualified. Specifications for the component parts and materials have been written. Procedures for fabrication, installation, hardware use, maintenance/repair, and training have been developed. This fiber optics interconnect system is fully qualified and ready for aircraft use. GRA

N85-25252# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
AUTOMATIC DYNAMIC AIRCRAFT MODELER (ADAM), VOLUME 1 Final Report, 1 Mar. - 30 Sep. 1984
H. GRIFFIS Jan. 1985 31 p
(Contract AF PROJ. AFSD)
(AD-A151410; ASD-TR-84-5032-VOL-1) Avail: NTIS HC A03/MF A01 CSCL 01C

This user's manual is a description of the input required for Automatic Dynamic Aircraft Modeler (ADAM). ADAM is designed to generate NASTRAN structural models with minimal data or knowledge. The model generated by ADAM includes the executive, case control, and bulk data decks. The model is setup for eigenvalue analysis with the appropriate plotting commands. Volume 2 and 3 are, respectively, the Demonstrated Problems Manual and the Programmer's Manual. The User's Manual contains the input format and description of variables. GRA

N85-25253# Aeronautical Research Labs., Melbourne (Australia).
CALIBRATION LOADING OF A STRAIN-GAUGED DIVERLESS HELICOPTER WEAPON RECOVERY SYSTEM
M. HELLER Jul. 1984 43 p
(AD-A151486; ARL-STRUC-TM-386) Avail: NTIS HC A03/MF A01 CSCL 15E

This memorandum from Australia presents the results of a ground calibration loading test carried out on the Diverless Helicopter Weapon Recovery System (DHWRS). The DHWRS is essentially an aluminum alloy (6061-T6) cage, suspended by a cable from a helicopter, that is used to recover Mk48 torpedoes from the sea. It had been found that some DHWRS used in service had developed cracks at the welds in the aft ring. It was decided that the structural integrity of the DHWRS should be verified. This was done by a calibration loading test to determine the strains for typical loading conditions, and for a load of 24050N, which corresponds to the US Navy static proof load for the acceptance of the DHWRS. A regression analysis was carried out on the load/strain data. Equations relating applied load to measured strain are presented for several locations, including the critical position on the aft ring. Stress levels for a load of 24050N were calculated from the load/strain data. GRA

N85-25254# Naval Postgraduate School, Monterey, Calif.
PRELIMINARY HELICOPTER DESIGN DECISION MAKING BASED ON FLIGHT PERFORMANCE FACTORS M.S. Thesis
P. V. ADAMCIK Sep. 1984 98 p
(AD-A151488) Avail: NTIS HC A05/MF A01 CSCL 06C

This thesis assists those evaluating helicopter design to make preliminary judgements about the feasibility of new designs. By using the computer program developed in this thesis, a designer can produce estimates for power requirements, endurance velocity, rate of climb, range velocity, hover ceiling, and service ceiling versus main rotor radius. These estimates can also be examined for the effects of changes in main rotor radius, chord, and rotational velocity. GRA

N85-25255# Institute for Defense Analyses, Alexandria, Va.
COST-ESTIMATING RELATIONSHIPS FOR TACTICAL COMBAT AIRCRAFT Memorandum Report, Oct. 1983 - Sep. 1984
J. W. STAHL, J. A. ARENA, and M. I. KNAPP Nov. 1984 44 p
(Contract MDA903-84-C-0031)
(AD-A151575; AD-E500700; IDA-M-14, IDA/HQ-84-28793) Avail: NTIS HC A03/MF A01 CSCL 01C

This document presents four separate cost-estimating relationships (CERs): one each for RDT&E and procurement for helicopters and fixed-wing aircraft used in tactical air missions. The CERs are functions of such major characteristics as weight, thrust/weight ratio, speed and year of IOC. GRA

N85-25256# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MINIMUM TIME TURNS USING VECTORED THRUST M.S. Thesis
G. L. SCHNEIDER Dec. 1984 212 p
(AD-A151693; AFIT/GAE/AA/84D-24) Avail: NTIS HC A10/MF A01 CSCL 01B

The objective of this thesis is to determine the optimal controls and trajectories which minimize the time to turn for a high performance aircraft with thrust vectoring capability. All determinations are subject to practical physical constraints. The determined controls and trajectories are then compared against other methods of turning in minimum time to conclude the effects and advantages of thrust vectoring. The results indicate that the use of vectored thrust can substantially reduce turning times and increase in-flight maneuverability. The greater the velocity at which the turn is initiated, the more the range of thrust vectoring capability is used and the greater the reduction in turning time. GRA

N85-25257# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
HIGH SPECIFIC POWER AIRCRAFT TURN MANEUVERS: TRADEOFF OF TIME-TO-TURN VERSUS CHANGE IN SPECIFIC ENERGY M.S. Thesis
S. B. DRON Sep. 1984 94 p
(AD-A151701; AFIT/GAE/AA/78D-5) Avail: NTIS HC A05/MF A01 CSCL 01B

This thesis deals with the tradeoff between time-to-turn and the change in specific energy during a turn of 180 deg, for an aircraft of high specific power. This type of aircraft possesses the capability to sustain flight at the corner velocity where both maximum lift coefficient and maximum load factor occur simultaneously. However, the classical necessary conditions breakdown on this corner velocity arc and an additional constraint must be defined to determine the optimal control histories. The report first defines the necessary conditions for a generic optimal control formulation and then applies the formulation to this high specific power aircraft problem. The result is a three-point boundary value problem with a discontinuous interior corner condition at the beginning of the sustained corner velocity arc. All state and costate derivative and end conditions are presented with numerical methods for determining both minimum time and maximum energy gradient solutions. Anticipated results are provided for the formulations beginning at initial conditions both above and below the corner velocity. Results are presented for the minimum time solution only. Recommendations for further work in this same area are also provided. GRA

N85-25258# Naval Postgraduate School, Monterey, Calif.
THE DEVELOPMENT OF A PERFORMANCE AND MISSION PLANNING PROGRAM FOR THE A-7E AIRCRAFT M.S. Thesis
R. D. HILL Sep. 1984 54 p
(AD-A151717) Avail: NTIS HC A04/MF A01 CSCL 09B

In this thesis, drag and performance data from the A-7E Naval Air Training and Operating Procedures Standardization Manual (NATOPS) were reduced to a series of analytical expressions and implemented in a mission planning program. The program was designed to be compatible with desk-top calculators (64K memory) of the type used in aircraft carrier Strike Operations Centers and to be interactive, so that air wing and operations personnel may use it regularly for mission planning. All or part of 15 NATOPS performance charts were reduced using math modeling techniques which included curve-fitting and cross-plotting coefficients. Program implementation was demonstrated on an IBM 3033 using a Waterloo BASIC Compiler, and the program was checked for accuracy and operational suitability by a sample group of Navy attack pilots. GRA

N85-25259# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MULTIVARIABLE CONTROL LAW DESIGN FOR THE X-29 AIRCRAFT M.S. Thesis
T. L. COURTHEYN Dec. 1984 308 p
(AD-A151828; AFIT/GE/ENG/84D-21) Avail: NTIS HC A14/MF A01 CSCL 01D

Flight control laws are designed for the X-29 forward swept wing demonstrator aircraft using a design technique based on multivariable control law theory developed professor Brian Porter. The computer-aided design program called MULTI is used to develop and refine the control laws. MULTI also simulates the complete closed-loop control system and generated appropriate time response plots for analysis. Aircraft dynamics for several points in the flight envelope are represented by linearized state space equations obtained from NASA Dryden, and agency responsible for the development and testing of the X-29. Decoupled longitudinal and lateral equations are used to design separate longitudinal and lateral controllers. Control laws are developed to stabilize the aircraft and perform longitudinal maneuvers (direct climb, vertical translation, and beta pointing) at three different flight conditions, with and without first order-actuator dynamics and computational time delay added to the simulation. The responses are compared. GRA

N85-25260# Sandia Labs., Albuquerque, N. Mex. Aerodynamics Simulation Div.
A USER'S MANUAL FOR AMEER FLIGHT PATH TRAJECTORY SIMULATION CODE
E. J. MEYER Dec. 1984 206 p refs Revised
(Contract DE-AC04-76DP-00789)
(DE85-006580; SAND-80-2056-REV) Avail: NTIS HC A10/MF A01

A guide to the use of the AMEER (Aero-Mechanical Equations Evaluation Routines) flight path-trajectory simulation code is presented. The input data requirements, computed output data available, code control features, and code flow logic are described for a rigid-body six-degree-of-freedom or point mass simulation. DOE

N85-26595*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HARRIER
S. CAFFEE *In its* NASA Ames Summer High School Apprenticeship Res. Program p 31-34 Apr. 1985
Avail: NTIS HC A06/MF A01 CSCL 01C

The Harrier Aircraft which has the ability to take off vertically and hover like a helicopter is discussed. This aircraft can also fly at high speeds like a conventional jet. It is this feature that separates the Harrier into a new class of airplanes. Two major characteristics of the Harrier aircraft are examined: (1) the hover ability; (2) the reaction control system which enables the Harrier to maneuver while in the hover mode. B.W.

N85-26605*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
YAV-8B HARRIER
D. ORNELAS *In its* NASA Ames Summer High School Apprenticeship Res. Program p 89-91 Apr. 1985 refs
Avail: NTIS HC A06/MF A01 CSCL 01C

The objective of the YAV-8B flight research program is to develop and validate the technologies required for V/STOL aircraft to effectively operate in all mission phases. Specifically, inflight dynamics, controls and guidance, and propulsive lift technologies that will contribute to an improved adverse weather launch and recovery operation capability will be developed and evaluated. The cockpit panel is measured and reproduced for integration into a flight simulator. B.G.

N85-26608*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTORCRAFT DIGITAL ADVANCED AVIONICS SYSTEM (RODAAS)
B. TAIRA *In its* NASA Ames Summer High School Apprenticeship Res. Program p 105-108 Apr. 1985
Avail: NTIS HC A06/MF A01 CSCL 01C

A simulator is being built to determine the practicality of using an advanced avionics system in a helicopter. Features include an autopilot; a navigation and flight planning component; an advisory system built into the computer; conventional gages and displays; a clock function; a fuel totalizer; a weight and balance computator; a performance evaluator; and emergency and normal checklists. The translation of a computer program written in PASCAL into a form that can be read by the graphics package for the simulator and basic electronic work in simulator construction are discussed. A.R.H.

N85-26622# Mitsubishi Heavy-Industries Ltd., Tokyo (Japan).
COMPUTATIONAL AERODYNAMICS IN DESIGNING AIRCRAFT
M. A. KONO *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 91-100 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

The utilization of computational aerodynamics in the major aircraft developments is reviewed. Aerodynamic calculation technology used in each aircraft is outlined as follows: (1) MU-2 business turboprop airplane, sources are introduced to simulate the airflow past the spoiler which is the aircraft's aerodynamic feature; (2) XC-1, the potential flow thoery with boundary layer correction is used for wing design together with the panel method for air-intakes; (3) XT-2, the transonic and supersonic area-rule was a reliable guide in the design of the fuselage, and the lifting surface theory was effective in the design of a wing with a small aspect ratio. (4) MU-300 business jet airplane, transonic aerodynamic calculations are ready for use, such as the transonic full potential code for airfoils and the small disturbance code for wings. The evaluation of the various effects with reasonable accuracy and the use of computer techniques is emphasized. E.A.K.

N85-26627# Mitsubishi Heavy-Industries Ltd., Nagoya (Japan).
COMPUTATIONAL AERODYNAMICS FOR AIRCRAFT WING DESIGN
T. TANIOKA *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 141-155 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

The progress in computer technology has made a variety of computational aerodynamics available for designing aircraft shapes, especially wings, for which wind tunnel test data were almost the only design tool for aerodynamic engineers. In order to more efficiently apply computational aerodynamics to the designing process, efforts were made, such as combining several computational codes, providing a common data base for input/output, and introducing interactive graphic displays for easy communication with the designer. Current computational technology and the overall aerodynamic design process of wings are discussed. E.A.K.

N85-26631# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL DESIGN METHOD FOR THREE-DIMENSIONAL TRANSONIC WINGS
S. TAKANASHI *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 199-205 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

A numerical design procedure for three-dimensional transonic wings is presented. The boundary value problem is solved for the wing geometry which induces a prescribed pressure distribution subject to additional requirements on trailing-edge closure. The method is based on the transonic small disturbance theory and utilizes a type-dependent relaxation technique. Design results for large aspect ratio supercritical swept wings are also presented. E.A.K.

N85-26698 Illinois Univ., Urbana-Champaign.
ROTOR BLADE FLAP-LAG STABILITY AND RESPONSE IN FORWARD FLIGHT IN TURBULENT FLOWS Ph.D. Thesis
T. N. B. SHIAU 1984 178 p
Avail: University Microfilms Order No. DA8502297

The effect of random air turbulence on the coupled flap-lag motion of a licopter rotor blade in forward flight was investigated. By assuming white noise turbulence and applying a special case of the stochastic averaging procedure, equations are developed which describe the stochastic first and second moments of the perturbations in flap and lead-lag angles due to turbulence. Numerical results for stability in forward flight illustrate that turbulence exhibits a stabilizing effect, compared to the deterministic (no turbulence) case. Results for the steady-state responses of the perturbations indicated that the average response of the blade is not significantly affected by turbulence. In contrast, the random fluctuations away from the average response exhibit significantly large values due to the effects of turbulence. The effects of various blade parameters on the steady-state response are also investigated. The stability of multibladed rotors in the presence of turbulence is investigated using the example of a three-bladed rotor. The constant coefficient approximation using multiblade coordinates is shown to be accurate for moderate advance ratio in the case of a trimmed rotor. For an untrimmed rotor the approximation is less accurate and provides very conservative stability boundaries. Dissert. Abstr.

N85-26699*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FORMULATION AND IMPLEMENTATION OF NONSTATIONARY ADAPTIVE ESTIMATION ALGORITHM WITH APPLICATIONS TO AIR-DATA RECONSTRUCTION
S. A. WHITMORE May 1985 11 p refs Presented at the IEEE Natl. Aerospace and Electron. Conf., Dayton, Ohio, 20-24 May 1985
(NASA-TM-86727; H-1285; NAS 1.15:86727) Avail: NTIS HC A02/MF A01 CSCL 01C

The dynamics model and data sources used to perform air-data reconstruction are discussed, as well as the Kalman filter. The need for adaptive determination of the noise statistics of the process is indicated. The filter innovations are presented as a means of developing the adaptive criterion, which is based on the true mean and covariance of the filter innovations. A method for the numerical approximation of the mean and covariance of the filter innovations is presented. The algorithm as developed is applied to air-data reconstruction for the space shuttle, and data obtained from the third landing are presented. To verify the performance of the adaptive algorithm, the reconstruction is also performed using a constant covariance Kalman filter. The results of the reconstructions are compared, and the adaptive algorithm exhibits better performance. A.R.H.

N85-26700# Naval Postgraduate School, Monterey, Calif.
DETERMINATION OF QUANTITATIVE RELATIONSHIPS BETWEEN SELECTED CRITICAL HELICOPTER DESIGN PARAMETERS M.S. Thesis
R. S. PETRICKA Sep. 1984 354 p
(AD-A152034) Avail: NTIS HC A16/MF A01 CSCL 01C

This thesis determines the relationships of helicopter design parameters by first depicting graphically all possible pairings of selected design parameter values and then, secondly, depicting graphically respective curve fits for the data point plots which meet an acceptance criteria. In generating the curve plots, the specific constants of each curve equation are determined, thus allowing the designer the ability to derive quantitatively the values of many of the design parameters heretofore selected by trial and error methods. GRA

N85-26702# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
STUDY OF LONGITUDINAL LANDING FLYING QUALITIES EVALUATION USING PILOT MODEL THEORY M.S. Thesis
E. D. DIDOMENICO 1 Dec. 1984 219 p
(AD-A152194; AFIT/GE/ENG/84D-14) Avail: NTIS HC A10/MF A01 CSCL 01B

Control Anticipation Parameter used as a longitudinal handling qualities criterion does not adequately distinguish between different flight phases. Recent flight test data from the Landing Approach Higher Order Systems (LAHOS) study further indicate the inadequacy of the second order approximation for higher order longitudinal landing flying qualities. Nine aircraft that fall within the Level 1 boundary reveal pilot ratings ranging from 1.5 to 10. These nine aircraft are studied be combining their longitudinal dynamics with pilot modelling to examine a better method of landing flying quality prediction and evaluation. Pilot model theory (cross-over pilot model) is successfully combined with classical root locus and frequency response techniques to establish a frequency separation criterion called Loop Separation Parameter (LSP). Landing longitudinal evaluation and pilot rating predictions are consistent using the LSP method. In this thesis LSP is defined as the difference in resonant frequencies in pitch attitude and flight path angle control loops (with a pilot in each loop). Very acceptable prediction of pilot ratings (Cooper/Harper scale) along with PIO frequencies are demonstrated using the LSP method. LSP can also be used as an measurement technique to estimate pilot lead (a linear pilot model parameter). The landing test data also indicates an apparent transition of pilot emphasis from pitch control to flight path angle control in the landing flare. Time series analysis were performed on two example aircraft to validate LSP theory independently. The theory developed is applied to estimate pilot ratings for the X-29A longitudinal mode flying qualities. GRA

N85-26704# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
PROTECTIVE COATINGS FOR AIRCRAFT STRUCTURES: A REVIEW
W. A. J. MOONEN Dec. 1983 155 p refs
(VTH-LR-413) Avail: NTIS HC A08/MF A01

The technology and properties of aircraft anticorrosion metal coatings, oxide films on aluminum, conversion coatings for aluminum, paint systems, water displacing corrosion inhibitors, and corrosion inhibitive sealants are summarized. Author (ESA)

N85-27728 Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
THE APPLICATION OF COMPUTER AIDED STRUCTURAL OPTIMIZATION TO THE DESIGN OF AIRCRAFT COMPONENTS [ANWENDUNG DER RECHNERGESTUETZTEN STRUKTUROPTIMIERUNG BEI DER AUSLEGUNG VON FLUGZEUGBAUTEILEN]
H. WELLEN *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 61-68 1984 refs In GERMAN Presented at DGLR-Fachausschusssitzung Festigkeit u. Bauweisen, Neubiberg, West Germany, 5 Jul. 1984
(MBB-UT-21/84-O) Avail: Issuing Activity

The Structural Analysis and Redesign System (STARS) program system was used for computer aided structural optimization of aircraft components. Practical use and results, present status, and planned extension of STARS are described. The application of computer aided structural optimization is demonstrated using the inner Airbus A-310 trailing-edge flaps. Computer aided structural optimization offers the possibility of automatic weight-optimal dimensioning of carrying parts using programmed, mathematical methods. The weight optimum leads to time-and cost advantages. Author (ESA)

N85-27730 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Flight Test Dept.
FLIGHT TEST SUPPORT AIRCRAFT ADVANCED TECHNOLOGIES TESTING AIRCRAFT SYSTEM (ATTAS) FOR THE DFVLR
T. FLECK *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 85-93 1984 Presented at AIAA/AHS/IES/SETP/SFTE/DGLR 2nd Flight Testing Conf., Las Vegas, Nev., 16-18 Nov. 1983
(MBB-FE-732/S/PUB/154) Avail: Issuing Activity

The flight testing system ATTAS is presented. The regulating variables for in-flight simulation are given. The control system and security system (controlling force simulation, electrohydraulic actuators, digital control electronics for the electrohydraulic actuators, and systems to switch on and off the test control) are described. The data processing system, including terminal computer, fly-by-wire computer, experiment and control computer, and central communication computer are presented. The cockpit instrumentation and cabin equipment are described. The electric and hydraulic energy systems are explained. Author (ESA)

N85-27736 Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Unternehmensbereich Transport- und Verkehrsflugzeuge.
UTILIZATION OF AN AUTOMATED RIVETING SYSTEM IN AIRCRAFT CONSTRUCTION [EINSATZ VON AUTOMATISIERTEN NIETANLAGEN IM FLUGZEUBAU]
J. MASKOW *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 301-307 1984 In GERMAN Presented at Jahrestagung der DGLR, Hamburg, 1-3 Oct. 1984
(MBB-UT-11/84-O; DGLR-84-087) Avail: Issuing Activity

Rationalization and human factors engineering of the production of riveted joints is described. Shell assembly, clip-frame assembly, and fuselage section assembly were investigated on alternative rationalized production techniques with reduced noise levels. The Automated Riveting Assembly System fulfills all the requirements concerning short time in process, high flexibility and operator comfort in civil aircraft construction. Author (ESA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-34585
FLIGHT INSTRUMENTATION
T. FORD Aircraft Engineering (ISSN 0002-2667), vol. 57, April 1985, p. 2-4, 23.

Current trends in flight instrumentation technology are briefly reviewed. Consideration is given to: integrated primary flight and navigation displays; two color CRTs; shadow mask color tubes; and head-up display designs. The flight intrumentation displays of the British Hawk and Harrier combat aircraft are discussed as examples of the state-of-the-art of CRT display systems. I.H.

A85-35450
ENHANCED COLLISION AVOIDANCE SYSTEM CUTS UNNEEDED ALERTS
P. J. KLASS Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, May 20, 1985, p. 120, 121, 125.

Test results of minimal and full traffic collision avoidance systems (T/CAS-2 and ET/CAS-2, respectively) have shown that the enhanced system reduces crew alerts by one-half and gives accurate vertical and horizontal avoidance advisories. An omnidirectional antenna is mounted on the top of the aircraft with T/CAS-2, and on the top and bottom of the fuselage with ET/CAS-2, the latter costing only 20 percent more. The circular antenna is only a 1 in. thick bulge in the fuselage. Monopulse emissions identify the bearing of other aircraft to 2 deg accuracy. Bearing rate of change is calculated to within 0.2 deg/sec. Appraisals are analyzed on the bases of vertical separation, vertical rate of change, slant range separation, and the rate of change of separation. The system also alerts the T/CAS on another aircraft if an avoidance maneuver is recommended. FAA flight tests with a Convair 580 and a 727 aircraft are planned. M.S.K.

A85-36144#
STALL WARNING - CATCHING IT EARLY
E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 23, June 1985, p. 42, 43.

A new device which warns pilots of the approach of stall conditions is described. The stall warning device (SWAD) detects turbulence on the upper wing surface. The sensor is a hot-film anemometer mounted at mid-span forward of the apron. The output data is fed to a computer for analysis of voltage fluctuations in terms of rms amplitudes. A preset threshold turbulence value, once reached, triggers an ennunciator. Tests with a Tiger aircraft demonstrated the SWAD's ability to detect the approach of stall levels of turbulence in icing, high angle-of-attack and bank angle situations. It is expected that SWAD could provide accurate warnings even during take-off rollout. It is doubted that the hot film will be sturdy enough for regular use, so attention may be given to laser doppler anemometers and solid-state pressure sensors as alternatives. M.S.K.

N85-26645# Singer Co., Wayne, N. J.
DESIGN-TO-COST (DTC) METHODOLOGY TO ACHIEVE AFFORDABLE AVIONICS
A. J. SHAPIRO *In* AGARD Cost Effective and Affordable Guidance and Control Systems 18 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

In response to the continual exponential growth in the complexity and cost of military weapon systems, especially the electronics portions, the United States Department of Defense has implemented a Design to Cost (DTC) procurement policy. The objective of this policy is to meet essential and desired operational requirements in the most cost effective manner by setting cost targets at the start of the procurement process. A methodology is described for developing electronic equipment to meet DTC requirements. Specific management action is required in establishing an appropriate organization as well as procedures and guidelines for the engineering development process and subsequent production to achieve the cost targets. The critical role of computer aided design in optimizing the electronic system design is highlighted. An example of a DTC program successfully applied to the Lightweight Doppler Navigation System (LDNS) AN/APN-128 is reviewed. Author

N85-26705*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PLANNING FUEL-CONSERVATIVE DESCENTS IN AN AIRLINE ENVIRONMENTAL USING A SMALL PROGRAMMABLE CALCULATOR: ALGORITHM DEVELOPMENT AND FLIGHT TEST RESULTS

C. E. KNOX, D. D. VICROY, and D. A. SIMMON (United Airlines, Inc., Chicago) May 1985 77 p refs

(NASA-TP-2393; L-15844; NAS 1.60:2393) Avail: NTIS HC A05/MF A01 CSCL 01D

A simple, airborne, flight-management descent algorithm was developed and programmed into a small programmable calculator. The algorithm may be operated in either a time mode or speed mode. The time mode was designed to aid the pilot in planning and executing a fuel-conservative descent to arrive at a metering fix at a time designated by the air traffic control system. The speed model was designed for planning fuel-conservative descents when time is not a consideration. The descent path for both modes was calculated for a constant with considerations given for the descent Mach/airspeed schedule, gross weight, wind, wind gradient, and nonstandard temperature effects. Flight tests, using the algorithm on the programmable calculator, showed that the open-loop guidance could be useful to airline flight crews for planning and executing fuel-conservative descents. M.G.

N85-26706# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A COMPARISON OF PICTORIAL AND SPEECH WARNING MESSAGES IN THE MODERN COCKPIT M.S. Thesis

C. P. ROBINSON Dec. 1984 156 p

(AD-A151917; AFIT/CI/NR-85-23T) Avail: NTIS HC A08/MF A01 CSCL 09C

This thesis presents a current trend in cockpit design to incorporate synthesized speech to present secondary information to the pilot in an attempt to reduce mental workload, and to allow the pilot to keep his or her view out of the cockpit. Theories of multiple resource information processing support both of these reasons to use synthesized speech, but theories of stimulus-central processing-response (S-C-R) compatibility suggest the possibility that spatial information presented visually may have some distinct advantages over speech even though it uses the same input modality as the primary (flying) task. If the response is to be manual, then spatial information is more compatible. Twenty subjects participated in three dual-task experiments which compared tracking and emergency response performance when information was presented in the visual/spatial (pictorial) mode as opposed to the auditory/verbal (speech) mode. In all three experiments the pictorial mode elicited quicker response times, though in one experiment the pictorial mode also elicited more errors. Also, the pictorial subjects improved more with learning than did the speech subjects. While the subjects were not successful at protecting their primary task when they added the secondary task, there were no interactions between the task type and any other factor. These results indicate that more research concerning the spatial advantages of pictorial displays needs to be conducted before too many speech displays are incorporated into the cockpit. GRA

N85-26707# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

AVIONICS INTEGRITY ISSUES PRESENTED DURING NAECON (NATIONAL AEROSPACE AND ELECTRONICS CONVENTION) 1984 Final Report, 21 May - 25 May 1984

H. C. FORTNA, ed. Dec. 1984 172 p

(AD-A151923; ASD-TR-84-5030) Avail: NTIS HC A08/MF A01 CSCL 09E

This report summarizes the failure modes (chemical, mechanical, or thermal) which reduce the operational life of avionic and electronic equipment. Lt. Gen. Thomas H. McMullen's speech at Tuesday's luncheon summarized the history of avionics and presents the great importance of avionics to the future of Aircraft. The notes from the management session, ASD Integrity Thrusts, discuss the important aspects of avionics integrity in design, manufacturing, and use. The important role people play in the development and manufacturing of an electronic product is shown. Stress screening of electronic components is important to having quality equipment and is discussed from the government's perspectives of maintenance and supply as well as from the view of the Institute of Environmental Sciences (IES). GRA

N85-26708# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION OF A NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTOMATED STALL WARNING SYSTEM FOR AN OV-1 AIRCRAFT Final Report, 5 Dec. 1983 - 1 May 1984

D. L. UNDERWOOD and R. S. ADLER Jul. 1984 61 p

(Contract DA PROJ. EN1-Y)

(AD-A152010; USAAEFA-81-06-1) Avail: NTIS HC A04/MF A01 CSCL 01D

The ASWS is an experimental system independent of conventional angle-of-attack sensors. It incorporates an onboard micro-computer which displays stall warning margin information as a function of computed calibrated airspeed and stall airspeed in real time. The test objective was to evaluate the feasibility of an ASWS an installed in the OV-1 and determine compliance of the system with the requirements of MIL-F-8785C. A limited evaluation of the ASWS was conducted at Edwards AFB, CA from 5 Dec 1983 to 1 May 1984. During the test program 33 flights were conducted. In all conditions and configurations tested, the system provided greatly improved stall warning margins when compared to the aerodynamic stall warnings of the OV-1 series aircraft. Adequate stall warnings were provided in most flight configurations tested and the requirements of MIL-F-8785C were met in 156 of the 164 stalls evaluated. System hysteresis and the effects of sideslip on the stall warning capability of the system were minimal and acceptable. Failure of the ASWS to accurately predict single engine stall airspeeds was identified as a deficiency. Additionally, attenuation of the aural warning cue during radio and interphone communications resulted in decreased crew awareness of impending stall and was a shortcoming. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A85-33404
SYSTEM-THEORETICAL SOLUTION OF THE FAILURE DIAGNOSIS PROBLEM USING THE EXAMPLE OF A FLIGHT ENGINE [EINE SYSTEMTHEORETISCHE LOESUNG DES FEHLERDIAGNOSEPROBLEMS AM BEISPIEL EINES FLUGTRIEBWERKES]
M. ROESNICK Hamburg, Hochschule der Bundeswehr, Fachbereich Maschinenbau, Dr.-Ing. Dissertation, 1984, 300 p. In German. refs

A failure diagnostic procedure for flight engines is developed which permits failure recognition and the determination of the location and magnitude of failure. A normalized, linearized thermodynamic model of a double-cell double-flow engine with high bypass ratio and variable geometry without mixing is developed. Component characteristics values are used to make engine module variations independent of engine equilibrium and thereby locate failure. The usefulness of the model is confirmed by sensitivity analysis. An observed analysis of the model is presented, and the model is used to calculate state variables from measured ones. Methods of evaluting state variables are discussed in the light of the model, and simulation results are presented. Sources of systematic failure in engines diagnosis are considered. C.D.

