NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(178)
September 1984

National Aeronautics and Space Administration

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Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering

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STAR (N-10000 Series)	N84-24528 - N84-26564
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NASA SP-7037(178)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 178)

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 1984 in

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

NASA Scientific and Technical Information Branch 1984
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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 426 reports, journal articles, and other documents originally announced in August 1984 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.

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

An annual cumulative index will be published.

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N84-10017*# Kansas Univ., Lawrence. Flight Research Lab.
A LIFTING SURFACE THEORY IN ROTATIONAL FLOW Topical Report, Jun. 1981 - Dec. 1982
M. J. SHIAU and C. E. LAN Oct. 1983 74 p refs
(Contract NAG1-75)
(NASA-CR-172233; NAS 1.26:172233; CRINC-FRL-467-2) Avail: NTIS HC A04/MF A01 CSCL 01A

The partial differential equation for small disturbance steady rotational flow in three dimensions is solved through an integral equation approach. The solution is obtained by using the method of weighted residuals. Specific applications are directed to wings in nonuniform subsonic parallel streams with velocity varying in vertical and spanwise directions and to airfoils in nonuniform freestream. Comparison with limited known results indicates that the present method is reasonably accurate. Numerical results for the lifting pressure of airfoil, lift, induced drag, and pitching moments of airfoil, lift, induced drag, and pitching moments of elliptic, rectangular, and delta wings in a jet, wake, or monotonic sheared stream are presented. It is shown that, in addition to the effect of local dynamic pressures, a positive velocity gradient tends to enhance the lift. Author

TYPICAL CITATION AND ABSTRACT FROM *IAA*

AIAA ACCESSION NUMBER

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A84-10131#
EXPERIMENTAL INVESTIGATION OF CURVATURE EFFECTS ON VENTILATED WALL JETS
R. M. EL-TAHER (King Abdulaziz University, Jeddah, Saudi Arabia) AIAA Journal (ISSN 0001-1452), vol. 21, Nov. 1983, p. 1505-1511. refs

The results of an experimental study for a ventilated plane jet attaching to an offset plane surface or to an offset convex surface of circular cross section are presented. The results demonstrate the dependence of the rate of entrainment through the gap, the location of the attachment point, the growth of the length scale, and the decay of the maximum velocity on the wall curvature. Moreover, the effect of wall curvature on the mean velocity, the turbulence velocity components, and the Reynolds shear stress in the different zones of the jet are investigated. Author

AEROSPACE MEDICINE AND BIOLOGY

(A Continuing Bibliography (Suppl. 178)

SEPTEMBER 1984

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AERONAUTICS (GENERAL)

A84-34171
EVOLUTION OF THE COMBAT AIRCRAFT [EVOLUTION DE L'AVION DE COMBAT]
L. ROSENTHAL (Centre de Documentation de l'Armement, Paris, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), *no. 104, 1984, p. 3-15. In French. refs*

The combat aircraft introduced at the 34th Airshow at Le Bourget (the F-20, Mirage III NG, C7, JAS 39, Lavi, and AMX) are described, together with aircraft about to undergo flight testing (e.g., the Grumman X-29A). Attention is also given to combat aircraft projects: the Agil Combat Aircraft, the Taktische Kampf Flugzeug, the Avion de Combat Experimental, and the Dornier-Northrop project (an F-18 with a delta airfoil and with vectorial thrust). Supersonic cruise interceptors (e.g., the Advanced Fighter Concept) and supersonic V/STOL are considered. Topics also covered include maneuverability, flow over tapered bodies, mobile canards, automatic camber variation, generalized automatic control, propulsion, and materials (e.g., with carbon fibers for aeroelastic stability). C.M.

A84-35214#
HISTORY OF SOLAR FLIGHT
R. J. BOUCHER (Astro Flight, Inc., Venice, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 14 p.
(AIAA PAPER 84-1429)

This paper discusses the seven solar powered aircraft flown to date. The characteristics of these airplanes are reviewed, and the prospects for future advancements in solar flight are addressed. Author

A84-35377#
AUSTRALIAN AIRSPACE MANAGEMENT
T. JENSEN Navigation (ISSN 0077-6262), vol. 6, Dec. 1983, p. 1149-1158. refs

The Australian Air Coordinating Committee (ACC), composed of two governmental departments (Defense and Aviation), was formed to resolve joint aviation problems by mutual agreement. ACC's basic principles (e.g., safety and expedition) and working groups (e.g., which determine high speed, low level military training routes) are considered. Also covered are airspace design and sharing, public transport, and air traffic control. A National Airspace Users Advisory Council and five Regional Committees are proposed, the objectives of which will include promoting discussion and consultation between the Department of Aviation and the civil airspace users. The Canadian airspace modernization system is considered as a future model. C.M.