A85-33768#
LOAD SHARING IN A PLANETARY GEAR STAGE IN THE PRESENCE OF GEAR ERRORS AND MISALIGNMENT
P. MA and M. BOTMAN (Pratt and Whitney Canada, Longueuil, Quebec, Canada) American Society of Mechanical Engineers, Design Engineering Technical Conference, Cambridge, MA, Oct. 7-10, 1984. 7 p. refs
(ASME PAPER 84-DET-54)

A method of analysis is described of dynamic loads occurring in the planetary gear stages of the gearboxes of PT6 turboprop engines. The dynamic loads are important for the design of lightweight and durable components. A rigorous dynamic analysis, which includes the effects of nonlinear tooth stiffnesses, ring gear flexibility, gear errors and misalignments, is necessary to determine dynamic tooth loads and the load sharing among the planets. Results are presented of sample calculations for a typical gear stage. Author

A85-33773#
A 2400 KW LIGHTWEIGHT HELICOPTER TRANSMISSION WITH SPLIT-TORQUE GEAR TRAINS
G. WHITE (Transmission Research, Inc., Cleveland, OH) American Society of Mechanical Engineers, Design Engineering Technical Conference, Cambridge, MA, Oct. 7-10, 1984. 12 p. refs
(ASME PAPER 84-DET-91)

A transmission for a twin engine helicopter is shown to offer 17 percent lower weight than comparable production designs; the high ratio of output torque to weight that results is attributed to the use of split-torque fixed-axis gears in the place of planetary gears. While in total the gear train arrangement is new in respect to helicopter transmissions, each reduction stage has its equivalent elsewhere. Other characteristics of the transmission such as totals of gears and bearings, drive train losses, redundancy, and number of noise-generating meshes either equal or surpass the best achieved in similar planetary transmissions. These advances result from the introduction of a high-ratio final reduction train formed from a simple spur-combining gear that is driven by four equally loaded pinions. A consequence is that the overall speed ratio of 81:1 is generated from only three stages of fixed-axis gear trains. A modified arrangement of the transmission based on three engines and six final-drive pinions is also discussed. A general analysis of a multiple-mesh gear train provides a set of nondimensional relations which give the speed ratio appropriate to any gear proportions, torque transmitted and tooth contact stress. Author

A85-33849
SOVIET AERO ENGINES
M. HIRST Air International (ISSN 0306-5634), vol. 28, May 1985, p. 233-237.

A development history is presented for the Soviet gas turbine engine design and manufacturing establishment, whose efforts can be dated from the capture of German jet fighter engines and their development scientists in 1945, as well as the proffering of both jet engines and their production technology by the concilliatory Labor government of Britain in 1946. Attention is given to the design and performance trends exhibited by turboprop, turboshaft, and turbofan engines, with emphasis on the consequentiality of low and high pass turbofans of the most recent, Wester-inspired design generation for fighter aircraft and long distance transport aircraft, respectively. O.C.

A85-34005#
DESIGN AND PERFORMANCE EVALUATION OF A TWO-POSITION VARIABLE GEOMETRY TURBOFAN COMBUSTOR
J. W. SANBORN, P. E. SCHEIHING, E. B. COLEMAN, K. P. JOHNSON, and F. G. DAVIS (Garrett Turbine Engine Co., Phoenix, AZ) Journal of Propulsion of Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 187-192. Previously cited in issue 17, p. 2432, Accession no. A84-36953.

A85-34010#
ANALYSIS OF UNSTEADY INVISCID DIFFUSER FLOW WITH A SHOCK WAVE
V. YANG and F. E. C. CULICK (California Institute of Technology, Pasadena, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 222-228. Research supported by the California Institute of Technology. refs
(Contract AF-AFOSR-80-0265)

A finite difference scheme with a shock-fitting algorithm has been used to investigate unsteady inviscide flow with a shock in an inlet diffuser. The flowfield consists of three different regions: the supersonic and the subsonic regions, and a region containing both air and liquid fuel droplets, separated by a normal shock wave and a fuel injection system. The analysis is based on a two-phase, quasi-one-dimensional model. The response of a shock wave to various disturbances has been studied, including large-amplitude periodic oscillations and pulse perturbations. Author

A85-34013*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTED TURBINE STAGE PERFORMANCE USING QUASI-THREE-DIMENSIONAL AND BOUNDARY-LAYER ANALYSES
R. J. BOYLE, J. E. HAAS (NASA, Lewis Research Center, Cleveland, OH), and T. KATSANIS (NASA, Lewis Research Center; U.S. Army, Research and Technology Laboratories, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 242-251. Previously cited in issue 17, p. 2432, Accession no. A84-36972. refs

A85-34014#
PERFORMANCE ESTIMATION FOR TURBOFANS WITH AND WITHOUT MIXERS
G. C. OATES (Washington, University, Seattle, WA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, May-June 1985, p. 252-256.

A relatively simple equation set is developed to estimate the optimal performance of mixed-stream turbofans with component losses included. The set provides the specific fuel consumption and required bypass flow and fan pressure ratios to give a prescribed specific thrust for given flight conditions, component design limits, and engine core stream Mach number entering the mixer. Example results confirm the expectation (based on ideal cycle analysis) that the optimal specific fuel consumption and bypass ratio are nearly independent of the fan pressure ratio, provided that an optimal mixer is employed. Further, an engine designed for use in a mixed-stream configuration only would best use a lower fan pressure ratio than would an engine deliberately designed for an unmixed exhaust. Author

A85-35354
PORSCHE'S NEW LIGHT-AIRCRAFT ENGINE
P. PLETSCHACHER Interavia (ISSN 0020-5168), vol. 40, May 1985, p. 533, 534.

The Porche 911 automobile engine, which is of air-cooled, six-cylinder, horizontally opposed configuration, has been modified to serve as a powerplant for single engine private aircraft that furnishes simplicity of operaiation and installation, low noise and exhaust emissions, and modest fuel consumption. The 3.2-liter engine can operate on either super grade automobile fuel or 100LL aviation gasoline. The cockpit control for the engine takes the form of a single lever which controls both throttle and propeller pitch settings. A maximum production rate for the engine of 200 units/year is envisaged. Its operating costs are anticipated to be 15-20 percent lower than those of competing engines. O.C.

A85-35448
USAF NEGOTIATING CONTRACTS FOR F100, F110 IMPROVEMENTS
R. R. ROPELEWSKI Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, May 20, 1985, p. 18, 19.

Competitive bidding is underway for fixed prices contracts to produce upgraded, more reliable, 29,000 lb and 29,500 lb thrust versions of the F100 and F110 engines for the F-15 and F-16 fighters. Initial test engines have demonstrated stall stagnation rates lower than specified, although still exceeding eventual goals. The contracts will specify the man-hours required for maintenance, reasonable life cycle costs, and warranty terms. The $454 million program will include funding for the development of improved engine materials, increased engine cycle lifetimes, higher fan pressure ratios, airflow levels, and compressor efficiency and an advanced afterburner. Engine controls will be digitized. The first operational engine is scheduled for a 1989 delivery. M.S.K.

N85-25261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND SURGE LIMITS OF A TF30-P-3 TURBOFAN ENGINE/AXISYMMETRIC MIXED-COMPRESSION INLET PROPULSION SYSTEM AT MACH 2.5
J. F. WASSERBAUER, H. E. NEUMANN, and R. J. SHAW May 1985 21 p refs
(NASA-TP-2461; E-2412; NAS 1.60:2461) Avail: NTIS HC A02/MF A01 CSCL 21E

Steady-state performance and inlet-engine compatibility were investigated with a low-bleed inlet. The inlet had minimum internal contraction, consistent with high total pressure recovery and low cowl drag. The inlet-engine combination displayed good performance with only about 2% of inlet performance bleed. The inlet-engine combination had 5.58 deg angle-of-attack capability with 6% bleed. Author

N85-25262*# Michigan State Univ., East Lansing. Coll. of Engineering.
DEVELOPMENT OF A TEMPERATURE MEASUREMENT SYSTEM WITH APPLICATION TO A JET IN A CROSS FLOW EXPERIMENT Final Report
C. WARK and J. F. FOSS Apr. 1985 123 p refs
(Contract NAG3-245)
(NASA-CR-174896; NAS 1.26:174896; FSFL-R-85-002) Avail: NTIS HC A06/MF A01 CSCL 21E

A temperature measurement system, which allows the simultaneous sampling of up to 80 separate thermocouples, was developed. The minimum resolution for the system corresponds to + or - 0.16 C per least significant bit of the A/D converter. The time constant values lambda, for each of the 64 thermocouples, were determined experimentally at 7 mps. Software routines were used to correct the measured temperatures for the effect of lambda for each thermocouple. The temperature measurement system was utilized to study the thermal field of a heated jet discharging perpendicularly into a low and a high disturbance level cross stream for a given momentum flux ratio and for three overheated values. The peak instantaneous temperatures reveal that strong molecular diffusion was operative. Various measures of the thermal field, for the disturbed case, suggest that the jet column remains relatively compact while being buffeted by the ambient turbulence field and that its penetration, into the cross wind, is inhibited by the presence of the strong disturbance field. E.A.K.

N85-25263*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL CALCULATION OF SUBSONIC JETS IN CROSSFLOW WITH REDUCED NUMERICAL DIFFUSION
R. W. CLAUS 1985 19 p refs Presented at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME
(NASA-TM-87003; E-2548; NAS 1.15:87003) Avail: NTIS HC A02/MF A01 CSCL 21E

A series of calculations are reported for two, subsonic jet in crossflow geometries. The parametric variation examined are the lateral spacing of a row of jets. The first series of calculations corresponds to a widely space jet geometry, S/D = 4, and the second series corresponds to closely spaced jets, S/D = 2. The calculations are done with alternate differencing schemes to illustrate the impact of numerical diffusion. The calculated jet trajectories agreed well with experimental data in the widely spaced jet geometry, but not in the closely spaced geometry. E.A.K.

N85-25265*# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
BEHAVIOR OF TURBULENT GAS JETS IN AN AXISYMMETRIC CONFINEMENT Final Report
R. M. C. SO and S. A. AHMED Jan. 1985 95 p refs
(Contract NAG3-260)
(NASA-CR-174829; NAS 1.26:174829; CR-R-84041) Avail: NTIS HC A05/MF A01 CSCL 20D

The understanding of the mixing of confined turbulent jets of different densities with air is of great importance to many industrial applications, such as gas turbine and Ramjet combustors. Although there have been numerous studies on the characteristics of free gas jets, little is known of the behavior of gas jets in a confinement. The jet, with a diameter of 8.73 mm, is aligned concentrically in a tube of 125 mm diameter, thus giving a confinement ratio of approximately 205. The arrangement forms part of the test section of an open-jet wind tunnel. Experiments are carried out with carbon dioxide, air and helium/air jets at different jet velocities. Mean velocity and turbulence measurements are made with a one-color, one-component laser Doppler velocimeter operating in the forward scatter mode. Measurements show that the jets are highly dissipative. Consequently, equilibrium jet characteristics similar to those found in free air jets are observed in the first two diameters downstream of the jet. These results are independent of the fluid densities and velocities. Decay of the jet, on the other hand, is a function of both the jet fluid density and momentum. In all the cases studied, the jet is found to be completely dissipated in approximately 30 jet diameters, thus giving rise to a uniform flow with a very high but constant turbulence field across the confinement. Author

N85-25266*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS IN DILUTION JET MIXING EFFECTS OF MULTIPLE ROWS AND NON-CIRCULAR ORIFICES
J. D. HOLDEMAN, R. SRINIVASAN (Garrett Turbine Engine Co.), E. B. COLEMAN (Garrett Turbine Engine Co.), G. D. MEYERS (Garrett Turbine Engine Co.), and C. D. WHITE (Garrett Turbine Engine Co.) 1985 16 p refs Presented at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME
(NASA-TM-86996; E-2542; NAS 1.15:86996) Avail: NTIS HC A02/MF A01 CSCL 21E

Experimental and empirical model results are presented that extend previous studies of the mixing of single-sided and opposed rows of jets in a confined duct flow to include effects of non-circular orifices and double rows of jets. Analysis of the mean temperature data obtained in this investigation showed that the effects of orifice shape and double rows are significant only in the region close to the injection plane, provided that the orifices are symmetric with respect to the main flow direction. The penetration and mixing of jets from 45-degree slanted slots is slightly less than that from equivalent-area symmetric orifices. The penetration from 2-dimensional slots is similar to that from equivalent-area closely-spaced rows of holes, but the mixing is slower for the 2-D slots. Calculated mean temperature profiles downstream of jets from non-circular and double rows of orifices, made using an extension developed for a previous empirical model, are shown to be in good agreement with the measured distributions. Author

N85-26618# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
NUMERICAL ANALYSES IN AERODYNAMIC DESIGN OF AERO-ENGINE FAN
S. NAGANO *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 55-62 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

A brief review is presented of the current status of numerical methods for aero-engine fan internal flow analyses used in the design stage. The following four topics are discussed: (1) meridional flow analysis; (2) transonic cascade flow analysis; (3) supercritical cascade design analysis; (4) Three dimensional blade-to-blade analysis; and (5) circumferential pressure distribution analysis. The streamline curvature method has been most widely used in meridional flow analysis. For the fan rotor outer region where the total pressure losses associated with shock waves play an important role, 2-D shock-capturing Euler codes are relevant, and schemes such as MacCormack's or Denton's are commonly built into standard design procedures. Supercritical airfoil technology developed for aircraft wings finds application in the cascade design. Both inverse method, such as the Bauer-Garabedian-Korn method using complex potentials, and direct methods with transonic potential analysis are utilized in this application. Three dimensional Euler codes are used to check the 3-D effects within blade-to-blade passage. The singularity distribution method with compressibility correction has proved useful for assessing the circumferential pressure distribution induced by downstream obstacles. B.W.

N85-26709*# Detroit Diesel Allison, Indianapolis, Ind. Allison Gas Turbine Div.
ANALYTICAL FUEL PROPERTY EFFECTS--SMALL COMBUSTORS Final Report
R. D. SUTTON, D. L. TROTH, and G. A. MILES Oct. 1984 224 p refs
(Contract NAS3-23165)
(NASA-CR-174738; EDR-11683; NAS 1.26:174738; AVSCOM-TR-84-C-14) Avail: NTIS HC A10/MF A01 CSCL 21E

The consequences of using broad-property fuels in both conventional and advanced state-of-the-art small gas turbine combustors are assessed. Eight combustor concepts were selected for initial screening, of these, four final combustor concepts were chosen for further detailed analysis. These included the dual orifice injector baseline combustor (a current production 250-C30 engine combustor) two baseline airblast injected modifications, short and piloted prechamber combustors, and an advanced airblast injected, variable geometry air staged combustor. Final predictions employed the use of the STAC-I computer code. This quasi 2-D model includes real fuel properties, effects of injector type on atomization, detailed droplet dynamics, and multistep chemical kinetics. In general, fuel property effects on various combustor concepts can be classified as chemical or physical in nature. Predictions indicate that fuel chemistry has a significant effect on flame radiation, liner wall temperature, and smoke emission. Fuel physical properties that govern atomization quality and evaporation rates are predicted to affect ignition and lean-blowout limits, combustion efficiency, unburned hydrocarbon, and carbon monoxide emissions. Author

N85-26710*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-SPEED AERODYNAMIC TEST OF AN AXISYMMETRIC SUPERSONIC INLET WITH VARIABLE COWL SLOT
A. G. POWELL (Douglas Aircraft Co., Long Beach, Calif.), H. R. WELGE (Douglas Aircraft Co., Long Beach, Calif.), and C. J. TREFNY 1985 6 p refs Proposed for presentation at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME
(Contract NAS1-16147)
(NASA-TM-87039; E-2595; NAS 1.15:87039; DOUGLAS-PAPER-7551) Avail: NTIS HC A02/MF A01 CSCL 21E

The experimental low-speed aerodynamic characteristics of an axisymmetric mixed-compression supersonic inlet with variable cowl slot are described. The model consisted of the NASA P-inlet centerbody and redesigned cowl with variable cowl slot powered by the JT8D single-stage fan simulator and driven by an air turbine. The model was tested in the NASA Lewis Research Center 9- by 15-foot low-speed tunnel at Mach numbers of 0, 0.1, and 0.2 over a range of flows, cowl slot openings, centerbody positions, and angles of attack. The variable cowl slot was effective in minimizing lip separation at high velocity ratios, showed good steady-state and dynamic distortion characteristics, and had good angle-of-attack tolerance. Author

N85-26711*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
EFFECTS OF SURFACE CHEMISTRY ON HOT CORROSION LIFE Annual Report, 2 May 1984 - 2 May 1985
R. E. FRYXELL Jun. 1985 47 p refs
(Contract NAS3-23926)
(NASA-CR-174915; NAS 1.26:174915; R85AEB307; AR-2) Avail: NTIS HC A03/MF A01 CSCL 21E

Burner rig tests were conducted under the following conditions: 900 C, hourly thermal cycling, 0.5 ppm sodium as MaCl in the gas stream, velocity 0.3 Mach. The alloys are Udiment 700, Rene 80, uncoated and with RT21, Codep, or NiCoCrAlY coatings. These tests were completed for specimens in the as-processed condition and after aging at 1100 C in oxidizing or inert evnivronments for time up to 600 hours. Coil inductance changes used for periodic nondestructive inspection of specimens were useful in following the course of corrosion. Typical sulfidation was observed in all cases, structurally similar to that observed for service-run turbine components. Aging at cuased a severe decrease in hot corrosion life of RT21 and Codep coatings and a significant but less decrease in the life of the NiCoCrAlY coating. The extent of these decreases was much greater for all three coatings on U700 substrates than on Rene 80 substrates. Coating/substrate interdiffusion rather than by surface oxidation. M.G.

N85-26713*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALTERNATIVES FOR JET ENGINE CONTROL Technical Progress Report, 1 Nov. 1983 - 31 Oct. 1984
M. K. SAIN 31 Oct. 1984 266 p refs
(Contract NSG-3048)
(NASA-CR-175831; NAS 1.26:175831) Avail: NTIS HC A12/MF A01 CSCL 21E

The technical progress of researches Alternatives for Jet Engine Control is reported. A numerical study employing feedback tensors for optimal control of nonlinear systems was completed. It is believed that these studies are the first of their kind. State regulation, with a decrease in control power is demonstrated. A detailed treatment follows. E.A.K.

N85-26714*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALTERNATIVES FOR JET ENGINE CONTROL Technical Progress Report, 1 Oct. 1982 - 31 Oct. 1983
M. K. SAIN 31 Oct. 1983 140 p refs
(Contract NSG-3048)
(NASA-CR-175832; NAS 1.26:175832) Avail: NTIS HC A07/MF A01 CSCL 21E

The technical progress of researches on alternatives for jet engine control, is reported. The principal new activities involved the initial testing of an input design method for choosing the inputs to a non-linear system to aid the approximation of its tensor parameters, and the beginning of order reduction studies designed to remove unnecessary monomials from tensor models. E.A.K.

N85-26715*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ALTERNATIVES FOR JET ENGINE CONTROL Semiannual Status Report, 1 Nov. 1983 - 30 Apr. 1984
M. K. SAIN 30 Apr. 1984 271 p refs
(Contract NSG-3048)
(NASA-CR-175833; NAS 1.26:175833) Avail: NTIS HC A12/MF A01 CSCL 21E

The technical progress of researches on alternatives for jet engine control is reported. Extensive numerical testing is included. It is indicated that optimal inputs contribute significantly to the process of calculating tensor approximations for nonlinear systems, and that the resulting approximations may be order-reduced in a systematic way. E.A.K.

N85-26718# Turbomeca S. A. - Brevets Szydlowski, Bordes (France). Dept. Materiaux et Techniques Associees.
NONDESTRUCTIVE TESTS OF CERAMIC COMPONENTS FOR AIRCRAFT TURBINES Final Report [CONTROLE NON DESTRUCTIF DE PIECES EN CERAMIQUE POUR TURBINES AERONAUTIQUES]
A. DUSSOULIER Oct. 1984 96 p refs In FRENCH
(Contract DRET-83-1080)
Avail: NTIS HC A05/MF A01

Quality control techniques of ceramic pieces used in aircraft turbines are compared and a correlation between manufacturing procedures and detected defects is discussed. Silicon carbide samples presenting typical defects were prepared. The inspection techniques studied included ultrasonics, X-rays, fluorescence, and acoustic scanning microscopy. It is shown that the most traditional methods such as ultrasonic inspection do not have enough resolution while the most advanced techniques are not yet sufficiently developed for use in routine control. Author (ESA)

N85-26719# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Energetique.
STUDY OF THE PRIMARY ZONE OF GAS TURBINE HEARTHS Final Report [ETUDE DE LA ZONE PRIMAIRE DES FOYERS DE TURBOMACHINES]
H. TICHTINSKY 17 Jul. 1984 29 p refs In FRENCH
(Contract DRET-83-34-134)
(ONERA-RTS-22/3256-EY) Avail: NTIS HC A03/MF A01

The numerical modeling of the primary zone of turbomachinery combustion chambers is studied. The geometrical configuration adopted is simpler than that of an industrial machine but includes three dimensional flow, jet effects, heat exchange, turbulence and combustion. Difficulties in simulating the flow with cold fluids, taking account of fuel injection are found. Nevertheless useful information on the behavior of the unsteady flow is obtained. Author (ESA)

08

AIRCRAFT STABILITY AND CONTROL

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

A85-33426#
UNSTABLE JAGUAR PROVES ACTIVE CONTROLS FOR EFA
E. DALEY (British Aerospace, PLC, Preston, Lancs., England) Aerospace America (ISSN 0740-722X), vol. 23, May 1985, p. 34.

A modified Jaguar fighter has been used as a technology demonstration platform for the active control technologies encompassed by 'artificial stability' and 'fly-by-wire' concepts. The Jaguar's mechanical controls have been replaced by a multiplex-redundant electronic system that is controlled by four computers operating in parallel. This system has demonstrated a capacity for withstanding lightning strikes and artificial EM interference. No analog electrical or mechanical backup systems are incorporated for flight control. O.C.

A85-34096
AN ANALOG CMOS AUTOPILOT
L. E. LARSON (Hughes Research Laboratories, Malibu, CA), R. J. BURNS, M. E. LEVY (Hughes Aircraft Corp., Missile Systems Group, Canoga Park, CA), and W. W. CHENG (California, University, Berkeley, CA) IEEE Journal of Solid-State Circuits (ISSN 0018-9200), vol. SC-20, April 1985, p. 571-578. refs

The present two-chip analog LSI CMOS missile autopilot, fabricated in a double poly p-well silicon-gate technology, performs precision filtering, full-wave demodulation, digital-to-analog conversion, pulse width modulation, and offset cancellation, together with a number of digital functions. The autopilot covers a total area of 210,000 sq miles, and consumes 700 mW of power. Output noise was 6.5 mV, integrated over a bandwidth of 5-500 Hz. The present results were obtained over the -55 to 125 C temperature range. O.C.

A85-35797#
THE ALLEVIATION AND CONTROL OF THE ASYMMETRY LOAD AT HIGH ANGLE-OF-ATTACK
Y. YANG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 112-116. In Chinese, with abstract in English. refs

Research on aerodynamic characteristics at high angles of attack performed in recent years is reviewed. Some methods for alleviating and controlling the asymmetric forces at high angles of attack and their typical results are described. These methods include transition strips and/or rings collocated at the nose, fixed or controlled strakes, various nose shapes, rotating nose devices, active blowing devices, etc. Problems which should be taken into consideration in the design of wind tunnel experiments with such active control devices are discussed. These include the interrelation between the parameters of the devices and the asymmetric forces, the design and adjustment of the control system, the design of models with active control devices, and the dynamic response of such models. C.D.

A85-35979*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ON THE IDENTIFICATION OF A HIGHLY AUGMENTED AIRPLANE

J. G. BATTERSON (NASA, Langley Research Center, Hampton, VA) and V. KLEIN (George Washington University, Hampton, VA) International Federation of Automatic Control, Symposium on Identification and System Parameter Estimation, 7th, York, England, July 2-8, 1985, Paper. 7 p. refs

The results of applying linear least squares and maximum likelihood estimation procedures to flight data from the AFTI/F-16 airplane are presented. Data from two flight control system modes are analyzed. It is shown that though a simple aerodynamic model structure is adequate for the simple mode, a more complicated model is necessary to adequately describe the highly augmented mode. The effect of augmentation of roll control is shown to be visible in the control parameters. Author

A85-35981*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE DESIGN, DEVELOPMENT, AND FLIGHT TESTING OF A MODERN-CONTROL-DESIGNED AUTOLAND SYSTEM

R. M. HUESCHEN (NASA, Langley Research Center, Hampton, VA) Institute of Electrical and Electronics Engineers and American Automatic Control Council, American Control Conference, Boston, MA, June 19-21, 1985, Paper. 9 p. refs

This paper discusses the design, development, and flight test results of a full-state feedback modern-controls-designed autoland system - the Digital Integrated Automatic Landing System (DIALS). The lateral and longitudinal control laws were designed by formulating a linear quadratic regulator with disturbances problem. Although the designs were independent of each other, in implementation cross-coupling of the lateral and longitudinal variables does occur. A brief discussion of the control modes - localizer capture, localizer track, decrab, glideslope capture, glideslope track, and flare - and the modifications made to the basic design during the simulation phase to achieve desired performance is given. Some of the efforts required to implement the system in the flight computers and some problems encountered in the ground hardware simulation checkout are discussed. Finally, flight test data is presented for this system which performed 10 'hands off' automatic landings. The flight test data includes the performance of the aircraft in mild, gust, and wind shear conditions. Author

A85-35982*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TECHNIQUES FOR ACCOMMODATING CONTROL EFFECTOR FAILURES ON A MILDLY STATICALLY UNSTABLE AIRPLANE

A. J. OSTROFF (NASA, Langley Research Center, Hampton, VA) Institute of Electrical and Electronics Engineers and American Automatic Control Council, American Control Conference, Boston, MA, June 19-21, 1985, Paper. 9 p. refs

Commercial airplanes are becoming increasingly more sophisticated, placing an increasing burden on pilots to detect and resolve the exhaustive set of possible control effector failures. Automatic techniques are needed to either reconfigure an existing control law or restructure a new control law after failure. A discrete control law has been designed for the longitudinal channel of a mildly statically unstable commercial airplane, to track the glideslope during the approach to landing phase of flight. Single effector failures with time delays for failure detection and identification are analyzed for both the reconfigured and restructured control laws, and results are compared with those from previous research using a statically stable airplane. Strategies considered include reconfiguration and restructuring with new flight conditions. Validation of all cases is made using a 6 DOF nonlinear airplane simulation. Author

A85-36148#

TAMING THE DEADLY SPIN

R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, June 1985, p. 74-77.

Research into techniques and aircraft components which avoid stall and spin and/or enhance recovery began in the 1930s. Devices which delayed stall frequently accelerated the transition when it did occur. Military aircraft received the most spin wind tunnel research from the 1940s to the 1970s, when NASA began looking at light aircraft in spin. Spinning aircraft forces and moments have been measured on a rotary balance. Wind tunnel tests have examined the spin aerodynamics of fuselages, airfoils, tail surfaces, strakes and fines. Stops and warning devices have been devised to keep the nose down. Studies are now focusing on the wing leading edge because it is the initiator and center of the stall conditions. Outboard drooping wings inhibit the spread of the stall vortices across the wing. The method has been extended to a discontinuous outboard droop which is being incorporated into the British Firecracker trainer. M.S.K.

A85-36483#

A SIMPLIFIED ANALYSIS OF AIRCRAFT STEADY SPIN [UPROSZCZONA ANALIZA USTALONEGO KORKOCIAGU SAMOLOTU]

W. BLAJER and J. MARYNIAK (Warszawa, Politechnika, Warsaw, Poland) Mechanika Teoretyczna i Stosowana (ISSN 0079-3701), vol. 22, no. 1-2, 1984, p. 151-158. In Polish. refs

An approximate graphic method for predicting the steady spin modes of fixed wing aircraft is presented. In the graphic method the aircraft is assumed to be a rigid body rotating around a vertical axis, and the angle of attack and roll angle are assumed to be small. Numerical results are presented for the Polish 'Iskra' training aircraft. I.H.

A85-36484#

EQUILIBRIUM CONDITIONS FOR AIRCRAFT STEADY SPIN [USTALONY KORKOCIAG SAMOLOTU, WARUNKI ROWNOWAGI]

W. BLAJER and J. MARYNIAK (Warszawa, Politechnika, Warsaw, Poland) Mechanika Teoretyczna i Stosowana (ISSN 0079-3701), vol. 22, no. 1-2, 1984, p. 159-169. In Polish. refs

Equations are derived to predict equilibrium conditions for the steady spin of a fixed wing aircraft. The aircraft is treated as a rigid body whose center of gravity describes a helix as it spins toward the ground. The axis of the helix is considered to be vertical, and the radius corresponds to the spin radius of the aircraft. Test calculations are presented for a Polish 'Iskra' training aircraft. I.H.

A85-36573#

AN APPROACH TO ADAPTIVE AUTOPILOT SYNTHESIS, WITH STABILIZATION OF A SINGLE-ROTOR HELICOPTER USED AS AN EXAMPLE [PEWNE PODEJSCIE DO SYNTEZY AUTOPILOTA ADAPTACYJNEGO NA PRZYKLADZIE STABILIZACJI SMIGLOWCA JEDNOWIRNIKOWEGO]

J. GALAJ (Warszawa, Politechnika, Warsaw, Poland) Archiwum Automatyki i Telemechaniki (ISSN 0004-072X), vol. 29, no. 3, 1984, p. 311-321. In Polish.

In the paper, an adaptive autpilot system intended for stabilization of a single-rotor helicopter in longitudinal motion is proposed. It is based on results presented by Galaj (1979). The significant advantage of a proposed four-channel adaptive autopilot is the simplicity of adaptation algorithms. They are derived from the analysis of changes in optimal feedback matrix coefficients occuring during the helicopter longitudinal motion under different flight conditions. Results of digital simulation point out to the fact that the differences between optimal and calculated values of the feedback matrix coefficients are small enough. Small applications of the proposed idea to other flying objects are also suggested. Author

A85-36581
A METHOD FOR CONTROLLING THE MOTION OF A FLIGHT VEHICLE RELATIVE TO ITS CENTER OF MASS [OB ODNOM SPOSOBE UPRAVLENIIA DVIZHENIEM LETATEL'NOGO APPARATA VOKRUG TSENTRA MASS]
V. I. BORZOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela (ISSN 0572-3299), Mar.-Apr. 1985, p. 49-53. In Russian.

An approach to the control of the motion of a flight vehicle relative to its center of mass is proposed whereby the problem of controlling the given attitude angles of the vehicles is reduced to that of stabilizing a given angular velocity determined in the space of control moments. The efficiency of the approach proposed here, which is applicable to a wide range of attitude control problems, has been demonstrated by results of computer-aided numerical experiments. V.L.

A85-36723
INVINCIBLE AIRCRAFT MAY BE A STEP CLOSER TO REALITY
D. J. HOLT Aerospace Engineering (ISSN 0002-1458), vol. 5, Jan. 1985, p. 8-11.

A discussion is presented concerning the development status and prospective performance enhancements available through 'self-repairing' electronic flight control systems for military aircraft. Such systems would be able to significantly reduce battlefield vulnerability by automatically compensating for damage incurred in one aircraft structure or component by altering the performance of others. Attention is given to the configurational, software logic, and technology validation requirements of such systems. O.C.

N85-25182# National Aerospace Lab., Amsterdam (Netherlands).
APPLICATION OF TIME-LINEARIZED METHODS TO OSCILLATING WINGS IN TRANSONIC FLOW AND FLUTTER
H. H. L. HOUNJET and J. J. MEIJER *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 16 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

Unsteady aerodynamic loads in the transonic domain were obtained with time-linearized methods in which a so-called field panel method is embedded which accounts for a proper radiation of signals towards infinity. The methods are used to predict the unsteady loads and first harmonic pressure distributions on an airfoil and a transport type wing. Results obtained with these methods were correlated with data of unsteady experiments and also with results of other calculation methods. Transonic flutter applications were made to a fighter-type configuration. Author

N85-25186# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
THE APPLICATION OF TRANSONIC UNSTEADY METHODS FOR CALCULATION OF FLUTTER AIRLOADS
H. ZIMMERMANN *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 21 p Jan. 1985 refs
Avail: NTIS HC A14/MF A01

With the development of supercritical profiles for aircraft wings the nonlinear unsteady aerodynamic methods in the application for flutter calculation became important. These nonlinear methods demand numerical methods of high accuracy and the inclusion of more physical effects was necessary than for the linear aerodynamic theory. For a representative section with two degrees of freedom and with the aerodynamic shape of the MBB-3 profile unsteady aerodynamic pressure distributions and coefficients for pitch and heave motions were calculated according to different unsteady aerodynamic methods. The steady and unsteady pressure distributions and coefficients were calculated by the Euler, the TSP, the Lin, TSP-Equation and by the Doublet Lattice method, with and without steady corrections. For the Lin, TSP (Linearized Transonic Small-Perturbation) the steady results of TSP and the full Potential Equation were used as the steady velocity potential. With the unsteady aerodynamic coefficients obtained with the different methods flutter calculations were done for the two-degree of freedom system in different frequency ranges. The so-called transonic-dip was found to differ for the aerodynamic methods used. Additionally effects were found which could be explained as probable two-dimensional effects. Author

N85-25267*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF SIDE-STICK CONTROLLERS ON ROTORCRAFT HANDLING QUALITIES FOR TERRAIN FLIGHT
E. W. AIKEN Apr. 1985 14 p refs Prepared in cooperation with Army Research and Technology Labs.
(NASA-TM-86688; A-85141; NAS 1.15:86688; USAAVSCOMTM-85-A-1) Avail: NTIS HC A02/MF A01 CSCL 01C

Pertinent fixed and rotary-wing feasibility studies and handling-qualities research programs are reviewed and the effects of certain controller characteristics on handling qualities for specific rotorcraft flight tasks are summarized. The effects of the controller force-deflection relationship and the number of controlled axes that are integrated in a single controller are examined. Simulation studies were conducted which provide a significant part of the available handling qualities data. The studies demonstrate the feasibility of using a single, properly designed, limited-displacement, multiaxis controller for certain relatively routine flight tasks in a two-crew rotorcraft with nominal levels of stability and control augmentation with a high degree of reliability are incorporated, separated three or two-axis controller configurations are required for acceptable handling qualities. E.A.K.

N85-25268# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.
A STUDY OF TRANSONIC FLUTTER OF A TWO-DIMENSIONAL AIRFOIL USING THE U-G AND P-K METHODS
B. H. K. LEE Nov. 1984 70 p
(AD-A151463; NAE-LR-615; NRC-23959) Avail: NTIS HC A04/MF A01 CSCL 20D

Transonic flutter of a NACA64A006 airfoil undergoing plunging and pitching oscillations is studied using the U-g and p-k methods. The aerodynamic coefficients are calculated using an improved version of an ONERA unsteady transonic aerodynamics code which include the second time derivative term of the velocity potential in the governing equation. Comparisons with LTRAN2-NLR show good agreement up to and in some cases exceeding kc = 0.4, except for the pitching moment curves at the transonic dip Mach number of 0.85. All flutter results are presented for M = 0.85. The p-k method gives flutter speeds identical to those from the U-g method. Subcritical damping ratios using the U-g method with Frueh's and Miller's damping formula are quite close to those obtained from the p-k method, especially for large values of the airfoil-air mass ratio. Response of the airfoil to externally applied forces and moments is studied using the p-k method and a viscous damping model for coupled motions. GRA

N85-25270# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ACTIVE CONTROL OF FORWARD SWEPT WINGS WITH DIVERGENCE AND FLUTTER AEROELASTIC INSTABILITIES Ph.D. Thesis
K. E. GRIFFIN 1 May 1984 164 p Document previously announced as N85-18063
(AD-A151837; AFIT/DS/AA-84-1) Avail: NTIS HC A08/MF A01 CSCL 01C

Active feedback control is applied to cantilever forward-swept wings (FSW) providing significant increases in the critical airspeeds of aeroelastic flutter and divergence. Feedback compensation improves the critical airspeed for a divergence critical FSW by 25% and improves the critical airspeed for a flutter critical FSW example by 30%. These improvements are limited by the emergence as most critical, instabilities that were only secondary without feedback. The method of analysis is linear control theory in the Laplace domain. A significant improvement is made in the Pade Approximant method for calculating damped unsteady aerodynamic forces in the Laplace domain. GRA

N85-25271# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MULTIVARIABLE CONTROL LAW DESIGN FOR THE AFTI/F-16 WITH A FAILED CONTROL SURFACE M.S. Thesis
R. A. ESLINGER Dec. 1984 350 p
(AD-A151908; AFIT/GE/ENG/84D-28) Avail: NTIS HC A15/MF A01 CSCL 01B

Two linearized models containing coupled aircraft equations are developed for the AFTI/F-16. The first is a model of the healthy aircraft with all control surface intact, and the second is a model of the aircraft with a free-floating right horizontal tail and all other surfaces operational. The multivariable design technique of Professor Brian Porter and the computer program MULTI are first used to design control laws for the healthy model. The control laws are tailored to perform seven maneuvers at four flight conditions. Maximum maneuvers are commanded to yield maximum control surface deflections. The same control law designs are then applied to the model with a failed right horizontal tail, and the performance is evaluated. Some maneuvers require modifications to the designs or lowered maximum maneuver requirements to avoid overshooting the deflection limits of the operational control surfaces. Simulation responses are presented for both the healthy and failure aircraft models. Generally, when the right horizontal tail fails, the left horizontal tail assumes primary pitch control and the flaperons take over complete roll control. The flaperons, rudder, and canards deflect to counter the rolling and yawing moments produced by the left horizontal tail deflection. GRA

N85-26630# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF TRANSONIC FLUTTER OF A HIGH-ASPECT RATIO TRANSPORT WING
K. ISOGAI *In its* Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 187-198 1983 refs In JAPANESE
Avail: NTIS HC A10/MF A01

The transonic flutter of a high-aspect ratio transport wing was numerically simulated using a transonic three dimensional aerodynamic approach with a consideration given to the effect of shock waves. In the numerical simulation, the equation controlling the flow (complete potential equation) and that for the wing motion were simultaneously solved and the time-dependent response of the elastic deformation of the wing was obtained directly. The flutter threshold predicted by the numerical simulation corresponded well with the experimental results. Transl. by B.G.

N85-26639# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
SOME ASPECTS OF HOW TO DESIGN COST-EFFECTIVE FLIGHT CONTROL SYSTEMS
U. BUTTER and L. BOTZLER *In* AGARD Cost Effective and Affordable Guidance and Control Systems 14 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The design of flight control systems for fighter aircraft is discussed with respect to areas which contribute to minimizing life-cycle costs. As life-cycle costs include all costs accumulating during the whole life of the system, all phases from the design to in-service use are considered. Any structural and technological design features that are introduced to save costs during system operation and maintenance require additional development effort. Therefore, the expected cost benefit has to be balanced against the development effort invested into the system to achieve a cost-effective design. Author

N85-26653# British Aerospace Public Ltd. Co., Preston (England).
A METHOD OF ESTIMATING AIRCRAFT ATTITUDE FROM FLY BY WIRE FLIGHT CONTROL SYSTEM DATA
R. J. V. SNELL *In* AGARD Cost Effective and Affordable Guidance and Control Systems 9 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The use of active control technology (ACT) to control the aircraft flight both led to flight path sensors and associated computing. The use of these data to extract aircraft attitude was studied. This would avoid the requirement for supplementary hardware in the form of an attitude references system and Artificial horizon and could endow the source of attitude with the high integrity annd availability associated with flight control systems. An experimental application was flown on the ACT Fly-by-Wire Jaguar Demonstration aircraft using digital data originating in the Flight Control System. The flight results demonstrated good accuracy and stability in the general course of flying. If attitude can be established with sufficient accuracy, it is feasible to extract magnetic heading from a three axis magnetometer. Heading, together with attitude and air data information provides the basis for a dead reckoning navigation system. Such a basic system could be aided by a continuous terrain profile matching system to provide high accuracy navigation. The method offers a source of high integrity attitude and could serve as the basis for a low cost, highly accurate navigation system suitable for operation over digitally mapped terrain, either as a stand alone system or a back up for cross monitoring an inertial navigation system. E.A.K.

N85-26720*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOTED SIMULATION OF ONE-ON-ONE HELICOPTER AIR COMBAT AT NOE FLIGHT LEVELS
M. S. LEWIS and E. W. AIKEN Apr. 1985 52 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.
(NASA-TM-86686; NAS 1.15:86686; USAAVSCOM-TR-85-A-2)
Avail: NTIS HC A04/MF A01 CSCL 01C

A piloted simulation designed to examine the effects of terrain proximity and control system design on helicopter performance during one-on-one air combat maneuvering (ACM) is discussed. The NASA Ames vertical motion simulator (VMS) and the computer generated imagery (CGI) systems were modified to allow two aircraft to be independently piloted on a single CGI data base. Engagements were begun with the blue aircraft already in a tail-chase position behind the red, and also with the two aircraft originating from positions unknown to each other. Maneuvering was very aggressive and safety requirements for minimum altitude, separation, and maximum bank angles typical of flight test were not used. Results indicate that the presence of terrain features adds an order of complexiaty to the task performed over clear air ACM and that mix of attitude and rate command-type stability and control augmentation system (SCAS) design may be desirable. The simulation system design, the flight paths flown, and the tactics used were compared favorably by the evaluation pilots to actual flight test experiments. Author

N85-26721*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT AND FLIGHT TEST OF A HELICOPTER, X-BAND, PORTABLE PRECISION LANDING SYSTEM CONCEPT
T. J. DAVIS, G. R. CLARY, J. P. CHISHOLM (Sierra Nevada Corp., Reno), and S. L. MACDONALD (Sierra Nevada Corp., Reno) May 1985 13 p refs
(NASA-TM-86710; NAS 1.15:86710) Avail: NTIS HC A02/MF A01 CSCL 01C

A beacon landing system (BLS) is being developed and flight tested as a part of NASA's Rotorcraft All-Weather Operations Research Program. The system is based on state-of-of-the-art X-band radar technology and digital processing techniques. The bLS airborne hardware consists of an X-band receiver and a small micropreocessor, installed in conjunction wht the aircraft instrument landing system (ILS) receiver. The microprocessor analyzes the X-band, BLS pulses and outputs ILS-compatible localizer and glide slope signals. Range information is obtained using an on-board weather/mapping radar in conjunction with the BLS. The ground station is an inexpensive, portable unit; it weighs less than 70 lb and can be quickly deployed at a landing site. Results from the flight-test program show that the BLS has a significant potential for providing rotorcaraft with low-cost, precision instrument approach capability in remote areas. Author

N85-26722# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FLIGHT CONTROL SYSTEM RECONFIGURATION DESIGN USING QUANTITATIVE FEEDBACK THEORY M.S. Thesis
P. B. ARNOLD Dec. 1984 253 p
(AD-A151771; AFIT/GE/ENG/84D-15) Avail: NTIS HC A12/MF A01 CSCL 01D

Quantitative theory is used to develop control laws for the AFTI/F-16 with a reconfigurable flight control system. Compensators are synthesized to control pitch rate and roll rate through individually controlled elevators and flaperons. Robust control of these variables is required over a larger portion of the flight envelope despite flight control surface failures. Linearized aerodynamic data are used to develop the aircraft model in state-variable format. The longitudinal and lateral-directional equations are coupled in the control matrix. Individual control of the elevators and flaperons is obtained by dividing the dimensionalized control derivatives for a control surface pair in half and assigning each surface of the pair one-half of the total derivative value. The system with individually controlled surfaces represents a four input-two output system which is transformed into an equivalent two input-two output system for each control surface configuration and flight condition. Quantitative feedback theory is then applied to the equivalent systems. GRA

N85-26723# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A MODERN CONTROL DESIGN METHODOLOGY WITH APPLICATION TO THE CH-47 HELICOPTER M.S. Thesis
R. D. HOLDRIDGE Jan. 1985 249 p
(AD-A151946; AFIT/CI/NR-85-33D) Avail: NTIS HC A11/MF A01 CSCL 01D

A control system design methodology is developed in this dissertation which produces robust, low-order optimal controllers for multiple-input multiple-output systems. The methodology attempts to focus the strengths of recent Modern Control design algorithms on the problems associated with real control system designs. The methodology is a set of procedures which aids the engineer in creating a realizable controller in either digital or analog form. To demonstrate the usefulness of the methodology, two control augmentation systems (CAS) were designed and flight tested on a CH-47 helicopter at NASA Ames Research Center. The first design was a longitudinal cruise CAS giving the pilot decoupled control of forward velocity and climb rate. This design task demonstrated the low-order controller and robustness features of the methodology. It also demonstrated the use of modern control techniques in designing integral-error controllers. Flight test results are presented. The second controller is a translational velocity command/precision hover hold system. This two mode controller demonstrates the methodology as applied to a more complicated design task which includes control law switching and inner loop/outer loop considerations. Flight test results are also presented. GRA

N85-26724# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE EFFECT OF LOAD FACTOR ON AIRCRAFT HANDLING QUALITIES M.S. Thesis
J. R. RIEMER 10 Aug. 1984 374 p
(AD-A152118; AD-E401303; AFIT/GAE/AA/84J-2) Avail: NTIS HC A16/MF A01 CSCL 20D

This thesis documents the results of a limited simulation and flight test of the A-7D to determine the effect of load factor on aircraft handling qualities. The test condition was 15,000 feet indicated pressure altitude, 0.6 indicated Mach number, at load factors ranging from 1 to 3G's for the mechanical and fully augmented flight control configurations. The equations of motion were developed to include turning flight. GRA

N85-26725# Grumman Aerospace Corp., Bethpage, N.Y.
ESP (EXTERNAL-STORES PROGRAM): A PILOT COMPUTER PROGRAM FOR DETERMINING FLUTTER-CRITICAL EXTERNAL-STORE CONFIGURATIONS. VOLUME 1: USER'S MANUAL
J. B. SMEDFJELD Feb. 1985 104 p
(Contract N00019-81-C-0395; N00019-84-C-0123)
(AD-A152268; AD-E801100; ADCR-85-1-VOL-1) Avail: NTIS HC A06/MF A01 CSCL 09B

A pilot computer program for determining flutter-critical external-store configurations has been developed and made operational on the Naval Air Development Center Central Computer System. The new program, designated ESP (External-Stores Program), is a derivative of the previously developed Flutter and Strength Optimization Program (FASTOP). Three key ingredients in ESP are: A p-k flutter-solution algorithm that includes an automated procedure for defining the flutter speed. A calculation of the derivatives of the flutter speed with respect to the store parameters. A gradient-directed numerical-search algorithm to seek out progressively lower flutter speeds within a parameter space defined by the range of store parameters at each aircraft store station. The version of ESP that exists as of this writing was developed primarily with the objective of quickly evaluating the feasibility of the store-search concept. The program structure has not been optimized for minimum computing time, and not all options in the program have been checked. Thus, the current ESP version should be considered as a pilot code. Nevertheless, the unique capabilities of ESP have been shown to provide substantial advantages over previous approaches to the store-flutter problem. Therefore, this user's manual was prepared to permit early utilization of ESP on practical problems. GRA

N85-26726# Grumman Aerospace Corp., Bethpage, N.Y.
ESP (EXTERNAL-STORES PROGRAM): A PILOT COMPUTER PROGRAM FOR DETERMINING FLUTTER-CRITICAL EXTERNAL-STORE CONFIGURATIONS. VOLUME 2: FINAL REPORT ON PROGRAM ENHANCEMENT AND DELIVERY Final Report
J. B. SMEDFJELD Feb. 1985 36 p
(Contract N00019-81-C-0395; N00019-84-C-0123)
(AD-A152269; AD-E801100; ADCR-85-1-VOL-2) Avail: NTIS HC A03/MF A01 CSCL 09B

A pilot computer program for determining flutter-critical external-store configurations, which was partially developed under two previous Naval Air Systems Command contracts, has been further enhanced and made operational on the Central Computer System at the Naval Air Development Center. The enhancements were introduced to: (1) Increase the applicability of the program to modern attack aircraft with thinner, more flexible wings, and (2) Permit the utilization of aircraft dynamics-model data from both the COSMIC and the MacNeal-Schwendler Corporation versions of NASTRAN, and also from card-image files. Additional modifications, including a substantial reduction in computer core requirements, were made to convert the original IBM code to a CDC version compatible with the computing facility at NADC. Also, logic was added to by-pass data required for store-search runs if only a conventional flutter analysis is desired. Finally, a user's manual was prepared (Volume I of this report), which, in conjunction with a FASTOP user's manual and previous theoretical documentation of the store-search procedure, should permit a practicing flutter analyst to use the new External-Stores Program (ESP) effectively. GRA

N85-26727# Grumman Aerospace Corp., Bethpage, N.Y.
ESP (EXTERNAL-STORES PROGRAM): A PILOT COMPUTER PROGRAM FOR DETERMINING FLUTTER-CRITICAL EXTERNAL-STORE CONFIGURATIONS. VOLUME 3, PART 1: PROGRAM COMPILATION
J. B. SMEDFJELD Feb. 1985 693 p
(Contract N00019-81-C-0395; N00019-84-C-0123)
(AD-A152270; AD-E801100; ADCR-85-1-VOL-3-PT-1) Avail: NTIS HC A99/MF A02 CSCL 09B

A pilot computer program for determining flutter-critical external-store configurations has been developed and made operational on the Naval Air Development Center Central Computer System. The new program, designated ESP (External-Stores Program), is a derivative of the previously developed Flutter and Strength Optimization Program (FASTOP). A compilation of the 264 subroutines in ESP is contained herein. The program consists of three major modules: (1) a vibration-analysis module, which begins with subroutine AVAM; (2) a flutter-analysis module, which begins with subroutine AFAM; and (3) a search module (called the flutter-optimization module in FASTOP), which begins with subroutine AFOM. These modules are entered via subroutine FOP, which performs most of the functions of a main program in the FASTOP and ESP Flutter Optimization Package. The actual MAIN program, which calls the FOP subroutine, is designated FASTOP herein. To facilitate locating the compile for a particular routine, two numbered lists of all subroutine names have been provided. The first list, which is in order of appearance in the compile, determines the subroutine numbers. The second list is alphabetical. Part 1 of this volume contains the first 119 subroutines, and Part 2 contains the remainder. GRA

N85-26728# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
STATIC LONGITUDINAL STABILITY AND CONTROL CHARACTERISTICS OF THE FOKKER F27 FRIENDSHIP CALCULATED BY SIMPLE HANDBOOK METHODS
J. C. VANDERVAART and H. MUHAMMAD Sep. 1983 118 p refs
(VTH-LR-394) Avail: NTIS HC A06/MF A01

The static stability and control characteristics of the F-27 aircraft were calculated using methods in DATCOM and older works of reference. The calculation of location of aerodynamic center, neutral and maneuver points (stick-fixed and stick-free), pitching moment, trim curves and control force curves are all based on the geometric data available in, for instance, the preliminary design stage. Comparison with measured data shows that a reasonable estimate of most of the static stability and control characteristics can be made for this class of aircraft. A more accurate estimate of wing-fuselage pitching moment can be obtained by using a slightly more refined method than the one in DATCOM. Horizontal tail lift due to angle of attack and elevator angle is estimated more accurately using older publications than DATCOM. Author (ESA)

N85-26729# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
APPLICATION OF LINEAR OPTIMAL CONTROL THEORY TO THE DESIGN OF THE ELEVATOR CONTROL SYSTEM OF THE DHC-2 BEAVER EXPERIMENTAL AIRCRAFT
O. QIU Dec. 1983 104 p refs
(VTH-LR-411) Avail: NTIS HC A06/MF A01

The design of elevator control laws for the electrohydraulic servo control valve of a DHC-2 aircraft based on measurements of actuator position and piston differential pressure such that the elevator follows as closely as possible the electrical command signals is described. State and output feedback optimal control are used. The elevator control system consists of an elevator coupled via two long, flexible cables to a system of bellcranks and rods. This latter system is connected directly to the pilot operated control column. An electrohydraulic servo actuator connected to one of the bellcranks prepares the aircraft for digital control. Author (ESA)

N85-26730# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS SYMPOSIUM ON ACTIVE CONTROL SYSTEMS: REVIEW, EVALUATION AND PROJECTIONS Abstracts Only
L. D. REID (Toronto Univ.) Loughton, England Mar. 1985 17 p Symp. held in Toronto, 15-18 Oct. 1984
(AGARD-AR-220; ISBN-92-835-1493-9) Avail: NTIS HC A02/MF A01

Research and development in active control systems (ACS) was evaluated. Areas discussed include; handling qualities specifications, use of flight control system backups, development of high integrity systems at reasonable cost, demonstration of system reliability, survivability, and certification.

N85-26732# General Electric Co., Binghamton, N.Y.
THE STATE-OF-THE-ART AND FUTURE OF FLIGHT CONTROL SYSTEMS Abstract Only
R. QUINLIVAN *In* AGARD Tech Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 2 Mar. 1985
Avail: NTIS HC A02/MF A01

The evolution of active control technology (ACT) from early stability augmentation systems to current full authority flight control systems was covered. The philosophy behind the design of current and future ACS is presented. Both the benefits and the problems involved are highlighted. The potential hazards inherent in reverting to a backup FCS following a total failure of the primary system are discussed.

N85-26733# Systems Technology, Inc., Hawthorne, Calif.
A PERSPECTIVE ON SUPERAUGMENTED FLIGHT CONTROL ADVANTAGES AND PROBLEMS Abstract Only
D. MCRUER, D. E. JOHNSTON, and T. T. MYERS *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 2 Mar. 1985
Avail: NTIS HC A02/MF A01

A superaugmented FCS both stabilizes an unstble aircraft and provides novel effective vehicle dynamics. The longitudinal dynamics of such an aircraft and FCS are discussed. The total available gain range (TAGR) factor was presented as a basic measure that relates degree of instability, control system limitations, and key control system adjustments. The flying qualities of superaugmented aircraft are discussed and highlighted. E.A.K.

N85-26734# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
ASPECTS OF APPLICATION OF ACT SYSTEMS FOR PILOT WORKLOAD ALLEVIATION Abstract Only
K. WILHELM and B. GMELIN *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 2 Mar. 1985
Avail: NTIS HC A02/MF A01

Aspects of the application of active control technology (ACT) systems for pilot workload alleviation were described for both fixed-wing aircraft and helicopters. The work involved wind tunnel tests of a rotor vibration control system and flight tests of a helicopter control decoupling system. Flight tests in the HFB 320 in-flight simulator were conducted on DLC incorporated within two flight path control techniques. It is found that DLC can only improve flight path control capability without HQ degradation if the pilot is supported by an inner loop augmentation system such as a Rate Command/Attitude Hold (RC/AH) system. Tests carried out in the same aircrft showed the influence of FCS time delays of up to 1.3s in degrading HQ ratings. E.A.K.

N85-26735# General Dynamics Corp., Fort Worth, Tex.
APPLICATION OF AFTI/F-16 TASK-TAILORED CONTROL MODES IN ADVANCED MULTIROLE FIGHTERS Abstract Only
R. D. TOLES, D. R. MCMONAGLE (Air Force Flight Test Center, Edwards AFB, Calif.), and D. C. ANDERSON *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 2-3 Mar. 1985
Avail: NTIS HC A02/MF A01

Flight tests carried out with a highly modified F-16 aircraft to demonsrate the effectiveness of a digital FCS and task-tailored modes are described. The tests specifically dealt with how task-tailoring the longitudinal control laws provide improved HQ for the air-to-air and bombing missions, how a flat turn mode gives the pilot an addedadvantages for the bombing and strafing tasks, and how Level 1 HQ for the landing system are obtained. The key to the flat turn mode is zero sideslip during the maneuver to reduce the aerodynamic load on the stores carried. E.A.K.

N85-26736# Grumman Aerospace Corp., Bethpage, N.Y.
X-29A DIGITAL FLIGHT CONTROL SYSTEM DESIGN Abstract Only
A. B. WHITAKER and J. CHIN *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

The structural and control elements going into the design and construction of this unique test aircraft incorporating a forward swept wing are outlined. A number of active control technology (ACT) related concepts were included such as relaxed longitudinal stability, triplex digital FBW system and high gain FCS, a DLC type of response, task-tailoring, drag minimization and an analog backup FCS. E.A.K.

N85-26737# Royal Aircraft Establishment, Farnborough (England).
THE EVALUATION OF ACS FOR HELICOPTERS: CONCEPTUAL SIMULATION STUDIES TO PRELIMINARY DESIGN Abstract Only
J. S. WINTER, G. D. PADFIELD, and S. L. BUCKINGHAM *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

The means by which design aims are defined and how they may be implemented through to the preliminary design stage were investigated. The use of a simplified helicopter model in a ground-based simulator was demonstrated to provide a quick means of studying control problems. A possible control law design for a helicopter is described. A technique for assessing the robustness of a control system design is outlined in the face of unknown or varying elements in the aircrft state matrix. This method, based on the use of maximum singular values, appears to be a useful design tool. E.A.K.

N85-26738# Smiths Industries Ltd., London (England).
ACT APPLIED TO HELICOPTER FLIGHT CONTROL Abstract Only
W. R. RICHARDS *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

The ACS configurations suitable for installation in the 1988 and 1992 time scales were identified. Reliability aspects, control law philosophy and the impact of advanced technology are discussed. It appears that fibre optics and the replacement of electrical devices by optical ones where possible will be required to meet the challenge of EMP/EMC and lightning strikes. E.A.K.

N85-26739# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
SOME FLIGHT TEST RESULTS WITH REDUNDANT DIGITAL FLIGHT CONTROL SYSTEMS Abstract Only
U. KORTE *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

The successful flight test program carried out in a modified F-104G was outlined. A digital quadruplex FBW and FCS was used to stabilize the airframe which was destabilized longitudinally by the addition of aft located ballast and a canard surface. Flights were completed in which the successful operation of the FCS was demonstrated along with reversion to a simplified digital backup system. It is indicated that FCS software verification is not as great a problem as many think and that reversion to a properly implemented backup FCS can be handled by pilots in an operational environment. E.A.K.

N85-26740# British Aerospace Aircraft Group, Preston (England).
AN UPDATE ON EXPERIENCE ON THE FLY BY WIRE JAGUAR EQUIPPED WITH A FULL-TIME DIGITAL FLIGHT CONTROL SYSTEM Abstract Only
E. DALEY *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

A technology demonstration program was presented which emphasized relaxed stability, carefree maneuvering and protection against EM interference in the form of lightning and high frequency radio signals. The quadruplex fly by wire (FBW) system had no mechanical backup. The FCS was demonstrated during close to 100 flights and the EM immunity of the complete system was proven during extensive ground tests. It is concluded that, both customer and aircraft manufacturer are confident that active control systems can be implemented safely and cheaply with similar integrity to present day mechanical systems, and that the aircrft can be acceptably hardened against natural and man-made EM interference'. E.A.K.

N85-26741# British Aerospace Public Ltd. Co., Brough (England).
ACT FLIGHT RESEARCH EXPERIENCE Abstract Only
D. J. WALKER and R. M. HORNER (RAE) *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3 Mar. 1985
Avail: NTIS HC A02/MF A01

The Hunter ACT aircraft development and flight test program was reviewed. A number of practical hardware aspects of the project were discussed. The FCS in-flight tests included a nonlinear pitch filter (with an effect much like the pitch axis task tailoring) and a depressed roll axis (about the sight axis). Mixed success in using ground based simulators during system development was reported.

N85-26742# McDonnell Aircraft Co., St. Louis, Mo.
OPERATIONAL AND DEVELOPMENTAL EXPERIENCE WITH THE F/A-18A DIGITAL FLIGHT CONTROL SYSTEM Abstract Only
W. A. MORAN *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 3-4 Mar. 1985
Avail: NTIS HC A02/MF A01

An operational aircraft making full use of ACT is described. Of particular interest was the use of the digital FCS to help solve several developmental problems encountered during the flight testing of the F/A-18A. Four problems were highlighted: poor nosewheel liftoff characteristics; insufficient roll performance; excessive structural loads; unwanted roll coupling. All these difficulties were overcome in a unique and cost effective manner with the help of the digital FCS. The system designers managed to reduce an unacceptably large FCS time delay to a reasonable value of 70 ms. E.A.K.

N85-26743# Naval Air Test Center, Patuxent River, Md.
FLIGHT TESTING AND DEVELOPMENT OF THE F/A-18A DIGITAL FLIGHT CONTROL SYSTEM Abstract Only
R. A. BURTON, B. T. KNEELAND, U. H. RABIN (Systems Control Technology, Inc.), and R. S. HANSEN (Systems Control Technology, Inc.) *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01

A new technique was presented for extracting equivalent system models, which uses several algorithms including a maximum likelihood estimator method. This and the use of closed loop pilot mission related task testing was successfully employed to evaluate the FCS during its development. The use of the equivalent model is recommended for ground based simulation during the design phase. E.A.K.

N85-26744# Dornier-Werke G.m.b.H., Munich (West Germany).
OLGA: AN OPEN LOOP GUST ALLEVIATION Abstract Only
H. BOHRET, B. KRAG (DFVLR, Brunswick, West Germany), and J. SKUDRIDAKIS (DFVLR, Brunswick, West Germany) *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01

Following sophisticated wind tunnel trials, a flight test program was carried out using a Do 28 TNT aircraft to evaluate the effectiveness of an open loop gust alleviation system. By using an open loop approach the basic airframe dynamics were left unaltered. Ecitation of the wing's first bending mode by the system was removed by employing a suitably tuned notch filter. It is found that the suppression of low frequency accelerations by the OLGA system made the passengers more conscious of other sources of discomfort. E.A.K.

N85-26745# Lockheed-California Co., Burbank.
DEMONSTRATION OF RELAXED STABILITY ON A COMMERCIAL TRANSPORT Abstract Only
J. J. RISING, W. J. DAVIS, and C. S. WILLEY *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01

The application of relaxed stability to current transport aircraft can lead to a 2% drag reduction. This can rise to 4% for next generation aircraft. A flight test program and a ground based flight simulator program employing an L-1011 aircraft have demonstrated the successful implementation of this concept. Stability augmentation was provided by a digital FCS and HQ ratings were obtained for a range of conditions. It was concluded that, careful tailoring of the augmentation system authority will result in acceptable failure characteristics, thereby eliminating the need for multisystem redundancy. Author

N85-26746# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany).
REALISATION OF RELAXED STATIC STABILITY ON A COMMERCIAL TRANSPORT Abstract Only
U. P. GRAEBER *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01

This paper deals with the use of fuel transfer to an aft located tank in order to reduce the trim drag on a commercial transport. Both ground based simulator trials and flight tests in an Airbus A300 were employed to demonstrate the aircraft could be flown both manually and by the autopilot with significantly aft o.g. locations. it is suggested that the use of such fuel transfer techniques is the only practical way to achieve reduced stability in an operational commercial transport. Author

N85-26747*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
ACTIVE CONTROL TECHNOLOGY EXPERIENCE WITH THE SPACE SHUTTLE IN THE LANDING REGIME Abstract Only
B. G. POWERS *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01 CSCL 01C

An interesting description was provided of the development of the shuttle flight control systems. Of particular concern was a tendency to excite PIO during the landing phase. Both ground based and in-flight simulation were used to study the problem. It was found that in-flight simulation was the only reliable method to use in the study of PIO. Two of the major contributions to the PIO problem were found to be system time delay and the lack of a clear motion cue at the pilot's location following a pitch up command. The PIO problem was solved by reducing the demands of the piloting task and introducing an adaptive stick gain limiter. Author

N85-26748# London Univ. (England).
THE AERODYNAMICS OF CONTROLS Abstract Only
A. D. YOUNG *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4 Mar. 1985
Avail: NTIS HC A02/MF A01

A comprehensive review is gien of the various conventional and unconventional control surfaces (or motivators) available for use as part of an active control system. A better understanding of the aerodynamics of such motivators is needed in order to make effective use of them. In particular, dynamic effects and the influence of flight at high angles of attack and at transonic speeds on these devices needs further study. A better data base must be generated to aid the designer. B.W.

N85-26749*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACTIVE CONTROL LANDING GEAR FOR GROUND LOADS ALLEVIATION Abstract Only
J. R. MCGEHEE *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 4-5 Mar. 1985
Avail: NTIS HC A02/MF A01 CSCL 01C

An active landing gear has been created by connecting the hydraulic piston in an oleo strut to a hydraulic supply. A controller modulates the pressure in the oleo to achieve the desired dynamic characteristics. Tests on ground rigs (docuumented by a film) have demonstrated the successful alleviation of induced structural ground loads and the next step will be a flight test using a fighter aircraft. Author

N85-26750# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
WING BUFFETING ACTIVE CONTROL TESTING ON A TRANSPORT AIRCRAFT CONFIGURATION IN A LARGE SONIC TUNNEL Abstract Only
R. DESTUYNDER *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 5 Mar. 1985
Avail: NTIS HC A02/MF A01

A sophisticated large aerelastic half model has been developed to duplicate the structural characteristics of a typical civil transport aircraft. An active flaperon system has been developed to dampen out structural response to buffeting experienced at high angles of attack and/or Mach numbers of the range 0.50-0.82. This was achieved without increasing the structural modal frequencies. The resulting reduced structural strain and airframe motion effectively increase the usable flight envelope. Author

N85-26752# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
HOW TO HANDLE FAILURES IN ADVANCED FLIGHT CONTROL SYSTEMS OF FUTURE TRANSPORT AIRCRAFT Abstract Only
M. P. C. VANGOOL *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 5 Mar. 1985
Avail: NTIS HC A02/MF A01

A ground-based simulator program in which reversion to an unstable flight control system backup occurred following the failure of the primary system. Of interest was the large scatter in the HQ ratings given to the backup system. It was found that existing longitudinal HQ criteria have difficulty in explaining the trend in pilot aircraft will be a very complicated task. B.W.

N85-26755# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
THE FLIGHT CONTROL SYSTEM FOR THE EXPERIMENTAL AIRCRAFT PROGRAMME (EAP) DEMONSTRATOR AIRCRAFT Abstract Only
J. KAUL, F. SELLA (Aeritalia S.p.A), and M. J. WALKER (British Aerospace Aircraft Group) *In* AGARD Tech. Evaluation Rept. on the Flight Mech Symp. on Active Control Systems p 5 Mar. 1985
Avail: NTIS HC A02/MF A01

The historial background of the Experimental Aircraft Program is (EAP) presented. Because the first flight is planned for May 1986 the FCS design is based on previously proven technology. The aircraft is intended to demonstrate: (1) advanced structures and materials; (2) advanced aerodynamics ; (3) active control; (4) digital data bus; (5) modern cockpit; (6) stealthiness; and (7) digital control of the engine. B.W.

N85-26756# Boeing Aerospace Co., Seattle, Wash.
AUTOMATIC FLIGHT CONTROL MODES FOR THE AFTI/F-111 MISSION ADAPTIVE WING AIRCRAFT Abstract Only
M. R. EVANS, R. J. HYNES, D. C. NORMAN, and R. E. THOMASSON *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 5 Mar. 1985
Avail: NTIS HC A02/MF A01

This program involves the fitting of an experimental F-111 with a variable-camber wing and a digital FCS that makes use of this feature. The following automatic modes have been implemented: (1) Maneuver camber control to maximize lift/drg; (2) Cruise camber control - to maximize horizontal velocity; (3) Maneuver load control - to reduce wing root bending; and (4) Maneuver enhancement and gust alleviation - uses variable camber and the horizontal tail to increase maneuver response and to reduce gust response. B.W.

N85-26757# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE STOL AND MANEUVER TECHNOLOGY PROGRAM INTEGRATED CONTROL SYSTEM Abstract Only
D. J. MOORHOUSE and D. R. SELEGAN *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 6 Mar. 1985
Avail: NTIS HC A02/MF A01

The application of STOL capability to a supersonic fighter is discussed. This will be accomplished by employing a level of control integration beyond any attempted so far. In particular to a highly modified propulsion system will be incorporated as a primary control element. The control system design will require an integrated team of aerodynamics, stability and control, flying qualities, guidance, display, propulsion and controls specialists. The test aircraft will be an F-15 and the project will extend over the next 4-5 years. B.W.

N85-26758# Westland Helicopters Ltd., Yeovil (England).
THE EVOLUTION OF ACTIVE CONTROL TECHNOLOGY SYSTEMS FOR THE 1990'S HELICOPTER Abstract Only
G. C. F. WYATT *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 6 Mar. 1985
Avail: NTIS HC A02/MF A01

A reviewed is presented of the application of active control systems in helicopters. System failures and how best to deal with them are discussed. The author emphasized the need for: (1) Considering civil active control technology applications when undertaking military R and D; (2) More study of the common mode failure problem; and (3) Increased flight testing of ACT aircraft. B.W.

N85-27729 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
SOME ASPECTS OF HOW TO DESIGN COST-EFFECTIVE FLIGHT CONTROL SYSTEMS
U. BUTTER and L. BOTZLER *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 71-84 1984 Presented at 39th AGARD-GCP Panel Meeting/Symp. on Cost-Effective and Affordable Guidance and Control System, Cesme, Turkey, 15-19 Oct. 1984
(MBB-LKE-32/S/PUB/143) Avail: Issuing Activity

The minimization of life cycle costs in design of flight control systems for fighter aircraft is discussed. Sensor information processing and actuation systems are dealt with. Size, weight, and power consumption of a system can be reduced using advanced technology components. The obtained benefit has to be balanced against the higher price of these components. There is an interactive relationship between development and operational phases. Increased development effort to improve reliability, maintainability and testability of the system helps to save costs during the in-service phase. Experience shows that the costs invested in development, production, and maintenance of a system are related to each other as 1:3:10. Author (ESA)

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A85-33800
NAVAL CENTER SEEKS NEW USES FOR CENTRIFUGE-BASED SIMULATOR
B. M. GREELEY, JR. Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, May 6, 1985, p. 81, 83, 87, 89, 90.

The U.S. Naval Air Development Center has undertaken a search for novel applications for its dynamic flight simulator (DFS) which would make good use of the high g forces and unusual attitudes that can be simulated by this facility. Attention is presently given to DFS operations in which the centrifuge cockpit was configured to simulate the F-14 fighter, for spin simulation studies. An important prospective application of the DFS is to evaluations of the high-g operation of helmet-mounted night vision systems. All DFS flight simulations are monitored by means of a TV camera that allows a flight surgeon to observe pilot behavior during maneuvers. O.C.

A85-34734
EXACT SOLUTION FOR WIND TUNNEL INTERFERENCE USING THE PANEL METHOD
S. K. OJHA and G. R. SHEVARE (Indian Institute of Technology, Bombay, India) Computers and Fluids (ISSN 0045-7930), vol. 13, no. 1, 1985, p. 1-14. refs

It is pointed out that the effect of wind tunnel wall constraints can be theoretically predicted only by solving the Navier-Stokes equations with the wall constraints as boundary conditions and comparing the solution with that having no wall constraints. In the absence of any such solution, the problem is generally studied by making use of the potential flow theory. The basic equation involved is the Laplace equation which is now generally solved by the method of surface singularities, also commonly known as the panel method. The existing wind tunnel interference theories are based on highly simplified assumptions, and fail to provide accurate results for large blockage ratios and incidences. The present investigation is concerned with the employment of the panel method, taking into account an extension of the method to account for wall constraints. The considered method brings out the nonlinear effect of the wall interference. G.R.

A85-34999

INVESTIGATIONS INTO THE EFFECTS OF SCALE AND COMPRESSIBILITY ON LIFT AND DRAG IN THE RAE 5M PRESSURISED LOW-SPEED WIND TUNNEL

S. P. FIDDES, D. A. KIRBY, D. S. WOODWARD, and D. H. PECKHAM (Royal Aircraft Establishment, Farnborough, Hants., England) Aeronautical Journal (ISSN 0001-9240), vol. 89, March 1985, p. 93-108. refs

Attention is given to results obtained in a 5-m, low speed pressurized wind tunnel that is capable of operating over a range of pressures from one to three atmospheres, thereby distinguishing between the effects of Mach and Reynolds number. The decoupling of scale and compressibility effects has facilitated the extrapolation of test results to full scale conditions, as well as given greater insight into underlying flow mechanisms. Emphasis is given to the prediction of high lift performance, high lift device optimization, and the drag of stores carried externally by military aircraft. O.C.

A85-35750#

WALL-INTERFERENCE CALCULATION OF WIND TUNNEL WITH OCTAGONAL SECTIONS USING CONFORMAL MAPPING METHOD

Y. XIA and C. LIN (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 78-82. In Chinese, with abstract in English. refs

The conformal mapping formula is used for the wall-interference calculation of wind tunnel with octagonal sections. The parameters in the mapping formula can be easily determined by computer. As particular examples, the results for rectangular, square, and regular octagon sections are also given in closed form. Some typical results are plotted and compared with other results. Author

A85-35752#

A CRYOGENIC HIGH-REYNOLDS NUMBER TRANSONIC WIND TUNNEL WITH PRE-COOLED AND RESTRICTED FLOW

R. PAN (China Aerodynamics Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 87-92. In Chinese, with abstract in English. refs

A cryogenic high-Reynolds number transonic wind tunnel with precooled and restricted flows is presented. The principle that air temperature falls through a flow restrictor which is also a regulator is applied. Air from a compressor is first cooled to 215 K and then enters the pressure vessels. During the wind tunnel operation, the regulating valve must be controlled so that fluid pressure is 5 atm and the fluid temperature is 154 K. Different temperatures and pressures may be used to achieve Reynolds numbers as high as 16.7 x 10 to the 7th under different Mach number conditions. The cooling system of the wind tunnel, the tunnel operating principles, and the 2.4 m transonic wind tunnel scheme are described in detail. C.D.

A85-35761#

OBSERVATION OF WAVE DIAGRAMS FOR SHOCK TUBE WITH THE DIVERGENT NOZZLE AT DIAPHRAGM SECTION

H. YU, J. LIN, Z. LI, and J. GU (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 3, 1984, p. 88-91. In Chinese, with abstract in English. refs

Piezoelectric pressure data were obtained in 185-mm diameter shock tube with a divergent section at shock Mach numbers in the range 1.5-2.5. It is shown that in an underexpansion flow a rarefaction wave exists, as previously predicted, but in an overexpansion flow compressive waves are observed instead of secondary shock wave. Author

A85-35781#

WALL LIFT INTERFERENCE CORRECTIONS IN GROUND EFFECT TESTING

J. LI and M. QI (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1984, p. 93-97. In Chinese, with abstract in English. refs

The wall lift interference parameters on ground effects for octagonal closed wind tunnels has been derived using image vortex systems. The fillet vortex system can be added to rectangular tunnel vortex system. The vortex lattice method can be used to determine fillet vortex strength. It has been found that the wall lift interference corrections on ground effect have related to not only the wall upwash and streamline curvature effects, but also the normal gradient of the upwash velocity at the horizontal tail. Author

A85-35804

LOW-SPEED WIND TUNNEL TESTING /2ND EDITION/

W. H. RAE, JR. (Washington, University, Seattle, WA) and A. POPE New York, Wiley-Interscience, 1984, 545 p. refs

The design, operation and applications of low-speed wind tunnels (WTs) are discussed and illustrated in an introductory and reference text for engineers and engineering students. Chapters are devoted to WT design; test-section calibration and instrumentation; measurements of model force, moment, and pressure; test procedures; WT boundary corrections; the use of WT data; small WTs; and nonaeronautical applications of WTs. Photographs, graphs, drawings, and tables of numerical data are provided. T.K.

A85-36419

WIND TUNNEL PROJECT DEMONSTRATES DIFFICULTIES OF EUROPEAN COOPERATION

M. FEAZEL Aviation Week and Space Technology (ISSN 0005-2175), vol. 122, June 3, 1985, p. 167, 169, 171, 173.

The processes, difficulties, and organizational structures developed over a 12 yr lag between the proposal and a signed agreement among four European nations to build a transonic cryogenic wind tunnel near Cologne, West Germany, are discussed. Originally to have had a 165.4 x 196.9 in. test section, the facility will instead have a 78.74 X 94.49 in. Section operating at cryogenic temperatures to obtain the Re range of transonic flight by transport aircraft. The site, selected from four candidates in West Germany, France, the Netherlands and the United Kingdom, was selected because of a higher contribution (38 percent) of the cost by West Germany. All design choices are accepted only when unanimously approved. A separate corporation is being established to ease the decision process and limit the liability of each nation. The staff positions will be apportioned in proportion to the levels of funding from the contributing nations. The tunnel is intended to keep the aerospace companies of the nations involved competitive during development of the next generation o transport aircraft. M.S.K.

N85-25190# Joint Publications Research Service, Arlington, Va.
ROUNDTABLE ON EFFECTIVE USE OF FLIGHT SIMULATORS
S. SOKOLOV, B. ORLOV, and I. KAZANSKIY *In its* USSR Rept.: Transportation (JPRS-UTR-85-008) p 12-19 3 May 1985 Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 1, Jan. 1985 p 12-15
Avail: NTIS HC A05

The problems and tasks of efficient utilization of simulators in civil aviation are explored. Expanded use of simulators in flight training, the reluctance of flight commanders to take simulator training, the quality of training of cockpit personnel, and the need for better housing for simulators are discussed. The extension of simulator capabilities is also considered. A.R.H.

N85-25273# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
WIND TUNNEL WALL INTERFERENCE Final Report, 1 Apr. 1982 - 31 Mar. 1983
D. B. BLISS and P. J. LU Apr. 1984 95 p
(Contract AF-AFOSR-0158-82)
(AD-A151212; AFOSR-85-0167TR) Avail: NTIS HC A05/MF A01 CSCL 20D

Behavior of isolated holes and slots in wind tunnel walls was studied. The aerodynamic characteristics of these individual wall elements can be used to help understand the behavior of walls with multiple perforations. Potential flow analysis similar to that employed in the kernel function approach to lifting surface theory was used to determine the pressure differential versus flowrate relationship for various hole planforms in high speed subsonic flow. The effect of an imposed pressure gradient was also analyzed. Good agreement with slender-body theory results was obtained for low aspect ratio planforms. Although the finite hole problem resembles the lifting wing problem, there are significant differences: the pressure differential is known and the free surface shape is unknown; the Kutta condition is applied to the hole leading edge; and there are no wake effects in the hole out-flow problem. The analysis was extended to include the effect of an inviscid rotational power law boundary layer over the hole by using a shear flow aerodynamics kernel function. The effect of the boundary layer was determined for transverse slots and holes with various planform shapes. Presence of a wall boundary layer tends to reduce the flow resistance coefficient and, since the layer thickness may be comparable to the hole size, the effect is reasonably strong. GRA

N85-25274# Naval Surface Weapons Center, White Oak, Md.
MACH-10 HIGH REYNOLDS NUMBER DEVELOPMENT IN THE NSWC (NAVAL SURFACE WEAPONS CENTER) HYPERVELOCITY FACILITY Final Report
R. A. KAVETSKY 13 Feb. 1984 327 p
(AD-A151241; NSWC/TR-83-526) Avail: NTIS HC A15/MF A01 CSCL 14B

The present NSWC hypervelocity facility has two Mach number capabilities (10 and 14) which operate over a range of Reynolds numbers. The Mach-10 leg had a maximum Reynolds number capability of 5.4 x 10 to the 6th power/ft. The Reynolds number region of interest for Mach-10, encompassing the reentry flight regime, has been established as 0 to 100 x 10 to the 6th power. Using oversized models in the present 5-foot diameter test cell, this Reynold's number regime scales down to a 0 to 20 x 10 to the 6th power/ft. The potential for a new, marketable testing capability, and the need to maintain a state-of-the-art facility, justified a major design effort to remove the constraints limiting the facility to the 5.4 x 10 to the 6th power/ft Reynolds number. This report documents this design effort, and subsequent performance of the new configuration. GRA

N85-25275# Calspan Field Services, Inc., Arnold AFS, Tenn.
MATHEMATICAL MODELING OF THE AEDC (ARNOLD ENGINEERING DEVELOPMENT CENTER) PROPULSION WIND TUNNEL (16T) Final Report, 1 Oct. 1978 - 30 Sep. 1982
P. B. STICH Mar. 1985 109 p
(Contract AF PROJ. D216)
(AD-A151293; AEDC-TR-84-32) Avail: NTIS HC A06/MF A01 CSCL 14B

An empirically based model of the 16-ft transonic Wind Tunnel (16T) in the Propulsion Wind Tunnel Facility at the Arnold Engineering Development Center, has been developed for calculating the distribution of tunnel component pressure losses and the effect of changes in these pressure losses on the tunnel total-power requirements. The model consists of two separate computer programs. The Historical Program assesses tunnel performance from a historical data base which was acquired during prior tunnel operation. The Analytical Model uses component pressure-loss information calculated by the Historical Program to evaluate potential changes in tunnel component pressure losses with respect to the tunnel power. The model was used to assess the potential power savings for a modification to the Tunnel 16T diffuser which involves the replacement of the compressor protective screen. Results indicate that for each 1-percent increase in diffuser recovery, a 4-percent decrease in main drive power will result. Less significant power savings were found for improvements to the other tunnel components. Author (GRA)

N85-25276# European Space Agency, Paris (France).
THE ONERA ESTABLISHMENT AT CANNES IN THE SERVICE OF AERONAUTICAL RESEARCH
A. BEVERT Nov. 1984 204 p refs Transl. into ENGLISH of "l'Etablissement ONERA de Cannes au Service de la Recherche Aeronautique" ONERA-P-1983-2 ONERA, Paris, 1983 Original language document was announced as ESA-92613
(ESA-TT-875; ONERA-P-1983-2) Avail: NTIS HC A10/MF A01

Research programs and test facilities of the French National Aerospace Research Office (ONERA) at Cannes are described. Wind tunnel apparatus, including balances, was developed. Research includes wind tunnel tests on highly sweptback wings; high lift; ground effect; vertical takeoff and landing; supersonic transport aircraft; and aerodynamic study of active control. Author (ESA)

N85-26759*# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.
STUDY ON NEEDS FOR A MAGNETIC SUSPENSION SYSTEM OPERATING WITH A TRANSONIC WIND TUNNEL Final Report
W. R. MARTINDALE, R. W. BUTLER, and R. F. STARR Washington NASA May 1985 107 p refs
(Contract NAS1-17423)
(NASA-CR-3900; NAS 1.26:3900) Avail: NTIS HC A06/MF A01 CSCL 14B

The U.S. aeronautical industry was surveyed to determine if current and future transonic testing requirements are sufficient to justify continued development work on magnetic suspension and balance systems (MSBS) by NASA. The effort involved preparation of a brief technical description of magnetic suspension and balance systems, design of a survey form asking specific questions about the role of the MSBS in satisfying future testing requirements, selecting nine major aeronautics companies to which the description and survey forms were sent, and visiting the companies and discussing the survey to obtain greater insight to their response to the survey. Evaluation and documentation of the survey responses and recommendations which evolved from the study are presented. Author

N85-26760*# Douglas Aircraft Co., Inc., Long Beach, Calif.
PROBABILISTIC COMPUTER MODEL OF OPTIMAL RUNWAY TURNOFFS Final Report
M. L. SCHOEN, O. W. PRESTON, L. G. SUMMERS, B. A. NELSON, L. VANDERLINDEN, and M. C. MCREYNOLDS Apr. 1985 62 p refs
(Contract NAS1-16202)
(NASA-CR-172549; NAS 1.26:172549) Avail: NTIS HC A04/MF A01 CSCL 01E

Landing delays are currently a problem at major air carrier airports and many forecasters agree that airport congestion will get worse by the end of the century. It is anticipated that some types of delays can be reduced by an efficient optimal runway exist system allowing increased approach volumes necessary at congested airports. A computerized Probabilistic Runway Turnoff Model which locates exits and defines path geometry for a selected maximum occupancy time appropriate for each TERPS aircraft category is defined. The model includes an algorithm for lateral ride comfort limits. Author

N85-26761# Clemson Univ., S.C. Dept. of Civil Engineering.
STUDY OF ACCEPTANCE CRITERIA FOR JOINT DENSITIES IN BITUMINOUS AIRPORT PAVEMENTS Final Report
J. L. BURATI and G. B. ELZOGHBI Feb. 1985 110 p refs
(Contract DTFA-01-81-C-10057)
(FAA-PM-85-5) Avail: NTIS HC A06/MF A01

A research project to: (1) collect data on field projects to determine joint density values currently obtained in the field on bituminous runway paving projets, (2) determine whether correlation exists between mat density and joint density results, (3) determine whether correlation exists between the results for nuclear density gages and the core densities obtained in the field and (4) determine whether to use nuclear density gages in the acceptance plan for bituminous runway pavements is summarized. Data were collected on 2 runway paving projects selected by the FAA Eastern Region during the spring of 1984 using 3 nuclear density gages (CPN M-2, Seaman C-75BP and Troxler 3411-B). These data were analyzed statistically to identify current production capabilities and possible correlations between mat and joint density results and between nuclear gage readings and core results. The findings indicate that joint density values are statistically significantly lower and more variable than density values attained in the paving mat. Statistically significant differences were also found in the nuclear gage results. The nuclear gage results were also significantly lower than corresponding core densities. Regression analyses indicated that the level of correlation among the core and gage results varied from gage to gage and from project to project. Author

N85-26762# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN AND SPECIFICATION OF A LOCAL AREA NETWORK ARCHITECTURE FOR USE IN REAL-TIME FLIGHT SIMULATION M.S. Thesis
L. R. MAKI Sep. 1984 209 p
(AD-A152242; AFIT/GCS/ENG/84S-3) Avail: NTIS HC A10/MF A01 CSCL 09E

This investigation examined the use of a Local Area Network (LAN) in the real-time environment of the Air Force Flight Dynamics Laboratory's Flight Control Development Laboratory (FCDL) flight simulation facility. Using the requirements of the FCDL's Manned Combat Station (MCS) project as a guideline, a LAN based on the Ethernet protocol specification was identified as suitable for use in the real-time flight simulation facility. Both the architecture and the performance of the Ethernet protocol were examined to make this conclusion. The selection of the Intel 82586 Local Communications Controller chip (which defaults to the Ethernet specification), the in-house design and manufacture of a Network Interface Board (NIB) using this chip, and the standard operating procedure for FCDL simulations allowed a software design to be completed for the control of the NIB. A recommended course of action for the FCDL is made for the eventual implementation of the proposed LAN and software design. GRA

N85-26764# Pacific Northwest Lab., Richland, Wash.
RADIOLUMINESCENT LIGHTING FOR RURAL ALASKAN RUNWAY LIGHTING AND MARKING
G. A. JENSEN and L. E. LEONARD (Dept. of Transportation and Public Facilities, Fairbanks, Alaska) Nov. 1984 31 p refs
Presented at the Ann. Meeting of the Illum. Eng. Soc. of North Am., Charleston, S.C., 14 Nov. 1984
(Contract DE-AC06-76RL-01830)
(DE85-007022; PNL-SA-12723; CONF-8411127-2) Avail: NTIS HC A03/MF A01

Various applications of tritium radioluminescent (RL) lighting are discussed for use in the State of Alaska with emphasis on airport lighting and landing aids. Estimates are made that attempt to quantify potential use of RL systems by the State of Alaska and others. Critical factors that are expected to influence the implementation of RL lighting systems are identified: regulatory agencies approvals, cost of tritium and tritium products, and public and institutional acceptance of RL systems. A summary of results of demonstrations, tests, and evaluations related to Alaskan and Arctic use of the lights is also included. DOE

N85-26765# Pacific Northwest Lab., Richland, Wash.
ACCEPTABILITY TESTING OF RADIOLUMINESCENT LIGHTS FOR VFR-NIGHT AIR TAXI OPERATIONS
G. A. JENSEN Jan. 1985 34 p refs
(Contract DE-AC06-76RL-01830)
(DE85-007303; PNL-5347) Avail: NTIS HC A03/MF A01

Tritium-powered radioluminescent (RL) lights under development for remote, austère, and tactical airfield lighting applications are discussed. The State of Alaska has requested FAA approval for use of the technology as a safe alternative lighting system to meet the airfield lighting needs of air taxi operations and general aviation in the state. The tests described in this report were performed for the DOE Defense Byproducts Production and Utilization Program. These tests are a step toward gaining the required approvals. DOE

N85-27731 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
ADVANCED FLIGHT SIMULATION FOR HELICOPTER DEVELOPMENT
H. HUBER, H. J. DAHL, and A. INGLSPERGER *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 173-188 1984 refs
Presented at AGARD/GCP 38th Panel Meeting Symp. on Helicopter Guidance and Control Systems for Battlefield Support, Monterey, Calif., 7-11 May 1984 Previously announced as N85-16815
Sponsored by West Germany Ministry of Defence
(MBB-UD-416/84-O) Avail: Issuing Activity

A simulation capability for fixed wing and rotary wing aircraft was developed. The fixed-based simulator consists of interchangeable cockpit stations, and a computer generated imagery (CGI) visual system, both coupled to the mathematical model simulation computer. Specific integration rigs for avionics, flight control and weapon systems can be operated with the simulator. The cockpit for helicopter applications consists of a BO 105 cockpit including flight control, trim system, and standard instruments. The visual scene is produced by a CGI-system consisting of the data base, image generator, and projection unit. The system allows different visibility conditions and simulation of fixed and moving objects. The projection system consists of a three-channel beam splitter. A comprehensive helicopter mathematical model representing the aerodynamic and dynamic complexities of rotary wing aircraft is applied. Author (ESA)

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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.

A85-34193
WAVERIDERS
D. LUNAN (Association in Scotland To Research Astronautics, Scotland) Space World (ISSN 0038-6332), vol. V-5-257, May 1985, p. 29, 30.

In the 1950's, Terence Nonweiler began to develop the concept of a 'waverider' reentry vehicle that functioned as a large wing area glider with very low wing loading. The curved shock waves generated by the leading edges of a vehicle with a concave belly would travel through the cavity immediately downstream in such a way that the craft could 'ride' on them. Since the vehicle would have a high angle of attack in hypersonic reentry flight, the upper slipstream would not touch the wing upper surface and would therefore obviate the otherwise required aerodynamic contours. The Association in Scotland To Research Astronautics (ASTRA) has formed the Waveriver Aerodynamic Study Project. A private developer has offered ASTRA a sounding rocket which will be ready to flight test the waverider concept in 1986. O.C.

A85-34426
IDENTIFICATION OF POWER ANALYSIS MODELS FOR ETS-III OPERATION
T. ITO (Toshiba Corp., Komukai Works, Kawasaki, Japan), F. IMAI, S. KUWAJIMA, and H. NAGANO (National Space Development Agency of Japan, Tokyo, Japan) Acta Astronautica (ISSN 0094-5765), vol. 12, Jan. 1985, p. 61-66.

The Engineering Test Satellite-III (ETS-III), which was launched in September of 1982, is presently considered in light of results from power analysis models of the Bus Equipment Operation Analysis Program, whose simulations furnish prior confirmation of safe operation in various electrical power and thermal control situations. The present model identification studies were conducted on the basis of flight data and simulation results. Good agreement is reported with actual ETS-III power situations. O.C.

A85-34859
THE EFFECT OF AERODYNAMIC LIFT ON NEAR CIRCULAR SATELLITE ORBITS
P. MOORE (Aston University, Birmingham, England) Planetary and Space Science (ISSN 0032-0633), vol. 33, May 1985, p. 479-491. Research sponsored by the Science and Engineering Research Council. refs

A theory is developed to evaluate the effect of aerodynamic lift on near circular satellite orbits. Consideration is given to a flat surface at constant altitude with respect to the velocity vector; and a sun oriented plate. In both cases the gas-surface interaction was restricted to diffuse or specular reflection. Numerical results are also presented for the nominal orbit of the ERS 1 satellite. It is shown that radial perturbations of the order of 1 cm every 5 days are likely during periods of moderate solar activity. During periods of high solar activity, however, a 10-fold increase in the severity of the effect is predicted. The effects of aerodynamic lift on stabilized satellites at altitudes of less than 800 km are illustrated in a hypothetical study of the orbital inclination of Skylab 1. I.H.

N85-25368*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA R AND T AEROSPACE PLANE VEHICLES: PROGRESS AND PLANS
S. C. DIXON May 1985 239 p refs Presented at the SAE Aerospace Vehicle Requirements Conf., Arlington, Va., 20-23 May 1985
(NASA-TM-86429; NAS 1.15:86429) Avail: NTIS HC A11/MF A01 CSCL 22B

Progress made in key technologies such as materials, structures, aerothermodynamics, hypersonic aerodynamics, and hypersonic airbreathing propulsion are reported. Advances were made in more generic, areas such as active controls, flight computer hardware and software, and interdisciplinary analytical design methodology. These technology advances coupled with the development of and experiences with the Space Shuttle make feasible aerospace plane-type vehicles that meet the more demanding requirements of various DOD missions and/or an all-weather Shuttle II with reduced launch costs. Technology needs and high payoff technologies, and the technology advancements in propulsion, control-configured-vehicles, aerodynamics, aerothermodynamics, aerothermal loads, and materials and structures were studied. The highest payoff technologies of materials and structures including thermal-structural analysis and high temperature test techniques are emphasized. The high priority technology of propulsion, and plans, of what remains to be done rather than firm program commitments, are briefly discussed.
E.A.K.

N85-26654# Marconi Avionics Ltd., Rochester (England). Airport Works.
THE IMPACT OF VLSI ON GUIDANCE AND CONTROL SYSTEM DESIGN
D. PRICE *In* AGARD Cost Effective and Affordable Guidance and Control Systems 4 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The potential of very large scale integrated circuit technology to reduce cost, including life cycle cost, of avionics systems was examined. Trends in methods of silicon realization and in system complexity are related to the necessary advances in methods of system design. A generic system design approach is outlined, which emphasis the discilines which are likely to enable cost-effective semicustom circuit design to become viable.
E.A.K.

N85-26862*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADVANCED HIGH PRESSURE O2/H2 TECHNOLOGY
S. F. MOREA, ed. and S. T. WU, ed. (Alabama Univ., Huntsville) Washington Apr. 1985 753 p refs Conf. held in Huntsville, Ala., 27-29 Jun. 1984
(NASA-CP-2372; NAS 1.55:2372) Avail: NTIS HC A99/MF E03; SOD HC CSCL 21H

Activities in the development of advanced high pressure oxygen-hydrogen stage combustion rocket engines are reported. Particular emphasis is given to the Space Shuttle main engine. The areas of engine technology discussed include fracture and fatigue in engine components, manufacturing and producibility engineering, materials, bearing technology, structure dynamics, fluid dynamics, and instrumentation technology.

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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.

A85-33537
DESIGN AND TESTING OF AXISYMMETRIC NOZZLES FOR ION-MOLECULE REACTION STUDIES BETWEEN 20 K AND 160 K
G. DUPEYRAT, J. B. MARQUETTE, and B. R. ROWE (CNRS, Laboratorie d'Aerothermique, Meudon, Hauts-de-Seine, France) Physics of Fluids (ISSN 0031-9171), vol. 28, May 1985, p. 1273-1279. refs

Solutions for axisymmetric contoured Laval nozzles have been calculated in order to obtain uniform supersonic flow. For nitrogen and oxygen gases the calculation uses only similarity techniques, but for helium complete calculations of the isentropic core and the boundary layer were performed for two sets of boundary conditions. Experimental testing has shown that the nitrogen or oxygen flows exhibit a good uniformity, but that the helium flow was uniform only for one set of boundary conditions. The purpose of this work is to provide flow reactors for studies of ion-molecule reactions in the real temperature range of interstellar clouds (T less than 80 K). Author

A85-34201
PERFORMANCE ASSESSMENT OF EXOTHERMIC COMPOUNDS FOR DIRECTIONAL SOLIDIFICATION
D. C. PRADHAN, S. N. TEWARI, and M. L. BHATIA (Defence Metallurgical Research Laboratory, Hyderabad, India) Indian Institute of Metals, Transactions (ISSN 0019-493X), vol. 37, June 1984, p. 206-213. Research supported by the Ministry of Defence of India. refs

The performance of four commercially available exothermic mixtures for solidifying NIMOCAST-90 turbine blade alloy is evaluated. Measurements were carried out in order to find the time of ignition, ignition temperature, burning time, and maximum burning temperature for each exothermic mixture. Optimum proportions for filler sand additions were estimated for each mixture. The mechanical properties of directionally solidified bars and slabs of NIMOCAST-90 are predicted on the basis of the experimental results. The performance characteristics of the different mixtures are given in a table. I.H.

A85-35524
MODIFICATION OF TITANIUM POWDER METALLURGY ALLOY MICROSTRUCTURES BY STRAIN ENERGIZING AND RAPID OMNI-DIRECTIONAL COMPACTION
Y. R. MAHAJAN, D. EYLON, F. H. FROES (USAF, Materials Laboratory, Wright-Patterson AFB, OH), C. A. KELTO, and T. EGERER (Deutsche Gesellschaft fuer Metallkunde, International Conference on Titanium, 5th, Munich, West Germany, Sept. 10-14, 1984) Powder Metallurgy International (ISSN 0048-5012), vol. 17, April 1985, p. 75-78. refs
(Contract F33615-82-C-5078)

A combination of the Strain Energizing Process (SEP) and rapid omnidirectional compaction (ROC) is used to promote the alpha recrystallization in Plasma Rotating Electrode Process (PREP) prealloyed Ti alloy powder which, it is hoped, will yield the superior crack initiation resistance and tolerance to material defects of low aspect ratio alpha phase microstructures. Such a microstructure was presently obtained through ROC and ROC/recrystallization annealed processing; the fatigue strength of noncontamination-related failures was higher than that of clean, undeformed PREP powder compacts produced by HIPping. Since SEP powder is not entirely recrystallized, due to particle satelliting, a double pass rolling process was employed. O.C.

A85-36234
COATING COMPOSITION AND THE FORMATION OF PROTECTIVE OXIDE LAYERS AT HIGH TEMPERATURES
G. WAHL (Brown, Boveri et Cie. AG, Heidelberg, West Germany) IN: Metallurgical coatings 1983; Proceedings of the Tenth International Conference, San Diego, CA, April 18-22, 1983. Volume 1 . Lausanne, Switzerland, Elsevier Sequoia, S.A., 1983, p. 417-426. Research supported by the Bundesministerium fuer Forschung und Technologie. refs

The selective oxide formation of coatings whose structure consists of precipitates rich in the selectively oxidizing element M, embedded in a matrix, is described. A semiquantitative model representing oxidation of homogeneous alloys is presented. The analysis indicates that the critical concentration of the matrix can be reduced by introduction of precipitates; quantitative dependences are established. It is further inferred that to obtain a coating of good quality the critical concentrations must be low, and the mechanical properties of the oxide layer must be very good. This can be achieved through an increase in the amount of precipitates, a decrease in the parabolic constant, and an increase in the diffusion coefficient of M. L.T.

N85-25198# Joint Publications Research Service, Arlington, Va.
CHRONIC FUEL SHORTAGES IN VOLGA CIVIL AVIATION ADMINISTRATION
A. SHERSTNEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-017) p 12-15 13 Jun. 1984 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 31 Mar. 1984 p 2
Avail: NTIS HC A04/MF A01

The causes and consequences of chronic aviation fuel and lubrication shortages in the Volga region are discussed. The planning of aviation fuel deliveries is analyzed. R.J.F.

N85-25439# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A FIELD REPAIR TECHNIQUE FOR MINI-SANDWICH KEVLAR/EPOXY AIRCRAFT SKIN M.S. Thesis
D. B. CRIPPS Jun. 1984 126 p
(AD-A151369) Avail: NTIS HC A07/MF A01 CSCL 01C

An experimental analysis was performed on Kevlar/epoxy cloth mini-sandwich panels with cellular foam core. Three undamaged panels and twenty-three other panels with damage and repairs were subjected to static shear loading. Four parameters were varied in the types of repairs, hole size, hole plug filler material, patch material, and patch overlap distance. All twenty-six panels were tested to failure. A repair technique employing a cellular foam plug and fiber-glass patches overlapping the original hole by 0.50 inches, symmetrically applied with structural adhesive, was found to be suitable for repair of up to three inch diameter circular holes at field repair level. Additionally, postbuckling energy absorption was qualitatively examined for undamaged panels and for hole sizes ranging from 1 to 5 inches diameter. GRA

N85-25448# Purdue Univ., Lafayette, Ind. Combustion Lab.
INFLUENCE OF FUEL PROPERTIES ON GAS TURBINE COMBUSTION PERFORMANCE Final Report, 3 Jan. 1983 - 30 Sep. 1984
A. H. LEFEBVRE Jan. 1985 157 p
(Contract F33615-81-C-2067)
(AD-A151464; AFWAL-TR-84-2104) Avail: NTIS HC A08/MF A01 CSCL 21D

Results of an analytical and experimental program to determine the effects of broad variations in fuel properties on the performance, emissions, and durability of several prominent turbojet engine combustion systems, including both turbo-annular and annular configurations, are presented. Measurements of mean drop size conducted at representative engine operating conditions are used to supplement the available experimental data on the effects of combustor design parameters, combustor operating conditions and fuel type, on combustion efficiency, lean blowout limits, lean lightoff limits, liner wall temperatures, pattern factor, and pollutant emissions. The results of the study indicate that the fuel's physical properties that govern atomization quality and evaporation rates strongly affect combustion efficiency, weak extinction limits, and lean lightoff limits. The influence of fuel chemistry on these performance parameters is quite small. Analysis of the experimental data shows that fuel chemistry has a significant effect on flame emissivity, flame radiation, and liner wall temperature, but its influence on the emissions of carbon monoxide, unburned hydrocarbons, and oxides of nitrogen, is small. Smoke emissions are found to be strongly dependent on combustion pressure, primary-zone fuel/air ratio, and the mode of fuel injection (pressure atomization or airblast). Fuel chemistry, as indicated by hydrogen content, is also important. GRA

N85-25478# Lehigh Univ., Bethlehem, Pa.
MECHANISMS OF CORROSION FATIGUE IN HIGH STRENGTH I/M (INGOT METALLURGY) AND P/M (POWDER METALLURGY) ALUMINUM ALLOYS Final Technical Report, 1 Jan. 1981 - 30 Sep. 1984
R. P. WEI and P. S. PAO (McDonnell Douglas Research Lab., St. Louis) Nov. 1984 145 p
(Contract F49620-81-K-0004)
(AD-A151177; IFSM-85-133; AFOSR-85-0163TR) Avail: NTIS HC A07/MF A01 CSCL 11F

High strength aluminum alloys are employed extensively in the primary structure of current and projected Air Force and civilian aircraft. The service lives and reliability of these aircrafts depend to a great extent on the corrosion fatigue resistance of the structural alloys. Significant efforts are underway to develop powder metallurgy (P/M) alloys that would provide improved corrosion fatigue resistance along with improvements in other mechanical properties. The objective of this study was to understand the chemical and metallurgical aspects of environmentally assisted fatigue crack growth (or corrosion fatigue) that can serve: (1) as a basis for guiding the development of new and improved alloys, and (2) as a basis for developing rational design procedures for service life predictions. The kinetics of fatigue crack growth, as a function of water vapor pressure and for water vapor-oxygen mixtures, and the accompanying fractographic observations on 7050-T7451, 7050-T651 and 7075-T651 (I/M) alloys and on 7091-T7E69 and 7091-T7E70 (P/M) alloys are described and discussed. GRA

N85-25539# Ashland Petroleum Co., Ky.
AVIATION TURBINE FUELS FROM TAR SANDS BITUMEN AND HEAVY OILS. PART 1: PROCESS ANALYSIS Interim Technical Report, 1 Jul. 1983 - 31 Mar. 1984
H. F. MOORE, C. A. JOHNSON, W. A. SUTTON, L. M. HENTON, and M. H. CHAFFIN Wright-Patterson AFB, Ohio AFWAL Sep. 1984 159 p
(Contract F33615-83-C-2301)
(AD-A151319; AFWAL-TR-84-2070-PT-1) Avail: NTIS HC A08/MF A01 CSCL 21D

Phase I work performed was directed toward defining the United States tar sands and heavy oil resources by a literature survey and the development of a preferred processing route that would produce quantities of JP4 and JP8 at optimum operating conditions attaining at least 70% energy efficiency and limiting coke and residual products to less than 10 percent. The overall objectives from this program are to provide cost, yield, chemical and physical properties of variable quality aviation turbine fuels produced from tar sands and heavy oils. GRA

N85-25785# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Aerothermodynamique.
THREE-DIMENSIONAL BOUNDARY LAYERS AND SHEAR FLOWS ACTIVITIES AT ONERA/CERT
R. MICHEL *In* AGARD Three-Dimensional Boundary Layers 15 p Feb. 1985 refs
Avail: NTIS HC A06/MF A01

Experimental and theoretical research activities devoted to three-dimensional boundary layers and turbulent shear flows are reviewed. Emphasis is on (1) development, application and control studies of calculation methods for turbulent boundary layers and wakes; (2) corner flows; and (3) stability and transition in three-dimensional flows. Typical results are presented. A.R.H.

N85-26923*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA/AIRCRAFT INDUSTRY STANDARD SPECIFICATION FOR GRAPHITE FIBER TOUGHENED THERMOSET RESIN COMPOSITE MATERIAL
Washington Jun. 1985 58 p
(NASA-RP-1142; L-15946; NAS 1.61:1142) Avail: NTIS HC A04/MF A01 CSCL 11D

A standard specification for a selected class of graphite fiber/toughened thermoset resin matrix material was developed through joint NASA/Aircraft Industry effort. This specification was compiled to provide uniform requirements and tests for qualifying prepreg systems and for acceptance of prepreg batches. The specification applies specifically to a class of composite prepreg consisting of unidirectional graphite fibers impregnated with a toughened thermoset resin that produce laminates with service temperatures from -65 F to 200 F when cured at temperatures below or equal to 350 F. The specified prepreg has a fiber areal weight of 145 g sq m. The specified tests are limited to those required to set minimum standards for the uncured prepreg and cured laminates, and are not intended to provide design allowable properties. Author

N85-26964*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIAXIAL AND THERMOMECHANICAL FATIGUE CONSIDERATIONS IN DAMAGE TOLERANT DESIGN
G. E. LEESE (TRW, Inc., Cleveland) and R. C. BILL 1985 21 p refs Presented at the 60th Meeting of the Struct. and Mater. Panel, San Antonio, 21-26 Apr. 1985; sponsored by AGARD Prepared in cooperation with Army Research and Technology Labs., Cleveland
(NASA-TM-87022; E-2514; NAS 1.15:87022; USAAVSCOM-TR-85-C-5) Avail: NTIS HC A02/MF A01 CSCL 11F

In considering damage tolerant design concepts for gas turbine hot section components, several challenging concerns arise: Complex multiaxial loading situations are encountered; Thermomechanical fatigue loading involving very wide temperature ranges is imposed on components; Some hot section materials are extremely anisotropic; and coatings and environmental interactions play an important role in crack propagation. The effects of multiaxiality and thermomechanical fatigue are considered from the standpoint of their impact on damage tolerant design concepts. Recently obtained research results as well as results from the open literature are examined and their implications for damage tolerant design are discussed. Three important needs required to advance analytical capabilities in support of damage tolerant design become readily apparent: (1) a theoretical basis to account for the effect of nonproportional loading (mechanical and mechanical/thermal); (2) the development of practical crack growth parameters that are applicable to thermomechanical fatigue situations; and (3) the development of crack growth models that address multiple crack failures. Author

N85-26996*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF EXPERIMENTAL EPOXY MONOMERS
W. T. HODGES (Army Research and Technology Lab., Hampton, Va.), T. L. ST.CLAIR, J. R. PRATT (Mississippi Univ. for Women), and R. FICKLIN (Mississippi Univ. for Women) 1985 16 p refs Submitted for publication
(NASA-TM-87476; NAS 1.15:87476) Avail: NTIS HC A02/MF A01 CSCL 11B

Future generation aircraft need higher performance polymer matrices to fully achieve the weight savings possible with composite materials. New resins are being formulated in an effort to understand basic polymer behavior and to develop improved resins. Some polymer/curing agent combinations that could be useful are difficult to process. In the area of epoxies, a major problem is that some components have physical properties which make them difficult to utilize as matrix resins. A previous study showed that the use of ultrasonic energy can be advantageous in the mixing of curing agents into a standard epoxy resin, such as MY 720 (Ciba-Geigy designation). This work is expanded to include three novel epoxides. R.J.F.

N85-27009# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

INVESTIGATION OF THE INFLUENCE OF SOME PAINT SYSTEMS AND WATER DISPLACING CORROSION INHIBITORS ON ANODIC UNDERMINING CORROSION OF ALUMINUM 2024 CLAD ALLOY

H. F. DEJONG and W. A. J. MOONEN Oct. 1984 30 p refs
(VTH-LR-443) Avail: NTIS HC A03/MF A01

The influence of 2 low-chromate paint systems and 2 water displacing corrosion inhibitors (WDCI) on the anodic undermining corrosion behavior of aluminum 2024-T3 clad alloy was investigated in salt spray and alternate immersion tests. Results indicate that the use of a top coat layer in a low-chromate paint system enhances the anodic undermining corrosion. This is attributed to a lower oxygen concentration in the blisters due to the reduced diffusion of oxygen through the thick paint layer. The oxygen concentration is too low to repassivate the anode. The application of a WDCI offers good protection only as long a good WDCI-layer is maintained. A partly washed off WDCI layer results in an increase in the number of blisters. Author (ESA)

N85-27012*# Exxon Research and Engineering Co., Linden, N.J. Products Research Div.

JET FUEL PROPERTY CHANGES AND THEIR EFFECT ON PRODUCIBILITY AND COST IN THE U.S., CANADA, AND EUROPE Final Report

G. M. VARGA, JR., A. J. AVELLA, JR., A. R. CUNNINGHAM, C. D. FEATHERSTON, J. F. GORGOL, A. J. GRAF, M. LIEBERMAN, and G. A. OLIVER Feb. 1985 205 p refs
(Contract NAS3-22769)
(NASA-CR-174840; NAS 1.26:174840; RL-1PD-85) Avail: NTIS HC A10/MF A01 CSCL 21D

The effects of changes in properties and blending stocks on the refinery output and cost of jet fuel in the U.S., Canada, and Europe were determined. Computerized refinery models that minimize production costs and incorporated a 1981 cost structure and supply/demand projections to the year 2010 were used. Except in the West U.S., no changes in jet fuel properties were required to meet all projected demands, even allowing for deteriorating crude qualities and changes in competing product demand. In the West U.S., property changes or the use of cracked blendstocks were projected to be required after 1990 to meet expected demand. Generally, relaxation of aromatics and freezing point, or the use of cracked stocks produced similar results, i.e., jet fuel output could be increased by up to a factor of three or its production cost lowered by up to $10/cu m. High quality hydrocracked stocks are now used on a limited basis to produce jet fuel. The conversion of U.S. and NATO military forces from wide-cut to kerosene-based jet fuel is addressed. This conversion resulted in increased costs of several hundred million dollars annually. These costs can be reduced by relaxing kerosene jet fuel properties, using cracked stocks and/or considering the greater volumetric energy content of kerosene jet fuel. E.A.K.

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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.

A85-33402#

PROCEDURE FOR THE CALCULATION OF THE CHARACTERISTICS OF AXIAL, RESPECTIVELY RADIAL, ONE OR MULTISTAGE THERMAL FLOW MACHINES, TAKING INTO CONSIDERATION ALSO THE EFFECT OF ADJUSTABLE GUIDE DEVICES [VERFAHREN ZUR BERECHNUNG DER KENNFELDER VON AXIALEN BZW. RADIALEN, EIN- ODER MEHRSTUFIGEN THERMISCHEN STROEMUNGSMASCHINEN, AUCH UNTER BERUECKSICHTIGUNG DES EINFLUSSES VON VERSTELLBAREN LEITAPPARATEN]

H. GOETTLICH Berlin, Technische Universitaet, Fachbereich Verkehrswesen, Dr.-Ing. Dissertation, 1984, 108 p. In German. refs

The determination of the characteristics of thermal flow machines requires the conduction of costly experiments, or the implementation of a computational procedure involving a great mathematical effort. The basic concept regarding the present investigation is related to the development of a simple procedure which makes it possible to calculate, without any great mathematical effort, characteristics which are sufficiently accurate. The calculation of one-stage or multistage compressors and turbines is considered along with the possibility to affect the characteristics by means of guide device adjustments, and aspects of guide device adjustment for one or several stages. The theory of the individual stage provides the basis for the calculation of the characteristics. The characteristic of the individual stage is approximated with the aid of a linear function. The characteristics of a multistage turbomachine are obtained as the sum of the behavior of each individual stage. G.R.

A85-33474

EXPERIMENTS IN SUPERPLASTIC FORMING OF HELICOPTER COMPONENTS

F. PERSIANI (Bologna, Universita, Bologna, Italy) and R. TRIPPODO (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Laboratorio Tecnologie Sperimentali, Gallarate, Italy) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 1, 1985, p. 83-92. refs

The impact of the superplastic forming technology on helicopter parts design is assessed, focusing on the development of an experimental device for superplastic forming and diffusion bonding for titanium and aluminum-based alloys and on the assessment of the design rules for optimization of helicopter components and the resulting weight and strength benefits. Two types of aluminum components were tested: double-bonded thin sheets with high stiffness features ensured by stiffening ribs and box-type assembly, and single relatively thick sheet. Weight savings of up to 50 percent were achieved, as compared to the presently used riveted component, with an increase in stiffness of 10 percent. For titanium components gains of 180 percent in the stiffness-to-weight ratio were attained. L.T.

A85-33630
APPLICATION OF LABORATORY TEST DATA TO ENGINEERING DESIGN
R. F. SIMENZ, J. J. PENGRA, and S. L. LANGENBECK (Lockheed-California Co., Burbank, CA) IN: Environment-sensitive fracture: Evaluation and comparison of test methods. Philadelphia, PA, American Society for Testing and Materials, 1984, p. 52-71. refs

The use of currently available stress corrosion threshold data in design is discussed. Examples of service failures are detailed for parts which laboratory data have assisted in determining the cause of failure and resolution of the problem. Stress corrosion test results of over 300 high-strength steel specimens are summarized. Specimens were tested by bend and axial tension loading and exposed to high humidity and alternate immersion in salt water. A comparison of 4340 and 300M alloys and the effect of product form, grain direction, part size, and stress concentration on the stress corrosion characteristics of these high-strength alloys are made. Methods for the use of these data and other published data are outlined. This use includes original design as well as analysis efforts to extend the service life of existing aircraft. Engineers' future needs for stress corrosion data point to the new-technology aluminum alloys and extended crack growth data under meaningful environments and loading conditions. Author

A85-34443
RADAR SIGNAL PROCESSING
S. HAYKIN (McMaster University, Hamilton, Ontario, Canada) IEEE ASSP Magazine (ISSN 0740-7467), vol. 2, April 1985, p. 2-18. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

The role of clutter in radar signal processing is considered with particular reference to an air-traffic environment. The characteristics of clutter are described, and the use of conventional moving-target indication filters to reduce the effects of clutter is considered. Adaptive clutter suppression schemes are addressed, and the adaptive detection of a moving target in the presence of clutter of unknown statistics is discussed. The use of a parametric spectrum estimation procedure as the basis of clutter classification is described. C.D.

A85-34661
PROBLEMS OF RADOME DESIGN FOR MODERN AIRBORNE RADAR. II
B. RULF (Radant Systems, Inc., Stow; Tufts University, Medford, MA) Microwave Journal (ISSN 0026-2897), vol. 28, May 1985, p. 265, 266, 270, 271. refs

Solution techniques devised for designing aircraft radomes, particularly AWACS and nose mounts, are presented. Consideration is given to the range of the angles of incidence and the ratio between polarization over the radome area. Methods are defined for selecting optimal ratios for the radome emitting/receiving segments, thus simultaneously controlling reflection and transmission effects. Nose radomes are primarily aerodynamic structures and thereby possess incidence angles of up to 80 deg. Reflected power is calculated with geometric optics. Both types of radome are constructed of carbon composite sandwich structures, which minimize reflection sufficiently to justify doubled costs. M.S.K.

A85-34706
A COMPATIBLE MIXED DESIGN AND ANALYSIS FINITE ELEMENT METHOD FOR THE DESIGN OF TURBOMACHINERY BLADES
R. D. CEDAR and P. STOW (Rolls-Royce, Ltd., Derby, England) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, April 1985, p. 331-345. refs

In this paper the development of a compatible mixed design and analysis method is presented for the quasi-three-dimensional finite element blade-to-blade program FINSUP. The method consists of two parts. The first is concerned with a method of modeling changes to a blade shape using a surface transpiration model. The second is concerned with determining the relationship between the displaced blade surface and the surface velocity distribution. It is shown that with the Newton-Raphson procedure adopted in the method a very efficient manner of introducing the design option is possible. As a consequence the resulting program is fast and completely interactive. A number of examples are given to illustrate how the mixed design and analysis mode can be used in practical blade design. Author

A85-34974
STRESS INTENSITY FACTORS FOR AN ARC CRACK IN A ROTATING DISC
R. N. L. SMITH (Royal Military College of Science, Shrivenham, Wilts., England) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 21, no. 3, 1985, p. 579-587. refs

Numerical solutions are obtained to the problem of an arc crack in a rotating disc. Two boundary element methods are used, one dependent on the problem symmetry and the other capable of solving rotational problems with quite general boundaries. Good agreement is obtained between the two methods, and the results cast some doubt on the validity of published values. Author

A85-35203* Aerometrics, Inc., Mountain View, Calif.
OPTICAL INTERFEROMETRY IN FLUID DYNAMICS RESEARCH
W. D. BACHALO and M. J. HOUSER (Aerometrics, Inc., Mountain View, CA) Optical Engineering (ISSN 0091-3286), vol. 24, May-June 1984, p. 455-461. Research supported by Douglas Aircraft Co. and NASA. refs

Optical interferometry techniques have been applied to the investigation of transonic airfoil flow fields in large-scale wind tunnels. Holographic interferometry techniques were used in the study of two-dimensional symmetric NACA 64A010 and Douglas Aircraft Company DSMA671 supercritical airfoil performance in the NASA Ames 2 ft x 2 ft transonic wind tunnel. Quantitative data obtained from the interferograms were compared to the surface pressure data. The excellent agreement obtained verified the accuracy of the flow visualization and demonstrated the potential for acquiring quantitative scalar results. Measurements of the inviscid flow speed and the boundary layer and wake velocity profiles were extracted from the interferograms and compared to laser Doppler velocimeter measurements. These results were also in good agreement. A method for acquiring real-time interferometric data in large-scale facilities was developed. This method, based on the point diffraction interferometer, was successfully tested in the Ames 2 ft x 2 ft transonic wind tunnel. The holographic and real-time interferometry methods were applied to the investigations of circulation control airfoils utilizing the Coanda effect. These results revealed the details of the jet interaction with the trailing edge boundary layer and the other parameters affecting the lift augmentation. Author

A85-35256
ELECTROFORMING OF COMPLEX PARTS AND HEAT EXCHANGER SYSTEMS
R. SUCHENTRUNK (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Institute of Metal Finishing, Annual Meeting, Bournemouth, Hants., England, Apr. 1985, Paper. 22 p. refs
(MBB-Z-42-85-OE)

Various aspects of producing complex structures by electrodeposition of thick adherent metallic layers on a preshaped mandrel are detailed. The electroforming process has extremely high reproducibility (peak-to-valley heights of 0.00005 mm can be reproduced) and provides for high stiffness and practically no distortion due to internal stresses. It is noted that the strength of the metal-to-metal bond can be made at least as high as the tensile strength of the weaker metal. The materials and processes used in electroplating are also outlined. Furthermore, the applications of the technique are discussed in detail through the examples of electroformed combustion chambers, concentrators for solar energy plants, water-cooled screens, boxes, and targets for nuclear fusion experiments, compact wind tunnel models, waveguides, and large-scale erosion protection shapes for aircraft. L.T.

A85-35296
FLUTTER ANALYSIS OF CANTILEVERED QUADRILATERAL PLATES
R. S. SRINIVASAN and B. J. C. BABU (Indian Institute of Technology, Madras, India) Journal of Sound and Vibration (ISSN 0022-460X), vol. 98, Jan. 8, 1985, p. 45-53. refs

In this paper, the title problem is solved by using a numerical method involving an integral equation technique and a normal mode method. Linear plate theory has been used for computing the strain energy and kinetic energy of the plate. Piston theory has been used to describe the aerodynamic pressure distribution. Numerical work has been done and convergence of the solution has been studied. Results have also been obtained for various cases and compared with those of other investigators. Author

A85-35589*# Massachusetts Inst. of Tech., Cambridge.
MEASUREMENT OF ICE ACCRETION USING ULTRASONIC PULSE-ECHO TECHNIQUES
R. J. HANSMAN, JR. and M. S. KIRBY (MIT, Cambridge, MA) Journal of Aircraft (ISSN 0021-8669), vol. 22, June 1985, p. 530-535. Previously cited in issue 07, p. 907, Accession no. A85-19769. refs
(Contract NAG1-100; NGL-22-009-640)

A85-35592#
COMPUTATION OF FORCED LAMINAR CONVECTION IN ROTATING CAVITIES
J. W. CHEW (Rolls-Royce, Ltd., Derby, England) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol. 107, May 1985, p. 277-282. Research supported by Rolls-Royce, Ltd. refs

Finite difference solutions are presented for forced laminar convection in a rotating cylindrical cavity with radial outflow. This forms a simple model of the cooling flow between two compressor disks in a gas turbine engine. If the fluid enters the cavity from a uniform radial source, it is shown that the local Nusselt number changes from that of a 'free disk' near the center of the cavity to that for Ekman layer flow at larger radii. With an axial inlet, the flow, and consequently, the heat transfer, is more complex. If vortex breakdown occurs, then the results are very similar to those for the radial inlet case, but otherwise a wall jet forms on the downstream disk, and the heat transfer from this disk may be several times that for the upstream disk. Variation of mean Nusselt number with rotational speed is qualitatively similar to previously published experimental measurements in turbulent flow. The effect of Prandtl number on heat transfer has also been demonstrated. Author

A85-35593#
HEAT TRANSFER FROM RECTANGULAR PLATES INCLINED AT DIFFERENT ANGLES OF ATTACK AND YAW TO AN AIR STREAM
D. G. MOTWANI, U. N. GAITONDE, and S. P. SUKHATME (Indian Institute of Technology, Bombay, India) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol. 107, May 1985, p. 307-312. refs

Average heat transfer coefficients for forced air flow convection over inclined and yawed rectangular plates have been experimentally determined. Tripping wires at the edges ensured that a turbulent boundary layer prevailed over the plates. The experiments were carried out for a constant surface temperature and covered two plates of different aspect ratios, angles of attack from 0 to 45 deg, angles of yaw from 0 to 30 deg, and Reynolds numbers from 20,000 to 350,000. The results show that the average heat transfer coefficient is essentially insensitive to the aspect ratio and angle of yaw. However, it is a function of Reynolds number and angle of attack. Correlation equations for various angles of attack are suggested. Author

A85-35746#
A STUDY FOR CALCULATING ROTOR LOADS USING FREE VORTEX CONCEPT
T. RUAN, Q. HAN, R. LI, and X. SHEN (Jiangxi Aeronautical Society, People's Republic of China) Acta Aerodynamica Sinica, no. 2, 1984, p. 50-60. In Chinese, with abstract in English. refs

Rotor discrete free wake geometries and the blade airloads at each instant are presented. These are obtained by step-by-step iteration using the three-dimensional classical theory of incompressible fluid in a process similar to the start-up of a rotor in a free stream. The calculation stops only when the wake has steadied. After the steady vortex wake is obtained, the wake-induced downwash at each point of interest and on the rotor is computed. The theory of thin airfoils and an approximate experimental formula for lift and drag coefficients are used to determine the blade airloads and responses. Comparison of the first four harmonic airloads from the calculations with those obtained from flight tests shows good agreement. C.D.

A85-35900
DETERMINATION OF THE DISCREPANCY VECTOR COMPONENTS USING NONLINEAR FUNCTIONS IN SOLVING CERTAIN BOUNDARY VALUE ELASTICITY PROBLEMS [OPREDELENIE KOMPONENT VEKTORA NEVIAZKI CHEREZI NELINEINYE FUNKTSII PRI RESHENII NEKOTORYKH KRAEVYKH ZADACH TEORII UPRUGOSTI]
E. K. ZAITSEV (Kiiv'skii Institut Inzheneriv Tsivil'noi Aviatsii, Kiev, Ukrainian SSR) Vychislitel'naia i Prikladnaia Matematika (ISSN 0321-4117), no. 52, 1984, p. 100-105. In Russian.

A system of nonlinear finite-difference equations describing the operation of elastic structures (e.g., take-off and landing strips, sluice heads, dry docks, etc) is solved through discrepancy vector minimization using the relaxation method. Formulas for calculating the vector components are derived. As an example, calculations are carried out for a plate supported by a nonliner elastic foundation. V.L.

A85-36302
SEPARATED FLOWS [ABGELOESTE STROEMUNGEN]
H. HORNUNG (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Forschungsbereich Stroemungsmechanik, Goettingen, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 3-T 14. In German. refs

The characteristics of two-dimensional and three-dimensional separated flows are discussed and illustrated with diagrams and photographs, and theoretical models are reviewed. Topics examined include transport and alteration of vortex strength, high-Reynolds-number separation in plane flows (the failure of classical boundary-layer theory, higher-order theories, and the effect of turbulence), and three-dimensional separation (flow-surface branching and vortex formation, local solutions of the Navier-Stokes equations, and the vortex-skeleton model). T.K.

A85-36321
ADAPTIVE CONTROL OF AN ELASTIC ROTOR WITH A MAGNETIC BEARING [ADAPTIVE REGELUNG EINES MAGNETGELAGERTEN ELASTISCHEN ROTORS]
J. WINTER (Universitaet Duisburg-Gesamthochschule, Duisburg, West Germany) (Gesellschaft fuer angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Regensburg, West Germany, Apr. 16-19, 1984) Zeitschrift fuer angewandte Mathematik und Mechanik (ISSN 0044-2267), vol. 65, no. 4, 1985, p. T 113-T 115. In German.

Blessing and Frik (1983) have considered the mathematical model of a rotor with a magnetic bearing as the adaption objective of a real adaptable system. The employed model makes use of a Riccati controller for stabilization. The requirements for a successful adaptation are examined. Difference matrices occur in cases in which these requirements are not satisfied. An adaption algorithm which ensures the asymptotic stability of the nonlinear, adaptive control system can be derived with the aid of a Liapunov function and P as the solution matrix of the Liapunov matrix equation. Adaption laws are obtained, and the conditions for the adaptability of a mechanical system are discussed. A mathematical model is formulated for an isotropic, standing rotor with an elastic shaft. However, the rotor does not satisfy the conditions of adaptability. An additional adjustment possibility is, therefore, provided by introducing a second radial magnetic bearing. Details regarding the adaptation procedures are discussed, taking into account aspects of simulation and mathematical relations. G.R.

A85-36414
TRIANGULAR FINITE ELEMENT METHODS FOR THE EULER EQUATIONS
F. ANGRAND (Institut National de Recherche en Informatique et en Automatique, Rocquencourt, Yvelines, France), V. BOULARD, J. PERIAUX (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France), A. DERVIEUX (Institut National de Recherche en Informatique et en Automatique, Valbonne, Alpes-Maritimes, France), and G. VIJAYASUNDARAM (Tata Institute of Fundamental Research, Bangalore, India) IN: Computing methods in applied sciences and engineering, VI; Proceedings of the Sixth International Symposium, Versailles, France, December 12-16, 1983 . Amsterdam and New York, North-Holland, 1984, p. 535-563. refs

Triangular finite element methods are developed for the unsteady Euler equations of compressible inviscid flows. A first-order Godunov-type scheme is presented and used for three-dimensional computations of internal flows. A second order Richtmyer-type implicit scheme is constructed; an efficiency comparison with an earlier explicit version is developed with transonic two-dimensional test cases. Author

A85-36672
A METHOD FOR THE PREDICTION OF CORIOLIS INDUCED SECONDARY FLOWS AND THEIR INFLUENCE ON HEAT TRANSFER IN ROTATING DUCTS
C. TAYLOR, J. RANCE, and J. O. MEDWELL (Swansea, University College, Swansea, Wales) Engineering Computations (ISSN 0264-4401), vol. 2, March 1985, p. 2-12. Research supported by the Science and Engineering Research Council. refs

During operation, the rotor blades of a gas turbine are exposed to high temperatures. By introducing cooling passages within the blade, it is possible to raise the gas temperature to which the blades can be subjected and to enhance, thereby, the overall thermal efficiency of the turbine. For the appropriate implementation of such an approach, an accurate prediction technique is required to evaluate the flow pattern and the heat transfer process. The present investigation is, therefore, concerned with the development of a model, based on finite element considerations, for the determination of the primary and secondary flow, and the associated heat transfer, in the cooling passages of rotating turbine blades. Attention is given to theoretical concepts, boundary conditions, the method of solution, and examples for illustrating the application of the discussed procedures. G.R.

N85-25172*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRENDS IN COMPUTATIONAL CAPABILITIES FOR FLUID DYNAMICS
V. L. PETERSON *In* AGARD Transonic Unsteady Aerodyn. and its Aeroelastic Appl. 9 p Jan. 1985 refs Document previously announced as N84-33383
Avail: NTIS HC A14/MF A01 CSCL 20D

Milestones in the development of computational aerodynamics are reviewed together with past, present, and future computer performance (speed and memory) trends. Factors influencing computer performance requirements for both steady and unsteady flow simulations are identified. Estimates of computer speed and memory that are required to calculate both inviscid and viscous, steady and unsteady flows about airfoils, wings, and simple wing body configurations are presented and compared to computer performance which is either currently available, or is expected to be available before the end of this decade. Finally, estimates of the amounts of computer time that are required to determine flutter boundaries of airfoils and wings at transonic Mach numbers are presented and discussed. Author

N85-25545# Textron Bell Aerospace Co., Buffalo, N. Y.
FINGER MATERIALS FOR AIR CUSHION VEHICLES. VOLUME 1: FLEXIBLE COATINGS FOR FINGER MATERIALS Final Report, Jan. 1978 - Apr. 1981
P. K. CONN, I. C. SNELL, and W. KLEMENS Dec. 1984 131 p
(Contract N00600-78-C-0250; F61-541)
(AD-A151438; REPT-7467-927048-VOL-1;
DTNSRDC-85/003-VOL-1) Avail: NTIS HC A07/MF A01
CSCL 11C

Twenty polymer formulations from ten selected gum rubber polymers or polymer blends and fourteen formulations of castable liquid polyurethane polymers were characterized as coatings for the coated fabric that is the type material used to make flexible fingers for air cushion vehicles. The formulations were screened for crack growth and flexural fatigue resistance; the results were compared to results from a natural rubber/cisabutadiene blend control coating. In addition, selected polymers were evaluated with primary and secondary characterization tests and the results compared to results from the control formulation. One polymer also was used to evaluate the use of a reticulated carbon black to improve thermal conductivity. Several polymers had better crack growth resistance and a number had better flexural fatique resistance than the control polymer. A clorinated polyethylene polymer coated on nylon fabric had properties equivalent to the control polymer coated on nylon fabric. Hysteresis tests at different rates of deformation yielded results which suggested that the standard tests may not identify polymers with improved performance on air cushion vehicles. Woven fabric, knit, and mat structures were evaluated as reinforcements for polymer coatings; the knit and mat structures were not as efficient on a strength-to-weight basis as woven fabrics. GRA

N85-25552# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY
18 Apr. 1984 61 p Transl. into ENGLISH from various West European articles
(JPRS-WST-84-012) Avail: NTIS HC A04/MF A01

This West Europe report presents news articles and reports on many areas of science and technology. Research topics covered include: (1) advanced materials; (2) aerospace, and (3) factory automation.

N85-25553# Joint Publications Research Service, Arlington, Va.
MBB USES NEW CFC FORM TOOL FOR TITANIUM ALLOY AIR INTAKE
In its West Europe rept.: Sci. and Technol. (JPRS-WST-84-012) p 1-2 18 Apr. 1984 Transl. into ENGLISH from VDI Nachrichte (Dusseldorf), 2 Mar. 1984 p 20
Avail: NTIS HC A04/MF A01

A method of manufacturing large structural components which is both weight saving and economical in comparison with presently employed processes is described. By superplastic forming in a forming tool made of carbon fiber reinforced carbon (CFC) the development engineers have produced an air intake section out of titanium alloy. The outlet pipe constructed out of the TiAl6V4 alloy has a plasma welded longitudinal seam, has a diameter of 460 mm, a wall thickness of 3.5 mm and a length of 1,500 mm. It is closed at both ends and blown at a temperature of 925 C with argon in a forming tool made of CFC. At this temperature the titanium alloy enters the superplastic state and may be formed with a forming velocity of about 1 percent per minute, with elongations of several hundred percent being easily attained. After the superplastic forming the nominal length of the finished test component amounts to 1,000 mm and comes to over 1,400 mm. An entirely new feature of the immediately successful is the first time use of carbon fiber reinforced carbon (CFC) as a forming material. B.W.

N85-25696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

HIGH FREQUENCY ESTIMATION OF 2-DIMENSIONAL CAVITY SCATTERING M.S. Thesis

R. S. DERING Dec. 1984 50 p

(AD-A151697; AFIT/GE/ENG/84D-24) Avail: NTIS HC A03/MF A01 CSCL 17I

This thesis develops a simple ray tracing approximation for the high frequency scattering from a two-dimensional cavity. Whereas many other cavity scattering algorithms are very time consuming, this method is very swift. The analytical development of the ray tracing approach is performed in great detail, and it is shown how the radar cross section (RCS) depends on the cavity's length and width along with the radar wave's angle of incidence. This explains why the cavity's RCS oscillates as a function of incident angle. The RCS of a two dimensional cavity was measured experimentally, and these results were compared to computer calculations based on the high frequency ray tracing theory. The comparison was favorable in the sense that angular RCS minima and maxima were exactly predicted even though accuracy of the RCS magnitude decreased for incident angles far off-axis. Overall, once this method is extended to three dimensions, the technique shows promise as a fast first approximation of high frequency cavity scattering. GRA

N85-25700# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE EFFECTS OF ATMOSPHERIC TURBULENCE ON AN AIR-TO-AIR OPTICAL COMMUNICATION LINK M.S. Thesis

J. N. KANAVOS Dec. 1984 109 p

(AD-A151840; AFIT/GE/ENG/84D-38) Avail: NTIS HC A06/MF A01 CSCL 17B

This thesis presents an analysis of the performance of an air-to-air optical communication link in the presence of atmospheric turbulence. As aircraft travel through the atmosphere, they encounter regions of atmospheric turbulence. While harmless to radio frequency communications, these regions of turbulence can cause both intensity and phase fluctuations within an optical beam, as a result, the communication link bit error rate rises. To evaluate the performance of such a link, a computer simulation was developed. By varying such parameters as the speed of the aircraft, its altitude, and propagation path length, a determination could be made about link performance. The results obtained from the simulation showed that atmospheric turbulence plays a significant role in determining link performance. GRA

N85-25759# National Aerospace Lab., Tokyo (Japan).

AN EXPERIMENTAL STUDY OF AERODYNAMIC DAMPING CHARACTERISTICS OF A COMPRESSOR ANNULAR CASCADE IN HIGH SPEED FLOW AND THE VISUALIZATION OF ANNULAR CASCADE FLOW

H. KOBAYASHI 1984 21 p refs In JAPANESE; ENGLISH summary

(NAL-TR-838; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

To clarify experimentally the characteristics of aerodynamic damping of a compressor cascade in high speed flow, which is an important factor of blade oscillatory fatigue, the time-variant aerodynamic pressure acting on the blade surface of harmonically oscillated annular cascade in torsional mode was measured with a Freon gas annular cascade test facility over a range from high subsonic to supersonic and over a wide range of reduced frequencies. Through these data, the variance of cascade aerodynamic stability of inlet flow Mach No. and reduced frequency, and the effects of shock wave movement due to blade oscillation on an unsteady aerodynamic force and on an aerodynamic stability of the cascade were made clear. The visualization of annular cascade flow by the new schlieren system is also described. Author

N85-25772# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

AN EXPLORATORY INVESTIGATION OF SHARP FIN-INDUCED SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTIONS AT HIGH SHOCK STRENGTHS M.S. Thesis

S. P. GOODWIN Nov. 1984 156 p

(AD-A151571; AD-E500700; AFIT/CI/NR-85-27T) Avail: NTIS HC A08/MF A01 CSCL 20D

For this thesis an experimental investigation of sharp fin-induced shock/boundary layer interactions was carried out at a Mach number of 2.95, unit Reynolds numbers ranging from 1 to 4 million per inch, boundary layer thicknesses of 0.14 and 0.50 inches, and fin angles of attack between 12 and 22 degrees. Surface pressure and surface flow visualization data were collected. Results showed that high shock strength interactions were qualitatively similar to those at low shock strengths. When compared to two-dimensional test results, the present three-dimensional data were seen to have a similar dependence on Reynolds number but a different sort of dependence on shock strength. The data were also seen to possess conical similarity. As was the case at lower shock strengths, the interactions could be scaled using unit Reynolds number, boundary layer thickness, and normal Mach number. The appearance of the feature termed secondary separation was noted to depend on boundary layer thickness. Competing feature and turbulence scales were hypothesized to produce this dependence. GRA

N85-25773# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

INVESTIGATION OF POTENTIAL AND VISCOUS FLOW EFFECTS CONTRIBUTING TO DYNAMIC STALL M.S. Thesis

A. J. S. ALLAIRE Sep. 1984 88 p

(AD-A151696; AFIT/GAE/AA/84S-1) Avail: NTIS HC A05/MF A01 CSCL 20D

This thesis explores the problem of dynamic stall, i.e., the stall of an airfoil undergoing pitching motion. General equations of continuity and momentum are developed for a non-inertial and unsteady control volume. They are written in momentum-integral form and the boundary layer on the pitching airfoil is computed using a modified von Karman-Pohlhausen method. The boundary layer edge velocity, velocity gradient and time rate of change of velocities required for the step by step integration of the von Karman-Pohlhausen working equations are obtained from the inviscid solution. The inviscid velocity profile along the surface of the airfoil is obtained by conformal mapping from the velocity profile around a rotating circular cylinder. Complex potential flow theory is used to obtain the velocity around the cylinder. The Kutta condition is continuously maintained at the point mapping to the trailing edge of the airfoil for each time step. This way, the flow is considered steady at each time step, but varies from one time step to the next when the angle of attack is increased. GRA

N85-25774# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

UNSTEADY NAVIER-STOKES CALCULATIONS IN AN ACCELERATED REFERENCE FRAME M.S. Thesis

T. E. SPEER Dec. 1984 84 p

(AD-A151751; AFIT/GAE/ENY/84D-26) Avail: NTIS HC A05/MF A01 CSCL 20D

The purpose of this project was to develop a numerical method capable of calculating the laminar flow about a two dimensional accelerating body using the incompressible Navier-Stokes equations. This problem arises in the calculation of the dynamic stall of an airfoil and in the calculation of pitching and heaving stability derivatives for an isolated airfoil. It is also a first step toward solving the three dimensional flow about a complete wing undergoing arbitrary motion at high angles of attack, including departure, spin, and post-stall maneuvers. Numerical calculations to date have not been satisfactory. Test cases presented are Stoke's first problem, a circular cylinder translating at a Reynolds number of 20, and a rotating stationary circular cylinder. GRA

N85-25776# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
GASDYNAMIC EVALUATION OF CHOKING CASCADE TURNS M.S. Thesis
D. R. PEREZ Dec. 1984 79 p
(AD-A151854; AFIT/GAE/AA/84D-21) Avail: NTIS HC A05/MF A01 CSCL 20D

Uses for ram air in airborne vehicles are increasing along with the need for sophisticated ducting of the compressed air. Inlets operating supercritically, a normal shock in the subsonic diffuser, and use an aerodynamic grid to control the normal shock position to a region of low total pressure losses are discussed. Turning of the flow requires long radius curves to maintain the total pressure. This study combines the internal shock positioning and flow turning into a flow choking cascade turn with a short radius. Several sets of 90 degree turning sections, for turning compressed air, were selected, designed, and tested gas dynamically. Two of the turn sections were totally subsonic and only turned the air flow. Two other sections turned and choked the flow during supercritical inlet operation. These flow controllers perform the same function as an aerodynamic grid and flow turning vanes used in current internal compressible airflow designs. These tests correlated the suitability of using a water table versus a gas dynamic apparatus for determining the flow control capabilities and pressure recovery of the cascades. The subsonic only turning section gave the best pressure recovery and total pressure distribution along the turning axis, but allowed the supercritical internal shock to move towards large shock/boundary layer interaction. The two shock positioning cascades provided good internal shock control with only slightly lower pressure recovery. Further investigation is needed for the effects of back pressure fluctuations on the flow dynamics. GRA

N85-25777# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INFLUENCE OF SURFACE ROUGHNESS ON COMPRESSOR BLADES AT HIGH REYNOLDS NUMBER IN A TWO-DIMENSIONAL CASCADE M.S. Thesis
G. P. MOE Dec. 1984 113 p
(AD-A151855; AFIT/GAE/AA/84D-19) Avail: NTIS HC A06/MF A01 CSCL 20D

A cascade test facility has been established which incorporates sidewall boundary layer control, permitting two-dimensional flow investigation over the center span (about 2/3 the width of the blade) of an airfoil in cascade, and an investigation has been conducted to determine the influence of roughness on the airfoil. Two representative compressor profiles, the NACA 64-A905 and 65-A506, with two inch chords and aspect ratios of one were tested at airflow inlet velocities comparable to those axial flow compressors. An Axial Velocity Density Ratio of unity was the criterion used to determine when two-dimensional flow was achieved. Test results indicate that initial small increases of roughness have a much greater effect on blade total pressure loss than do subsequent larger roughness values. A small increase in roughness produces a substantial increase in free stream turbulence with practically no effect on the wake. Further increase in roughness produces a substantial effect on the wake but little effect on the free stream turbulence. Surface roughness is shown to have a much greater influence on blade wake turbulence intensity for the higher camber airfoils tested than for lower camber airfoils. GRA

N85-25778# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
FLOW OVER A BICONIC CONFIGURATION WITH AN AFTERBODY COMPRESSION FLAP Final Report, Jan. - Apr. 1984
J. S. SHANG and R. W. MACCORMACK Apr. 1984 49 p
(AD-A151882; AFWAL-TR-84-3059) Avail: NTIS HC A03/MF A01 CSCL 20D

Three-dimensional Navier-Stokes solutions were obtained for flow over a biconic configuration with an afterbody compression flap. The simulated flow was achieved for a Mach number of 7.97, a characteristics Reynolds number of 9.23 million and at a zero degree angle of attack. A comparison study was conducted using the vectorized MacCormack's explicit and implicit numerical schemes. Results from both the explicit and the implicit algorithms correctly yielded the detailed flow field structure and the heat transfer information in comparison with experimental data. However, the implicit numerical procedure exhibited a significant improvement in numerical efficiency over the explicit method. For fine mesh clustering near the solid body surface, necessary to resolve surface shear stress and heat transfer rates, the implicit scheme achieved an order of magnitude reduction in computing time. GRA

N85-25784# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THREE-DIMENSIONAL BOUNDARY LAYERS
Loughton, England Feb. 1985 118 p refs Proc. of the Round Table Discussion on 3D Boundary Layers, Brussels, 24 May 1984
(AGARD-R-719; ISBN-92-835-1491-2; AD-A153279) Avail: NTIS HC A06/MFA01

Progress in understanding three dimensional boundary layers is reported and guidance for future work in this field is provided. Turbulence modelling, which is unsatisfactory in 2-D flows, is even less suitable for three-dimensional boundary layers. More sophisticated models do not appear to work better in many cases than simple ones. The situation is even less satisfactory for separated flows where the validity of certain computations is in question. Lack of accurate, extensive data hampers efforts to comprehend important flow mechanisms and validate computational results. The paucity of high-quality experimental data is remarkable.

N85-25787# National Aerospace Lab., Amsterdam (Netherlands).
THREE-DIMENSIONAL BOUNDARY LAYER RESEARCH AT NLR
B. VANDENBERG *In* AGARD Three-Dimensional Boundary Layers 17 p Feb. 1985 refs
Avail: NTIS HC A06/MF A01

The experimental and theoretical research work on three-dimensional boundary layers, carried out at NLR between 1970 and 1984, or presently under development is reviewed. The development of a practical calculation method and its extension to compressible laminar and turbulent boundary layers on developable as well as nondevelopable surfaces is discussed. The main features of the improved method are: (1) an arbitrary non-orthogonal curvi-linear surface coordinate system can be chosen by the user; (2) the organization of the calculation method was designed with the emphasis on the users-oriented properties; (3) an efficient finite-difference method is employed for the whole boundary layer, including the wall layer; and (4) an algebraic eddy viscosity turbulence model is used, because the model is simple, while for boundary layer flows, no other current turbulence models do a significantly better job. A.R.H.

N85-25788# London Univ. (England). Dept. of Aeronautical Engineering.
BRIEF REVIEW OF CURRENT WORK IN THE UK ON THREE DIMENSIONAL BOUNDARY LAYERS
A. D. YOUNG *In* AGARD Three-Dimensional Boundary Layers 17 p Feb. 1985 refs
Avail: NTIS HC A06/MF A01

Work in progress in industry, the universities and the R.A.E is summarized. Areas of study include theoretical work on laminar boundary layers (flow round obstacles, outside streamwise corners, internal flows in turbo-machinery), transition effects on bodies at large angles of incidence associated with cross flow and leading edge contamination, experimental and theoretical work on turbulent boundary layers (swept wings with and without separation, curvature and cross flow, blunt trailing edges, wakes with large cross flow, flow outside streamwise corners, integral and finite difference prediction methods both direct and inverse). It is increasingly appreciated that more work is needed on the fundamental effects of cross flow on the dynamics of turbulence. Author

N85-25792*# General Electric Co., Schenectady, N. Y. Corporate Research and Development.
ADVANCED SMOKE METER DEVELOPMENT SURVEY AND ANALYSIS Final Report
R. W. PITZ, C. M. PENNEY, C. M. STANFORTH, and W. M. SHAFFERNOCKER Nov. 1984 59 p refs
(Contract NAS3-23532)
(NASA-CR-168287; NAS 1.26:168287) Avail: NTIS HC A04/MF A01 CSCL 14B

Ideal smoke meter characteristics are determined to provide a basis for evaluation of candidate systems. Five promising techniques are analyzed in detail to evaluate compilance with the practical smoke meter requirements. Four of the smoke measurement concepts are optical methods: Modulated Transmission (MODTRAN), Cross Beam Absorption Counter (CBAC), Laser Induced Incandescence (LIN), and Photoacoustic Spectroscopy (PAS). A rapid response filter instrument called a Taper Element Oscillating Microbalance (TEOM) is also evaluated. For each technique, the theoretical principles are described, the expected performance is determined, and the advantages and disadvantages are discussed The expected performance is evaluated against each of the smoke meter specifications, and the key questions for further study are given. The most promising smoke meter technique analyzed was MODTRAN, which is a variation on a direct transmission measurement. The soot-laden gas is passed through a transmission cell, and the gas pressure is modulated by a speaker. B.W.

N85-25794*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSIENT TECHNIQUE FOR MEASURING HEAT TRANSFER COEFFICIENTS ON STATOR AIRFOILS IN A JET ENGINE ENVIRONMENT
H. J. GLADDEN and M. P. PROCTOR 1985 17 p refs
Proposed for presentation at the 21st Joint Propulsion Conf., Monterey, Calif., 8-10 Jul. 1985; sponsored by AIAA, SAE and ASME
(NASA-TM-87005; E-2501; NAS 1.15:87005) Avail: NTIS HC A02/MF A01 CSCL 14B

A transient technique was used to measure heat transfer coefficients on stator airfoils in a high-temperature annular cascade at real engine conditions. The transient response of thin film thermocouples on the airfoil surface to step changes in the gas stream temperature was used to determine these coefficients. In addition, gardon gages and paired thermocouples were also utilized to measure heat flux on the airfoil pressure surface at steady state conditions. The tests were conducted at exit gas stream Reynolds numbers of one-half to 1.9 million based on true chord. The results from the transient technique show good comparison with the steady-state results in both trend and magnitude. In addition, comparison is made with the STAN5 boundary layer code and shows good comparison with the trends. However, the magnitude of the experimental data is consistently higher than the analysis. Author

N85-25795*# Alabama Univ., Huntsville.
SUPERCONDUCTING GYROSCOPE RESEARCH Final Report
J. B. HENDRICKS and G. R. KARR Feb. 1985 203 p refs
(Contract NAS8-29316)
(NASA-CR-171406; NAS 1.26:171406) Avail: NTIS HC A10/MF A01 CSCL 14B

Four basic areas of research and development of superconducting gyroscopes are studied. Chapter 1 studies the analysis of a SQUID readout for a superconducting gyroscope. Chapter 2 studies the dependence of spin-up torque on channel and gas properties. Chapter 3 studies the theory of super fluid plug operation. And chapter 4 studies the gyro rotor and housing manufacture. E.R.

N85-25801# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TRAJECTORY MEASUREMENTS FOR TAKE-OFF AND LANDING TESTS AND OTHER SHORT-RANGE APPLICATIONS, VOLUME 16
P. DAGUT (Centre d'Essais en Vol, Bretigny-sur-Orge, France), H. RIEBEEK (Fokker B.V., Amsterdam), and A. POOL, ed. (National Aerospace Lab., Amsterdam) Jan. 1985 86 p refs 16 Vol.
(AGARD-AG-160-VOL-16; AGARDOGRAPH-160; ISBN-92-835-1487-4) Avail: NTIS HC A05/MF A01

A review of the methods that are used for short-range trajectory measurements is presented. This report also reviews the instrumentation requirements of the applications: take-off and landing performance measurement, autoland performance measurement, noise measurement and flight inspection of radio beacons. Optical methods (including lasers), methods using radio or radar and methods using inertial sensing are discussed. B.W.

N85-25875*# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Nuclear Survivability Group.
AUTOMATIC DYNAMIC AIRCRAFT MODELER (ADAM) FOR THE COMPUTER PROGRAM NASTRAN
H. GRIFFIS *In* NASA, Washington 13th NASTRAN Users Colloq. p 188-198 May 1985 refs
Avail: NTIS HC A20/MF A01; also available from COSMIC, Athens, Ga. CSCL 20K

Large general purpose finite element programs require users to develop large quantities of input data. General purpose pre-processors are used to decrease the effort required to develop structural models. Further reduction of effort can be achieved by specific application pre-processors. Automatic Dynamic Aircraft Modeler (ADAM) is one such application specific pre-processor. General purpose pre-processors use points, lines and surfaces to describe geometric shapes. Specifying that ADAM is used only for aircraft structures allows generic structural sections, wing boxes and bodies, to be pre-defined. Hence with only gross dimensions, thicknesses, material properties and pre-defined boundary conditions a complete model of an aircraft can be created. Author

N85-25883*# Gates Learjet Corp., Wichita, Kans.
LEARJET MODEL 55 WING ANALYSIS WITH LANDING LOADS
R. R. BOROUGHS *In* NASA, Washington 13th NASTRAN Users Colloq. p 320-346 May 1985 refs
Avail: NTIS HC A20/MF A01; also available from COSMIC, Athens, Ga. CSCL 20K

The NASTRAN analysis was used to determine the impact of new landing loads on the Learjet Model 55 wing. These new landing loads were the result of a performance improvement effort to increase the landing weight of the aircraft to 18,000 lbs. from 17,000 lbs. and extend the life of the tires and brakes by incorporating larger tires and heavy duty brakes. Landing loads for the original 17,000 lb. airplane landing configuration were applied to the full airplane NASTRAN model. The analytical results were correlated with the strain gage data from the original landing load static tests. The landing loads for the 18,000 lb. airplane were applied to the full airplane NASTRAN model, and a comparison was made with the original Model 55 data. The results of this comparison enable Learjet to determine the difference in stress distribution in the wing due to these two different sets of landing loads. E.A.K.

N85-25885*# Lockheed-Georgia Co., Marietta.
THE STRUCTURAL FINITE ELEMENT MODEL OF THE C-5A
G. W. MCCLELLAN *In* NASA, Washington 13th NASTRAN Users Coll., p 364-376 May 1985
Avail: NTIS HC A20/MF A01; also available from COSMIC, Athens, Ga. CSCL 20K

A substructured NASTRAN model of the C-5A was analyzed for several different load conditions. The size of the model and the number of load cases used presented special problems in computer file and space management. This resulted in revisions to the in-house NASTRAN code. Despite the problems encountered the analyses were completed with excellent results. E.A.K.

N85-25894*# Akron Univ., Ohio. Dept. of Civil Engineering.
ON THERMOMECHANICAL TESTING IN SUPPORT OF CONSTITUTIVE EQUATION DEVELOPMENT FOR HIGH TEMPERATURE ALLOYS Final Report
D. N. ROBINSON May 1985 32 p refs
(Contract NAG3-379)
(NASA-CR-174879; NAS 1.26:174879) Avail: NTIS HC A03/MF A01 CSCL 11F

Three major categories of testing are identified that are necessary to provide support for the development of constitutive equations for high temperature alloys. These are exploratory, charactrization and verification tests. Each category is addressed and specific examples of each are given. An extensive, but not exhaustive, set of references is provided concerning pertinent experimental results and their relationships to theoretical development. This guide to formulating a meaningful testing effort in support of consitutive equation development can also aid in defining the necessary testing equipment and instrumentation for the establishment of a deformation and structures testing laboratory. Author

N85-25895*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTURES AND DYNAMICS DIVISION RESEARCH AND TECHNOLOGY PLANS FOR FY 1985 AND ACCOMPLISHMENTS FOR FY 1984
K. S. BALES Apr. 1985 102 p
(NASA-TM-86417; NAS 1.15:86417) Avail: NTIS HC A06/MF A01 CSCL 20K

The objectives, FY 1985 plans, approach, and FY 1985 milestones for the Structures and Dynamics Division's research programs are presented. The FY 1984 accomplishments are presented where applicable. This information is useful in program coordination with other government organizations in areas of mutual interest. E.A.K.

N85-25899# Aeronautical Research Labs., Melbourne (Australia). Structures Div.
TENSILE AND FRACTURE TOUGHNESS PROPERTIES OF MIRAGE III SPARS
W. F. LUPSON and J. Y. MANN Apr. 1984 17 p refs
(AR-003-019; ARL-STRUC-TM-376) Avail: NTIS HC A02/MF A01

Tensile and fracture toughness tests were conducted on specimens manufactured from the flange portions of the main spare of seven Mirage 3 wings. These have provided specific information relating to the mechanical properties of this component at locations close to where fatigue cracking occurred in service. Author

N85-25907# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CRACK CLOSURE CHARACTERISTICS CONSIDERING CENTER CRACKED AND COMPACT TENSION SPECIMENS M.S. Thesis
C. L. HENKEL Dec. 1984 112 p
(AD-A151702; AFIT/GAE/AA/84D-9) Avail: NTIS HC A06/MF A01 CSCL 20K

Due to growing use of expensive, high performance gas turbine engines in the United States Air Force, there is no need for improved failure prediction methods for critical high temperature engine components. This thesis expands current research in the area of high temperature, low cycle fatigue of IN-100 at 1350 F. IN-100 is a superplastically forged, nickel-based superalloy used in F-100 engine turbine disks. This thesis describes an in-house 2-D, finite element program named VISCO which employs the Bodner-Partom Constitutive equation to accurately model the principal features of completely reversed cyclic loading. VISCO is used to compare the effects on material behavior by considering a 2.5 Hz compact tension specimen, a .167 Hz compact tension specimen, and a 2.5 Hz center cracked specimen subjected to fully reversed cyclic loading with a stress intensity factor of 35 and 45 ksi/sq in. The comparisons point out that the findings of Linear Elastic Mechanics must be modified under conditions of high temperature viscoplasticity. GRA

N85-25911# Sandia Labs., Albuquerque, N. Mex.
NASTRAN-BASED SOFTWARE FOR THE STRUCTURAL DYNAMIC ANALYSIS OF VERTICAL AND HORIZONTAL AXIS WIND TURBINES
D. W. LOBITZ 1984 17 p refs
(DE85-001712; SAND-84-0547C; CONF-841071-1) Avail: NTIS HC A02/MF A01

Throughout the vertical axis wind turbine program at Sandia, a significant effort has gone into developing finite element tools for predicting structural dynamic rotor response. Instead of creating new finite element packages, appropriate modifications to the NASTRAN code were made for the development of these tools. With this approach duplication of such things as input and output coding, finite element processors, and solution algorithms is avoided. Although some IMAP programming is required, most of the changes are effected through the use of NASTRAN a direct matrix input option. These matrix alterations are necessary to model a structure moving in a rotating frame. To date, tools which predict natural frequencies and mode shapes, and the forced vibration frequency response of the rotating turbine have been developed. More recently, for horizontal axis rotors, a capability has been created for computing transient behavior as the rotor turns in the wind. In this case, a solution procedure external to NASTRAN had to be employed in order to correctly attach the rotor hub, which moves in the rotating frame, to the lower which is modelled in a fixed frame. In all cases, these tools were compared with experimental data collected from various wind turbines and, for each, very satisfactory agreement was achieved. Author

N85-26616# Tokyo Univ. (Japan). Inst. of Space and Astronautical Sciences.
SOME NUMERICAL ANALYSES OF FLOWS WITH SEPARATION
K. KUWAHARA *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 37-42 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

Computational study of high Reynolds number flow with large separation is the most important problem now in computational aerodynamics. Some examples of recent results of studies of such flows are presented. The methods used are finite-difference methods and vortex methods. The first example is that of an incompressible flow past two cylinders computed by the finite-difference method based on a stream function-vorticity formulation of the Navier-Stokes equations. It is pointed out that special care must be taken to determine the boundary values of the stream function on the bodies when using this method. The second example is that of an incompressible flow past a circular cylinder at a critical Reynolds number computed by the MAC method using an improved upwind difference. The sharp drag reduction is first captured numerically by this computation. Third is an example of the simplest version of the new vortex methods without conformal mapping, which enables us to compute incompressible flows with large separation very easily and economically. The last example is of a transonic flow past an oscillating airfoil computed by the Beam-Warming scheme. B.W.

N85-26629# Kawasaki Heavy Industries, Ltd., Akashi (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING
J. OKUMURA, T. JYONOUCHI, and K. SAWADA *In* National Aerospace Lab. Proc. of the NAL Symp. on Aircraft Computational Aerodyn. p 169-186 1983 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A10/MF A01

Some of the available methods in actual design and the trend in computational fluid dynamics (CFD) are presented. Inviscid linear flow, the panel method and the vortex lattice method are the only methods for analyzing arbitrary practical configurations and are the most useful engineering tools available. Although these approach a relatively mature level, the improvement required for these methods are: (1) capability of treating more complicated realistic geometries; (2) development of the resources needed to supply the error-free input data; and (3) extension to the free boundary problem such as leading-edge vortex. The inviscid nonlinear flow, the vigorous advance of CFD, especially in the transonic regime, had a strong impact on changing the previous semiempirical design methods to more rational ones and it has shortened the design time and reduced costs. The most promising available codes, which analyze wing-body combinations, are expected to provide the new technological capability of interpreting the various useful design rules. The separated viscous flow, the calculations of Reynold's averaged equations are expected to become effective design tools for evaluating off-design features. It leads to the elimination of oversized margins in design. The three groups of numerical methods are expected to make progress more or less in parallel with each other. E.A.K.

N85-26642# Naval Air Systems Command, Washington, D. C.
DESIGN ADEQUACY: AN EFFECTIVENESS FACTOR
A. R. HABAYEB *In* AGARD Cost Effective and Affordable Guidance and Control Systems 16 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

The concept of system effectiveness is reviewed and examined from the perspective of weapon systems consisting of launch platforms, targeting avionics, weapons, and targets. The application of system effectiveness to hardware systems is based on three effectiveness factors: (1) reliability (dependability), (2) readiness (availability); and (3) design adequacy (capability). Design adequacy is a measure of how well a system performs its functions. It is the most desired factor in the definintion, design, and early stages of system development. A design adequacy quantification methodology is presented and the relationship between design limitation and adequacy is discussed. The design adequacy methodology is based on the measures of adequacy, system parameters, subsystem parameters and the employment phases of the system. In a weapon system context, the performance parameters of a guidance and control subsystem, are interdependent with the parameters of the remaining subsystems. The paper deals with three employment phases of a weapon system. The three phases are: (1) prelaunch phase; (2) free flight phase; and (3) end-game phase. Examples based on air-to-air missiles are given to illustrate these relationships and concepts. B.W.

N85-26660# Technische Univ., Brunswick (West Germany).
THE USE OF PRESSURE SENSING TAPS ON THE AIRCRAFT WING AS SENSOR FOR FLIGHT CONTROL SYSTEMS
D. BRUNNER *In* AGARD Cost Effective and Affordable Guidance and Control Systems 8 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

For the low speed operation of aircraft, during STOL-take off or STOL-landing and for windshear situations a precise measurement of the state of the aerodynamic flow is required. Normally the dynamic pressure is used to assess the state of flow, thus defining the stall margin in terms of a speed factor. However, flying at higher lift coefficients, a precise maintainence of a given lift coefficient by controlling the speed is no longer feasible. Instead, controlling the angle of attack or controlling the lift coefficient directly should be used. Some methods for the measurement and the control of the state of the aerodynamical flow including wing tap pressure measurements are discussed. Wind tunnel results are presented, that show the pressure distribution of a slotted STOL-wing and the typical relationship between the tap pressure, angle of attack and flap angle. Wing tape pressure measurements taken with the STOL-aircraft Do 28 aircraft are then discussed showing the feasibility of the method described to sense the state of flow. G.L.C.

N85-27027# General Dynamics/Fort Worth, Tex.
INITIAL QUALITY OF ADVANCED JOINING CONCEPTS Final Report, Jun. 1980 - Dec. 1983
W. R. GARVER, D. Y. LEE, and K. M. KOEPSEL Wright-Patterson AFB, Ohio AFWAL 12 Dec. 1984 188 p
(Contract F33615-80-C-3226)
(AD-A152241; AFWAL-TR-84-3066) Avail: NTIS HC A09/MF A01 CSCL 11A

This initial fatigue quality of three types of aircraft construction were studied. The three types included conventional mechanically-fastened joints, adhesively-bonded joints, and monolithic aluminum castings. The objectives are to obtain data for setting initial flaw assumptions for U.S. Air Force damage tolerance specifications, and to develop a method for comparing the relative merit of competing structural concepts. Two hundred test elements representing these joining concepts were prepared and tested under realistic spectrum load histories. Nondestructive inspections were performed on all specimens, but no correlation to crack growth performance was found. Crack growth data were obtained by fractographic examination and analyzed using the equivalent initial flaw size (EIFS) concept. Statistical distributions, representing the variation in EIFS and in crack growth rate, were obtained. Adhesively-bonded structure was found to give the best overall combination of benefits. The scatter in crack growth was highest in castings, which limits reliability at high stresses. An improved methodology was developed for comparing structural performance and efficiency. The methods include consideration of initial material and manufacturing quality, and can be used to quantify reliability at any confidence level and service time. GRA

N85-27062# Joint Publications Research Service, Arlington, Va.
AERODYNAMIC FORCES DEVELOPING IN CHANNELS BETWEEN VASES IN TURBINE DRIVE WHEELS Abstract Only
In its USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-006) p 55 6 Aug. 1985 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energetika (Minsk, USSR), no. 9, Sep. 1983 p 79-83
Avail: NTIS HC A05/MF A01

The steady flow of an ideal gas in a field of centrifugal forces is considered. A jet theory is used in which the mean absolute velocity of gas flow is determined by a quadratic equation. It is assumed that the angles between the tangential and curved paths are piecewise constant. Solution of the equation of continuity and an Euler system of equations of motion, as well as kinematic and thermodynamic equations for turbine machines, is used to develop the method for determining the aerodynamic forces arising in the channels between the vanes of the drive wheels of the turbine. Author

N85-27114# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SURVEY OF NARROW BAND VOCODER TECHNOLOGY M.S. Thesis
W. B. MCMINN, JR. Dec. 1984 177 p
(AD-A151919; AFIT/CI/NR-85-24T) Avail: NTIS HC A09/MF A01 CSCL 17B

The USAF has a need to identify a vocoder to insert into a Low Probability of Intercept (LPI) communications system. It should be small, lightweight, low power, capable of operating in many types of aircraft, and capable of processing intelligible, natural sounding speech at 400 to 600 bits/seconds. Two separate units are needed: one to be used in a near-term brassboard test system and one to be used in a far-term production system. Weighted characteristic values are combined through a mapping and summing procedure to form a Figure of Merit for each system. Using these characteristic values, primary vocoder candidates have been identified and are discussed in this paper. Author (GRA)

N85-27115# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EMPIRICAL SELF-PROTECTION CHAFF MODEL M.S. Thesis
R. J. ROHRS Dec. 1984 73 p
(AD-A151928) Avail: NTIS HC A04/MF A01 CSCL 17F

The purpose of this study was to develop a computer model to calculate the probability of attaining breaklock in an aircraft-chaff-tracking radar encounter. Although some of the assumptions made may seem to oversimplify the model, these were necessary to create the simple, quick running simulation that was desired. This thesis produced a simulation capable of charting the effectiveness of chaff used in the self-protective mode. Simulation results can be used to determine which type/design of chaff/chaff canister will produce a greater probability of breaklock for a given scenario. The radar included in this simulation is a Scan with Compensation tracking radar. Variable parameters include pulse width, beamwidth, pulse repetition frequency, and operation frequency. An ideal MTI filter is incorporated into the model to negate the effect of MTI blind speeds. Results of several simulation runs illustrate the effects of varying chaff radar cross section and aircraft velocity on the probability of attaining breaklock. Although aircraft maneuvers are not included in the simulation, conclusions as to how the probability of breaklock is affected can be made by varying the velocity vector. GRA

N85-27119# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EVALUATING SYNTACTIC CONSTRAINTS TO SPEECH RECOGNITION IN A FIGHTER AIRCRAFT ENVIRONMENT M.S. Thesis
D. B. STOCKTON Dec. 1984 292 p
(AD-A152117; AD-E401303; AFIT/GE/ENG/84D-64) Avail: NTIS HC A13/MF A01 CSCL 05G

A flexible software system has been developed to test the effects of adding syntactic knowledge to an isolated speech phoneme-based word recognizer. Words from seventy-word fighter plane vocabulary, spoken by five pilots at four different levels of background noise, are automatically concatenated into commands randomly chosen from a set of over seven trillion. These commands are then recognized using an existing word recognizer together with grammars of differing specificity. Results are compiled automatically. The system is flexible in that system components such as the command generator, parser, grammar, or word recognizer can be interchanged with very little software modification. Preliminary testing demonstrated that, although the modified word recognizer exhibited very poor performance, the use of more specific grammars enhanced recognition accuracy, sometimes drastically. Author (GRA)

N85-27148# Naval Postgraduate School, Monterey, Calif.
PULSEWIDTH MODULATED SPEED CONTROL OF BRUSHLESS DC MOTORS M.S. Thesis
A. A. ASKINAS Sep. 1984 67 p
(AD-A151966) Avail: NTIS HC A04/MF A01 CSCL 10B

Until recently, few alternatives existed for the use of hydraulic and pneumatic actuators in primary flight control applications. With the advent of the samarium-cobalt permanent magnet brushless DC motor, consideration must now be given to the utilization of an electromechanical actuator in missiles which require significant maneuvering capability and hence, greater torques. This thesis investigates the theory and techniques of pulse width modulator speed control of brushless DC motors. After describing basic pulse width modulation (PWM) concepts, two constant velocity control schemes are presented: current feedback and a limit cycle scheme. By calculating the motor form factor (a figure of merit for power losses in the switching transistors which comprise the PWM network), the relative worth of each scheme is then evaluated. An in depth study is conducted of the limit cycle approach, with an emphasis on the power loss reductions obtained through the reduction of the velocity limit settings. Author (GRA)

N85-27167*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OBSERVATIONS, THEORETICAL IDEAS AND MODELING OF TURBULENT FLOWS: PAST, PRESENT AND FUTURE
G. T. CHAPMAN and M. TOBAK May 1985 41 p refs
(NASA-TM-86679; REPT-85072; NAS 1.15:86679) Avail: NTIS HC A03/MF A01 CSCL 20D

Turbulence was analyzed in a historical context featuring the interactions between observations, theoretical ideas, and modeling within three successive movements. These are identified as predominantly statistical, structural and deterministic. The statistical movement is criticized for its failure to deal with the structural elements observed in turbulent flows. The structural movement is criticized for its failure to embody observed structural elements within a formal theory. The deterministic movement is described as having the potential of overcoming these deficiencies by allowing structural elements to exhibit chaotic behavior that is nevertheless embodied within a theory. Four major ideas of this movement are described: bifurcation theory, strange attractors, fractals, and the renormalization group. A framework for the future study of turbulent flows is proposed, based on the premises of the deterministic movement. E.A.K.

N85-27177# Rutgers - The State Univ., New Brunswick, N. J.
THEORETICAL INVESTIGATION OF THREE-DIMENSIONAL SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTIONS. PART 3 Annual Report, 1 Oct. 1983 - 30 Sep. 1984
D. D. KNIGHT 12 Dec. 1984 52 p
(Contract AF-AFOSR-0040-82)
(AD-A152251; RU-TR-162-MIAE-F-PT-3; AFOSR-85-0280TR-PT-3) Avail: NTIS HC A04/MF A01 CSCL 20D

The focus of the research effort is the understanding of three-dimensional shock wave-turbulent boundary layer interactions. The approach uses the full mean compressible Navier-Stokes equations with turbulence incorporated through the algebraic turbulent eddy viscosity model of Baldwin and Lomax. This year's principle accomplishments are: (1) the Baldwin-Lomax model was evaluated for a series of non-separated two-dimensional turbulent boundary layers; (2) the 3-D Navier-Stokes codes was rewritten innto CYBER 200 FORTRAN; (3) the computed results for the 3-D sharp fin alpha sub g = 10 deg were compared with the results of a separate calculation by C. Horstmann using the k-epsilon turbulence model, and the experimental data of McClure and Dolling; and (4) the 3-D sharp fin at alpha sub g =20 deg was computed, and the results compared with the available experimental data. The examination of the flowfield structure of the 3-D sharp fin at alphaa sub g = 20 deg was initiated. GRA

N85-27218 Virginia Polytechnic Inst. and State Univ., Blacksburg.
AN ANALYTICAL INVESTIGATION OF DYNAMIC COUPLING IN NONLINEAR, GEARED ROTOR SYSTEMS Ph.D. Thesis
J. W. DAVID 1984 170 p
Avail: Univ. Microfilms Order No. DA8500906

The topic of dynamic response of geared rotor systems is addressed. In particular, the effects of second-order coupling terms (dynamic coupling) in the disk equations of motion on the predicted response of geared rotor systems are investigated. The equations of motion for a rigid disk attached to a rotating shaft are derived. A qualitative analysis of these equations shows that the dynamic-coupling terms, neglected in most conventional rotor analyses, are important in geared systems. The harmonic-balance technique is shown to provide good approximate solutions to these types of nonlinear differential equations even with large nonlinearities. Two test problems having large nonlinearities are solved by the harmonic-balance technique. The results compare well with numerical solutions. The harmonic-balance technique was used to develop a nonlinear transfer matrix modeling technique which provides a route to a generalized geared-rotor modeling technique. Finally, a transfer matrix model of a trial geared system is developed to show that the inclusion of dynamic coupling

produces significant changes in the predicted response.
Dissert. Abstr.

N85-27228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE LIFE ANALYSIS OF A TURBOPROP REDUCTION GEARBOX
D. G. LEWICKI (Army Research and Technology Lab., Cleveland, Ohio), J. D. BLACK (Detroit Diesel Allison, Indianapolis, Ind.), M. SAVAGE (Akron Univ.), and J. J. COY (Army Research and Technology Lab., Cleveland, Ohio) 1985 25 p refs Prepared for presentation at the Design Tech. Conf., Cincinnati, 11-13 Sep. 1985; sponsored by ASME
(NASA-TM-87014; E-2559; NAS 1.15:87014; USAAVSCOM-TR-84-C-4) Avail: NTIS HC A02/MF A01 CSCL 13I

A fatigue life analysis of the Allison T56/501 turboprop reduction gearbox was developed. The life and reliability of the gearbox was based on the lives and reliabilities of the main power train bearings and gears. The bearing and gear lives were determined using the Lundberg-Palmgren theory and a mission profile. The five planet bearing set had the shortest calculated life among the various gearbox components, which agreed with field experience where the planet bearing had the greatest incidences of failure. The analytical predictions of relative lives among the various bearings were in reasonable agreement with field experience. The predicted gearbox life was in excellent agreement with field data when the material life adjustment factors alone were used. The gearbox had a lower predicted life in comparison with field data when no life adjustment factors were used or when lubrication life adjustment factors were used either alone or in combination with the material factors. Author

N85-27237# Centre d'Essais Aeronautique Toulouse (France). Groupe de Travail Fiabilite.
GUIDE FOR THE EXECUTION OF RELIABILITY TESTS IN THE LABORATORY [GUIDE POUR LA REALISATION D'ESSAIS DE FIABILITE EN LABORATOIRE]
10 Oct. 1984 208 p refs In FRENCH Sponsored by Delegation Generale pour l'Armement
Avail: NTIS HC A10/MF A01

The guide includes reliability mathematics, reliability test planning, administration aspects, experimental design, estimation of reliability parameters, report content and information storage and retrieval. Author (ESA)

N85-27238# Centre National d'Etudes Spatiales, Toulouse (France).
CHARACTERIZATION OF SOLDERLESS MINIWRAPPING CONNECTIONS [ETUDE DE CARACTERISATION DE LA TECHNIQUE DE LIAISON PAR CONNEXIONS ENROULEES MINIATURES]
S. CLEMENT and F. DEBENTZMANN 1984 93 p In FRENCH; ENGLISH summary
(CNES-NT-112) Avail: NTIS HC A05/MF A01

Miniature wrapping connections for aerospace application, including tools and operation techniques, connectors, wire characteristics, applicable quality tests, and reliability were studied. It is concluded that the technique is very reliable and the utilization in the aerospace industry is recommended. Author (ESA)

N85-27257*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
DEVELOPMENT AND APPLICATION OF OPTIMUM SENSITIVITY ANALYSIS OF STRUCTURES Semiannual Progress Report, Aug. - Dec. 1984
J. F. M. BARTHELEMY and W. L. HALLAUER, JR. 1984 6 p refs
(Contract NAG1-145)
(NASA-CR-175857; NAS 1.26:175857) Avail: NTIS HC A02/MF A01 CSCL 20K

The research focused on developing an algorithm applying optimum sensitivity analysis for multilevel optimization. The research efforts have been devoted to assisting NASA Langley's Interdisciplinary Research Office (IRO) in the development of a mature methodology for a multilevel approach to the design of complex (large and multidisciplinary) engineering systems. An effort was undertaken to identify promising multilevel optimization algorithms. In the current reporting period, the computer program generating baseline single level solutions was completed and tested out. G.L.C.

N85-27276# Technical Research Centre of Finland, Espoo. Lab. of Structural Engineering.
DYNAMIC AND AEROELASTIC ACTION OF GUY CABLES Ph.D. Thesis
T. KAERNAE May 1984 94 p refs Sponsored by Broadcasting Company, Technical Research Centre of Finland, Finnish Foundation of Technology, Deutsche Akademischer Austauschdienst and Eemil Aaltonen Foundation
(VTT-18; ISBN-951-38-2005-X; ISSN-0358-5069) Avail: NTIS HC A05/MF A01

A complete mathematical model and simplified spring-mass model for linear three-dimensional dynamic analysis of guyed masts with the frequency response method and a substructure technique where frequency dependent springs and dashpots are substituted for the guys were derived. Examples of the dynamic and aeroelastic behavior of guys are computed in terms of complex dynamic stiffness. The crossover behavior of the natural frequencies is shown to exert significant effects on guy action. The dynamic sensitivity of a guy can be assessed using a single stiffness parameter which depends on gravity and wind load. The results show that the direction and intensity of the mean wind force have a marked influence on the dynamic behavior of light guys. The effects of icing on the aerodynamic stability of guys is discussed.
Author (ESA)

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A85-33579
HYGIENIC EVALUATION OF NOISE IN LIVING QUARTERS NEAR AN AIRPORT [GIGIENICHESKAIA OTSENKA SHUMA V ZHILYKH POMESHCHENIIAKH, NAKHODIASHCHIKHSIA VBLIZI AERODROMA]
O. P. LOMOV and E. V. TATARINOVA Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), March 1985, p. 45, 46. In Russian.

A85-35957#
THE HISTORY AND EVOLUTION OF AERONAUTICAL METEOROLOGY [HISTOIRE DE LA METEOROLOGIE AERONAUTIQUE ET DE SON EVOLUTION]
M. REDDAN (Compagnie Nationale Air France, Paris, France) La Meteorologie (ISSN 0026-1181), Feb. 1985, p. 11-17. In French.

The importance of developing aeronautical meteorological prediction techniques became evident as soon as the first aircraft were flown at the beginning of the 20th century. By 1919, thirty countries had formed an organization to standardize navigation practices and share meteorological data regarding 24 hr forecasts, particularly on flight routes. Meteorological stations became a feature of every major airport. Early instrumentation consisted of pluviometers, barometers, thermometers, anemometers and the human eye. Data were communicated by telephone, telegraph, radio and, occasionally, messenger pigeons. Balloon borne radiosondes entered development after 1927, about the same time that surface observations were collected daily from a hundred vessels at sea. Data sharing between the U.S. and Europe became a practice just prior to routine transatlantic passenger flights in the later 1930s. Pilots flying the routes also reported observations at flight altitudes. Attempts at 5-6 day forecasts were made as an aid to the Normandy landing. Weather data and reporting, as well as worldwide grid of stations, have become standardized since the Chicago Convention of 1944 and the subsequent formation of the WMO. The most significant improvements since then, and still being upgraded, are meteorological radar, computerized assimilation and analyses of data, and automated zonal weather map generation. M.S.K.

N85-25957# New South Wales Univ., Kensington (Australia).
A STUDY OF THE METHODS FOR EVALUATING THE NOISE IMPACT OF A PROPOSED AIRPORT ON A COMMUNITY M.S. Thesis. Abstract Only
P. J. GRIFFITHS 1984 3 p
Avail: NTIS HC A02/MF A01

This project compares six different methods of evaluating the noise impact of a proposed airport. This comparison is made in terms of land use plans based on aircraft noise exposure. Land use plans are developped from community levels of annoyance correllated with some method of describing the noise exposure. The general principles and assumptions used in developing aircraft noise rating procedures are discussed. From this discussion, six indices are selected and used to assess the impact of aircraft noise on an area surrounding a (formerly) proposed site. B.W.

N85-25963# California Univ., Los Angeles. School of Engineering and Applied Science.
SIZE DISTRIBUTIONS OF ELEMENTAL CARBON IN ATMOSPHERIC AEROSOLS
A. H. MIGUEL (Pontifica Univ. Catolica do Rio de Janeiro) and S. K. FRIEDLANDER Jan. 1985 9 p refs
(Contract EPA-R-801455)
(PB85-153534; EPA-600/D-85-003) Avail: NTIS HC A02/MF A01 CSCL 13B

Because of the importance played by particulate elemental carbon (PEC) on climatic impact, the size distribution of PEC was examined in samples collected in an urban area, inside the air duct of an urban tunnel, and next to the take off runway of a busy airport. Besides providing needed data to improve the precision of calculations of potential local and global environmental effects, the PEC size distributions reported facilitate the understanding the mechanism of association of PEC and polycyclic aromatic hydrocarbons (PAHs), a class of organic compounds that include several mutagens. GRA

N85-25985*# Northrop Corp., Los Angeles, Calif.
APPLICATION OF INFRARED RADIOMETERS FOR AIRBORNE DETECTION OF CLEAR AIR TURBULENCE AND LOW LEVEL WIND SHEAR, AIRBORNE INFRARED LOW LEVEL WIND SHEAR DETECTION TEST Final Report, 31 Dec. 1982 - 31 Mar. 1985
P. M. KUHN 31 Mar. 1985 50 p refs
(Contract NAS2-10592)
(NASA-CR-175725; NAS 1.26:175725) Avail: NTIS HC A03/MF A01 CSCL 04B

The feasibility of infrared optical techniques for the advance detection and avoidance of low level wind shear (LLWS) or low altitude wind shear hazardous to aircraft operations was investigated. A primary feasibility research effort was conducted with infrared detectors and instrumentation aboard the NASA Ames Research Center Learjet. The main field effort was flown on the NASA-Ames Dryden B57B aircraft. The original approach visualized a forward-looking, infrared transmitting (KRS-5) window through which signals would reach the detector. The present concept of a one inch diameter light pipe with a 45 deg angled mirror enables a much simpler installation virtually anywhere on the aircraft coupled with the possibility of horizontal scanning via rotation of the forward directed mirror. Present infrared detectors and filters would certainly permit ranging and horizontal scanning in a variety of methods. CRT display technology could provide a contoured picture with possible shear intensity levels from the infrared detection system on the weather radar or a small adjunct display. This procedure shoud be further developed and pilot evaluated in a light aircraft such as a Cessna 207 or equivalent. Author

N85-27441# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FLUID-DYNAMIC MODEL OF A DOWNBURST
S. ZHU and B. ETKIN Apr. 1983 47 p refs
(UTIAS-271; CN-ISSN-0082-5255) Avail: NTIS HC A03/MF A01

The downburst phenomenon associated with thunderstorms produces a flow like that of a jet directed vertically downward at the ground. The flow field near the ground has been modelled as a classical ideal fluid flow generated by a suitable singularity distribution. The resulting model of vertical, lateral and horizontal winds near the ground is useful for studying landing and takeoff of airplanes under thunderstorm conditions. It is used both for analysis, and for on-line real time simulation. With the model developed, analytical simulations of a large jet transport landing through a microburst were carried out on a digital computer. The wind fields generated confirm that phugoid resonance can occur, and is a hazardous condition. Author

N85-27734 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
INVESTIGATIONS OF THE ACCURACY OF THE DIGITAL PHOTOGRAMMETRY SYSTEM (DPS), A RIGOROUS THREE-DIMENSIONAL COMPILATION PROCESS FOR PUSHBROOM IMAGERY
O. HOFMANN *In its* Res. and Develop. Tech. and Sci. Repts. 1984 p 277-286 1984 refs Presented at ISPRS Kongr., Rio de Janeiro, Jun. 1984 Previously announced in IAA as A85-26393
(MBB-UA-753/83-O) Avail: Issuing Activity

A concept for a digital stereoscanner with three line sensor arrays working according to the pushbroom principal, and a suitable analytical compilation method was developed. The system gives the orientation data of the camera along the flight trajectory of aircraft, spacecraft or missiles; the three-dimensional coordinates of the digital elevation model (DEM); ortho and stereo-orthophotos; and geometrically rectified multispectral images. The procedure involves a digital correlation process and does not need any additional information besides the scanner data except a few control points for absolute orientation. Special stabilizations or measurements of flight data are not required. The accuracy of the process was tested by computer simulated models. Author (ESA)

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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.

A85-34131* College of William and Mary, Williamsburg, Va.
MOVING TARGET, DISTRIBUTED, REAL-TIME SIMULATION USING ADA
W. R. COLLINS, S. FEYOCK, L. A. KING, and L. J. MORELL (College of William and Mary, Williamsburg, VA) IN: Simulation in Ada; Proceedings of the Eastern Simulation Conference, Norfolk, VA, March 3-8, 1985 . San Diego, CA, Society for Computer Simulation, 1985, p. 27-32. refs
(Contract NAG3-232)

Research on a precompiler solution is described for the moving target compiler problem encountered when trying to run parallel simulation algorithms on several microcomputers. The precompiler is under development at NASA-Lewis for simulating jet engines. Since the behavior of any component of a jet engine, e.g., the fan inlet, rear duct, forward sensor, etc., depends on the previous behaviors and not the current behaviors of other components, the behaviors can be modeled on different processors provided the outputs of the processors reach other processors in appropriate time intervals. The simulator works in compute and transfer modes. The Ada procedure sets for the behaviors of different components are divided up and routed by the precompiler, which essentially receives a multitasking program. The subroutines are synchronized after each computation cycle. M.S.K.

A85-35175
ACCELERATED CONVERGENCE OF JAMESON'S FINITE-VOLUME EULER SCHEME USING VAN DER HOUWEN INTEGRATORS
J. PIKE and P. L. ROE (Royal Aircraft Establishment, Bedford, England) Computers and Fluids (ISSN 0045-7930), vol. 13, no. 2, 1985, p. 223-236. refs

It is pointed out that the interest in the Euler equations as a model for inviscid transonic flow has been greatly stimulated by the results of Jameson (1982). The present investigation is mainly concerned with one aspect of Jameson's finite volume method, taking into account the Runge-Kutta time-marching algorithm. Jameson's speculation that the efficiency of his standard method can be improved is confirmed by a search of the existing literature, and an apparently new theoretical result, concerning optimal schemes of even order, is obtained. According to three different tests of efficiency, the best method is a six-stage, first-order accurate scheme, which improves the standard four-stage method by some 15-20 percent. G.R.

A85-35796#
NUMERICAL COMPUTATION OF EXTENDED KALMAN FILTER AND ITS APPLICATION TO AERODYNAMIC PARAMETER IDENTIFICATION OF REENTRY SATELLITE
Q. CHEN and Q. JIANG (China Aerodynamic Research and Development Centre, People's Republic of China) Acta Aerodynamica Sinica, no. 1, 1985, p. 96-100. In Chinese, with abstract in English. refs

A85-35853
THE SELECTION OF THE DESIRED TRANSFER COEFFICIENTS FOR ANALOG COMPUTERS [VYBOR ZHELAEMYKH PEREDATOCHNYKH KOEFFITSIENTOV AVM]
F. M. BABUSHKIN (Belorusskii Politekhnicheskii Institut, Minsk, Belorussian SSR) Elektronnoe Modelirovanie (ISSN 0204-3572), vol. 7, May-June 1985, p. 13-17. In Russian. refs

In connection with the preparation of a problem for a solution on an analog computer, it is often necessary to calculate the coefficients for the system configuration needed. Sometimes, the values are determined by the design characteristics of the analog computer, while in other cases accuracy requirements are the determining factor. The values needed for the coefficients are obtained by employing resistors with the appropriate characteristics at the input of the operational amplifier, and by using suitable feedback resitors or capacitors. The determination of the coefficients by means of an informal approach, such as that discussed by Saprykin et al. (1971), does not always provide the desired results. The present investigation is, therefore, concerned with a formalized method for obtaining the desired values. Attention is given to the formulation of the problem, an analysis regarding the problem conditions, and the method of solution. The implementation of the considered procedures is illustrated with the aid of an example representing an aerodynamic problem for an aircraft. G.R.

N85-26221*# Boeing Commercial Airplane Co., Seattle, Wash.
IPAD: INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN Final Report
R. E. MILLER, JR. Washington NASA May 1985 29 p
(Contract NAS1-14700)
(NASA-CR-3890; NAS 1.26:3890) Avail: NTIS HC A03/MF A01 CSCL 09B

Early work was performed to apply data base technology in support of the management of engineering data in the design and manufacturing environments. The principal objective of the IPAD project is to develop a computer software system for use in the design of aerospace vehicles. Two prototype systems are created for this purpose. Relational Information Manager (RIM) is a successful commercial product. The IPAD Information Processor (IPIP), a much more sophisticated system, is still under development. E.A.K.

N85-26753# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
INTERACTIVE DESIGN OF SPECIFICATIONS FOR AIRBORNE SOFTWARE SET (GISELE) Abstract Only
J. CHOPLIN and D. BEURRIER *In* AGARD Tech. Evaluation Rept. on the Flight Mech. Symp. on Active Control Systems p 5 Mar. 1985
Avail: NTIS HC A02/MF A01

An flight control system software development process/system is described that possesses the features needed to generate production level certifiable software. It was designed to assist the user at all stages of development and testing and to generate the required level of documentation. Giesele has been in use since 1983.

N85-27576# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DIAGNOSIS: USING AUTOMATIC TEST EQUIPMENT AND AN ARTIFICIAL INTELLIGENCE EXPERT SYSTEM M.S. Thesis
J. E. RAMSEY, JR. Dec. 1984 367 p
(AD-A151918; AFIT/GE/ENG/84D-53) Avail: NTIS HC A16/MF A01 CSCL 09B

This reviews three different expert systems (ATEOPS, ATEFEXPERS, and ATEFATLAS) created to direct automatic test equipment (ATE). Although related, each expert system uses a different knowledge base or inference engine and base their testing on the circuit schematic, test requirements document (TRD), or ATLAS code. Implementing generalized modules allows the expert systems to be used for any unit under test. Because of numerous errors in the ATLAS code and problems with the actual hardware connection, a fully operational system was not developed. These expert systems provide insight into the necessary knowledge bases and inference engines needed by an expert system to direct ATE. Using converted ATLAS to LISP code allows the expert system to direct any ATE using ATLAS. The CP-FRL allows the expert system to expand its control by creating the ATLAS code, checking the code for good software engineering techniques, directing the ATE, and changing the test sequence as needed. GRA

N85-27584*# Pratt and Whitney Aircraft, East Hartford, Conn. Engineering Div.
ERROR REDUCTION PROGRAM Final Report
S. A. SYED, L. M. CHIAPPETTA, and A. D. GOSMAN 11 Jan. 1985 246 p refs
(Contract NAS3-23686)
(NASA-CR-174776; NAS 1.26:174776; PWA-5928-25) Avail: NTIS HC A11/MF A01 CSCL 12A

The details of a study to select, incorporate and evaluate the best available finite difference scheme to reduce numerical error in combustor performance evaluation codes are described. The combustor performance computer programs chosen were the two dimensional and three dimensional versions of Pratt & Whitney's TEACH code. The criteria used to select schemes required that the difference equations mirror the properties of the governing differential equation, be more accurate than the current hybrid difference scheme, be stable and economical, be compatible with TEACH codes, use only modest amounts of additional storage, and be relatively simple. The methods of assessment used in the selection process consisted of examination of the difference equation, evaluation of the properties of the coefficient matrix, Taylor series analysis, and performance on model problems. Five schemes from the literature and three schemes developed during the course of the study were evaluated. This effort resulted in the incorporation of a scheme in 3D-TEACH which is usuallly more accurate than the hybrid differencing method and never less accurate. M.G.

N85-27606# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ADAPTIVE GRID GENERATION FOR NUMERICAL SOLUTION OF BURGER'S EQUATION M.S. Thesis
B. D. BOYD Dec. 1984 90 p
(AD-A152217; AFIT/GAE/AA/84D-2) Avail: NTIS HC A05/MF A01 CSCL 12A

An adaptive grid generation method is presented which is based on the reduction of truncation error in the computational plane. Grid adaption is achieved through minimization of the third derivative of the dependent variable in the computational plane. Burger's equation is solved because it represents typical nonlinear fluid-flow equations. An optimized Successive-Over-Relaxation method is used to solve Burger's equation using second-order-upwind differences for the convective term. Results are presented for several cases which are compared to the results of a test case. The results show grid points are concentrated in high gradient regions. GRA

N85-27623# Army Command and General Staff Coll., Fort Leavenworth, Kansas.
COMPUTER ASSISTED FLIGHT SCHEDULE OPTIMIZATION M.S. Thesis
R. D. DROWLEY 1 Jun. 1984 94 p
(AD-A151689; AD-E750969) Avail: NTIS HC A05/MF A01 CSCL 05I

This project focuses on integrating flying requirements, duties, and training accomplishments on a microcomputer to produce an optimized weekly flight schedule. The thesis includes research for and examination of earlier attempts to solve this problem as well as a detailed explanation of the method used in approaching this work. The main and supporting programs are written in U.C.S.D. Pascal. The programs use a weekly flying schedule, track pilot availability, and integrate training accomplishments to arrive at an optimized flying schedule as prioritized by squadron supervisors. GRA

N85-27624# Naval Postgraduate School, Monterey, Calif.
THE NAVTAG (NAVAL TACTICAL GAME) SYSTEM AND ITS MODIFICATION TO INCLUDE THE SH-60B HELICOPTER M.S. Thesis
F. R. GOODWIN Sep. 1984 77 p
(AD-A152004) Avail: NTIS HC A05/MF A01 CSCL 15G

The Naval Tactical Game (NAVTAG) Training Systems are to become the standard war gaming computers in fleet use to train Surface Warfare Officers in tactical operations. As modern weapons platforms are developed, they need to be modeled into NAVTAG in order that they might be included in applicable atsea engagements. In support of this objective, the SH-60B (SEAHAWK) Anti-Submarine Warfare Helicopter, which is currently not supported by NAVTAG, is incorporated into the NAVTAG system. The SH-60B is incorporated into the NAVTAG System with the full range of functions that are enjoyed by other aircraft modeled in NAVTAG. Using NAVTAG the SH-60B is tested in an AntiSubmarine Warfare (ASW) scenario developed to test its capabilities against a Soviet submarine. For comparison and testing purposes the SH-60B is also compared to the SH-2F helicopter previously modeled in NAVTAG. Both helicopters have comparable mission objectives and tactics. This is a research project to determine if NAVTAG can be modified in a research environment and with what degree of difficulty this may be accomplished. This in no way is meant to modify the Standard NAVTAG Systems that have been distributed to fleet units without the consent of the Program Manager. GRA

16

PHYSICS

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

A85-33915* California Univ., Los Angeles.
DIFFRACTION OF A BAFFLED DIPOLE - FREQUENCY DEPENDENCE
S. A. MCINERNY, W. C. MEECHAM, T. V. NGO, and S. C. LIU (California, University, Los Angeles, CA) Acoustical Society of America, Journal (ISSN 0001-4966), vol. 77, May 1985, p. 1713-1715. NASA-supported research. refs

Experimental results are presented which confirm the diffraction effects predicted by the MacDonald (1915) form of the Green's function for the baffled field in the theory of trailing edge noise. Using this Green's function, the acoustic intensity of noise generated by flow over a trailing edge has been determined to be proportional to the 5th-power of the flow velocity. O.C.

A85-35128#
CONTROLLED SUPPRESSION OR AMPLIFICATION OF TURBULENT JET NOISE
D. F. LONG, H. KIM, and R. E. A. ARNDT (Minnesota, University, Minneapolis, MN) AIAA Journal (ISSN 0001-1452), vol. 23, June 1985, p. 828-833. Previously cited in issue 07, p. 988, Accession no. A84-20050. refs
(Contract F49620-80-C-0053; N00014-83-K-0145)

A85-35870
THE EFFECT OF THE FORCE STRUCTURE ON MOTION STABILITY [K VOPROSU VLIIANIIA STRUKTURY SIL NA USTOICHIVOST' DVIZHENIIA]
L. G. LOBAS (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR) Matematicheskaia Fizika i Nelineinaia Mekhanika (ISSN 0233-7568), no. 3, 1985, p. 28-33. In Russian. refs

An analysis is made of a two-degrees-of-freedom system exposed to inertial, dissipative, gyroscopic, potential, and nonconservative positional forces. It is shown that for dissipative forces with full dissipation, instability occurs only in the case of medium gyroscopic forces when the gyroscopic force parameter has both lower and upper bounds. For partial dissipation, depending on the stability coefficient ratio, instability occurs either in the case of medium gyroscopic forces or in the case of small gyroscopic forces, with the gyroscopic force parameter having only an upper bound. The self-excitation of vibrations in the front strut of aircraft landing gear and in the front suspension of a car with respect to the body is analyzed. V.L.

N85-26316 Pennsylvania State Univ., University Park.
AN EXPERIMENTAL STUDY OF THE NOISE GENERATED BY VAPOROUS CAVITATION IN TURBULENT SHEAR FLOWS PRODUCED BY CONFINED ORIFICE PLATES Ph.D. Thesis
S. R. BISTAFA 1984 284 p
Avail: Univ. Microfilms Order No. DA8429059

An experimental investigation of the noise generated by vaporous cavitation in turbulent shear flows produced by confined sharp-edged orifice plates is reported. The investigation was conducted in two recirculating water tunnels, one with 6-inch and the other with 12-inch inside diameter test sections. The acoustic source strength of cavitation was determined based on reciprocity type measurements. SA review of the theory related to the incipient mechanism in turbulent sheer flows is presented, as well as an overview on bubble dynamics and the spectral characteristics of a single bubble cavitation noise. The statistical theories of cavitation noise are also presented. Author

N85-26320*# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering.
FUNDAMENTAL STUDIES OF STRUCTURE BORNE NOISE FOR ADVANCED TURBOPROP APPLICATIONS Semiannual Report
W. EVERSMAN and L. R. KOVAL May 1985 14 p refs
(Contract NAG1-394)
(NASA-CR-175737; NAS 1.26:175737) Avail: NTIS HC A02/MF A01 CSCL 20A

The transmission of sound generated by wing-mounted, advanced turboprop engines into the cabin interior via structural paths is considered. The structural model employed is a beam representation of the wing box carried into the fuselage via a representative frame type of carry through structure. The structure for the cabin cavity is a stiffened shell of rectangular or cylindrical geometry. The structure is modelled using a finite element formulation and the acoustic cavity is modelled using an analytical representation appropriate for the geometry. The structural and acoustic models are coupled by the use of hard wall cavity modes for the interior and vacuum structural modes for the shell. The coupling is accomplished using a combination of analytical and finite element models. The advantage is the substantial reduction in dimensionality achieved by modelling the interior analytically. The mathematical model for the interior noise problem is demonstrated with a simple plate/cavity system which has all of the features of the fuselage interior noise problem. A.R.H.

N85-26358# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LOW-RESOLUTION TARGET CLASSIFICATION FROM A STARING INFRARED SENSOR M.S. Thesis
J. N. TILLEY Dec. 1984 192 p
(AD-A151690; AFIT/GE/ENG/84D-67) Avail: NTIS HC A09/MF A01 CSCL 17E

A unique method to extract and classify aircraft targets from low-resolution staring infrared data is presented which uses sequences of sensor frames to obtain target signature samples. The classifier is based on a target feature description consisting of X and Y energy projections of the target. The target information is first extracted from sensor data through sampling windows consisting of contiguous rows and columns of detectors in the path of the expected target. The samples are then reduced to remove degradations from noise and sensor optics. The classifier assumes that approximate target position and velocity are available from a target detection and track subsystem. Tests were performed using a software sensor simulation that includes optical blur and sensor motion models. The classifier is shown through simulation to successfully extract and classify various transport and fighter class aircraft with sensor footprint resolution of 11 to 45 meters. Author (GRA)

N85-27646# Institut Franco-Allemand de Recherches, St. Louis (France).
ANALYSES OF ORDERLY STRUCTURES IN JETS AND THE RELATIONSHIP WITH EMITTED NOISE [ANALYSE DES STRUCTURES ORDONNEES DANS LES JETS ET RELATION AVEC LE BRUIT EMIS]
J. HAERTIG and H. OERTEL 1 Aug. 1983 27 p refs In FRENCH
(Contract DRET-80/078)
(ISL-R-117/83) Avail: NTIS HC A03/MF A01

Excited subsonic and supersonic jets were studied using respectively a continuous jet and a shock tube to examine the regularity of the Mach waves, the structure of the acoustic field, and the aerodynamic characteristics of the flow in the pattern-containing regions. No differences in coherent structures are found between subsonic and supersonic jets. In the supersonic case the pressure field associated with the structures generates regular Mach waves which produce a dominant part of the noise. Author (ESA)

N85-27647# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
PREDICTION OF FREE-FIELD NOISE LEVELS FROM AIRCRAFT FLYOVER MEASUREMENTS
G. J. J. RUIJGROK May 1984 31 p refs
(VTH-LR-427) Avail: NTIS HC A03/MF A01

Results from a flight experiment on a light propeller-driven aircraft were used to examine the ability to correct flyover noise spectra to free-field conditions. Flyover noise was measured when the aircraft was overhead. Average direct measurement spectra were obtained at a measuring station comprising a microphone placed at a height of 1.2 m over grassland and a microphone laid on a metal plate at ground level. Both measurement spectra were corrected for ground interference effects to yield the free-field noise characteristics. The theoretical model used for the prediction of the effects of ground reflection on aircraft noise recorded above a partly reflecting ground surface is presented. Comparison of corrected noise spectra from the two receiver positions demonstrates the potential to accurately deduce free-field noise levels from acoustic data measured by a single microphone arrangement. Author (ESA)

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SOCIAL SCIENCES

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

A85-35817
INTERNATIONAL AIR TRANSPORT - ECONOMIC ASPECTS [MIROVOI VOZDUSHNYI TRANSPORT: EKONOMICHESKII ASPEKT]
V. G. AFANASEV Moscow, Izdatel'stvo Mezhdunarodnye Otnosheniia, 1985, 272 p. In Russian. refs

An economic analysis of the international civil aviation industry is presented. A brief history of the development of international air transport is given, and some important organizational trends are identified. The influence of state-regulated monopolies on the development of bilateral and multilateral economic agreements in the field of civil aviation is examined from a Marxist perspective. The related problems of price setting and tariff regulation are also considered. I.H.

N85-26440*# National Aeronautics and Space Administration, Washington, D. C.
THE 1985 LONG-RANGE PROGRAM PLAN
1984 247 p refs
(NASA-TM-87464; NAS 1.15:87464) Avail: NTIS HC A11/MF A01 CSCL 05A

That continual evolution of NASA's research and development, is reflected in the missions, goals, and objectives planned for FY1985 and later years, in accordance with the responsibilities by the National Aeronautics and Space Act of 1958, as amended. New starts for the next ten years and space program activities to year 2000 are highlighted including space science and applications, space flight, space station, space tracking and data systems, and space research and technology. Space programs for the early 21st century and aeronautics programs up to and beyond the year 2000 are also covered. A.R.H.

N85-26651# European Organisation for the Safety of Air Navigation, Brussells (Belgium).
A COST-EFFICIENT CONTROL PROCEDURE FOR THE BENEFIT OF ALL AIRSPACE USERS
A. BENOIT and S. SWIERSTRA *In* AGARD Cost Effective and Affordable Guidance and Control Systems Feb. 1985 refs
Avail: NTIS HC A13/MF A01

A control procedure for conducting time of arrival constrained flights in an economic manner is proposed. This procedure is intended to be compatible with present day voice communications (human or synthetic) although it is primarily designed to be used in conjunction with future automated digital data communications. The procedure is applicable to the transit of flights through terminal areas such as are considered in connection with Zone-of-Convergence-type systems, and the final approach phase is accordingly integrated with the en route descent, cruise and (possibly) climb phases, or appropriate parts thereof. A detailed description of the procedure is presented together with brief summaries of the tests conducted in present and simulated future environments to assess its efficiency, and then sets out the results obtained to date and analyses them in terms of 4-d navigational accuracy and operational effectiveness. Author

N85-26657# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany). Missile Div.
SIMULATION: A TOOL FOR COST-EFFECTIVE SYSTEMS DESIGN AND LIVE TEST REDUCTION
R. GAUGETT *In* AGARD Cost Effective and Affordable Guidance and Control Systems 9 p Feb. 1985 refs
Avail: NTIS HC A13/MF A01

Taking advanced passive infrared guided missiles as an example of missile system simulation - both software and realtime hardware-in-the-loop including background - is a valuable tool to find cost-effective system designs and also to drastically reduce costs of field testing and live firing trials. The development of complex missile systems becomes questionable from a cost standpoint if the majority of the increased test efforts for this type of missiles is not substituted by missile system simulation. The author addresses Bodenseewrk's missile system simulation philosophy, simulation methods, high level programming language and the interfaces between the involved hardware and software. An in-depth discussion of the influence of simulation onto the flight testing requirements of missile developments and the resultant cost savings conclude this paper. G.L.C.

N85-27724 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
RESEARCH AND DEVELOPMENT. TECHNICAL AND SCIENTIFIC REPORTS 1984 [FORSCHUNG UND ETWICKLUNG. TECHNISCHE-WISSENSCHAFTLICHE N 1984]
1984 354 p refs Partly in ENGLISH and GERMAN
Avail: Issuing Activity

Flow-physical aspects in aerodynamics; ultrasonic testing of carbon fiber reinforced plastics using pattern recognition methods; characteristics and applications of superplastic materials for aeronautics and astronautics; and design of cost-effective flight control systems are discussed. The application of computer aided structural optimization to the design of aircraft components; the flight test support aircraft ATTAS; advanced flight simulation for helicopter development; a modular optoelectronic multispectral scanner for Earth observation; and a station for in-orbit testing of satellites are treated. Trends in warhead design; a remotely piloted vehicle for mine identification and disposal; and the transient behavior of a single-blade horizontal axis wind turbine are considered. A digital photogrammetry system; an automated riveting system for aircraft construction; and the testing of slip-controlled railroad wheel sets are outlined.

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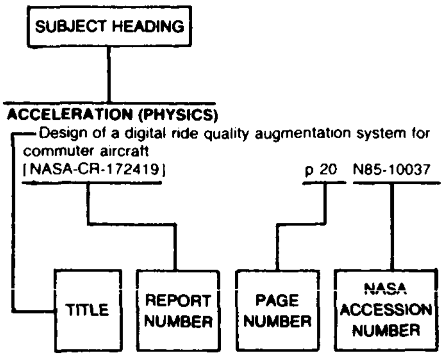
GENERAL

N85-26590*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AMES SUMMER HIGH SCHOOL APPRENTICESHIP RESEARCH PROGRAM
P. POWELL Apr. 1985 108 p refs Program held at Moffett Field, Calif., 16 Jun. - 17 Aug. 1984
(NASA-TM-86006; A-9852; NAS 1.15:86006) Avail: NTIS HC A06/MF A01 CSCL 05I

The Summer High School Apprenticeship Research Program (SHARP) is described. This program is designed to provide engineering experience for gifted female and minority high school students. The students from this work study program which features trips, lectures, written reports, and job experience describe their individual work with their mentors.

Typical Subject Index Listing



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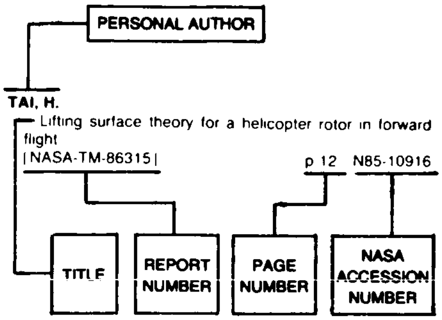

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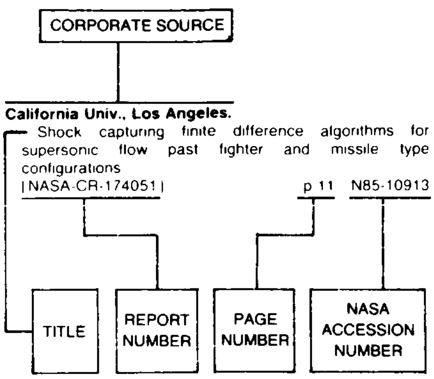

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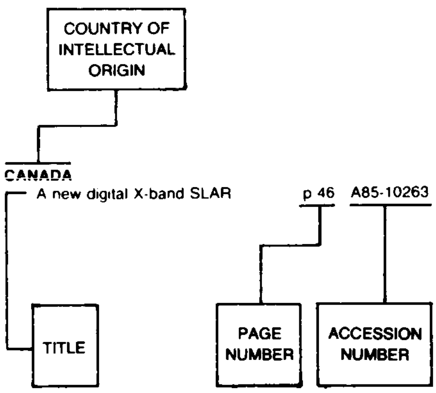

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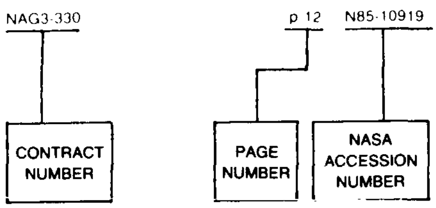

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REPORT NUMBER INDEX

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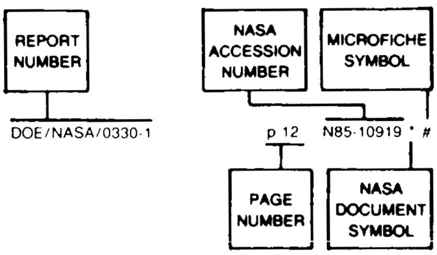

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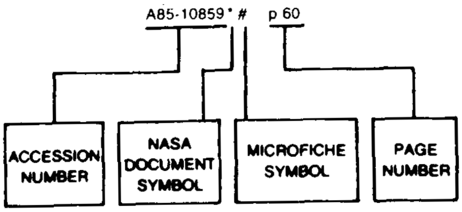

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NASA SP-7037(191)		

4. Title and Subtitle	5. Report Date
Aeronautical Engineering A Continuing Bibliography (Supplement 191)	September 1985
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
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