N84-24528*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL WIND-TUNNEL TESTING
D. G. KOENIG May 1984 74 p refs
(NASA-TM-85936; A-9694; NAS 1.15:85936) Avail: NTIS HC A04/MF A01 CSCL 01B

Factors influencing effective program planning for V/STOL wind-tunnel testing are discussed. The planning sequence itself, which incudes a short checklist of considerations that could enhance the value of the tests, is also described. Each of the considerations, choice of wind tunnel, type of model installation, model development and test operations, is discussed, and examples of appropriate past and current V/STOL test programs are provided. A short survey of the moderate to large subsonic wind tunnels is followed by a review of several model installations, from two-dimensional to large-scale models of complete aircraft configurations. Model sizing, power simulation, and planning are treated, including three areas is test operations: data-acquisition systems, acoustic measurements in wind tunnels, and flow surveying. Author

N84-24529# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Control Systems Development Branch.
PROCEEDINGS OF THE WORKSHOP ON MULTIVARIABLE CONTROL SYSTEMS Final Report, Mar. 1982 - Sep. 1983
M. A. MASI and D. E. RUSS Sep. 1983 667 p refs Workshop held at Wright-Patterson AFB, Ohio, 3 Dec. 1982
(AD-A139050; AFWAL-TR-83-3098) Avail: NTIS HC A99/MF A01 CSCL 01C

The advent of highly augmented flight control systems, system integration at all levels, and the use of multiple function control surfaces, has led to the extensive requirement for multivariable multi-input/multi-output control systems. The need for alternative multivariable design techniques was documented. The present control law design methodologies of linear quadratic regulator (LQR), eigenvalue/eigenvector assignment, and classical single input/output do not always meet the handling qualities performance and control system specifications, i.e., phase and gain margins and bandwidth, without modification to cope with the high dynamic uncertainties of an aircraft. Application of singular perturbation method of asymptotic eigenvalue assignment as applied to control systems has progressed from modal control theory through complete eigenstructure assignment to the use of high gain feedback to the use of output feedback for error-actuated tracker controllers using the method described for the design of several multivariable control systems.

N84-24536# Transportation Systems Center, Cambridge, Mass.
GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY Annual Summary Report
J. C. SCHWENK and B. A. ROVNER Dec. 1983 232 p
(AD-A139936; TSC-FAA-83-3; FAA-MS-83-5) Avail: NTIS HC A11/MF A01 CSCL 01B

This report presents the results and a description of the 1982 General Aviation Activity and Avionics Survey. The survey was conducted during 1983 by the FAA to obtain information on the activity and avionics of the United States registered general aviation aircraft fleet, the dominant component of civil aviation in the U.S. The survey was based on a statistically selected sample of about 10.2 percent of the general aviation fleet and obtained a response rate of 68 percent. Survey results are based upon responses but are expanded upward to represent the total population. Survey results revealed that during 1982 an estimated 36.5 million hours of flying time were logged by the 209,779 active general aviation aircraft in the U.S. fleet, yielding a mean annual flight time per aircraft of 174 hours. The active aircraft represented about 82 percent of the registered general aviation fleet. The report contains breakdowns of these and other statistics by manufacturer/model group, aircraft type, state and region of based aircraft, and primary use. Also included are fuel consumption, lifetime airframe hours, avionics, and engine hours estimates. In addition, tables are included for detailed analysis of the avionics capabilities of the GA fleet. GRA

N84-25605*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ADVANCED PITCH CHANGE MECHANISM INCORPORATING A HYBRID TRACTION DRIVE
B. M. STEINETZ, D. F. SARGISSON (GE, Evendale, Ohio), G. WHITE (Transmission Research Inc.), and S. H. LOEWENTHAL 1984 18 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(Contract NAS3-23044)
(NASA-TM-83709; E-2137; NAS 1.15:83709; AIAA-84-1383)
Avail: NTIS HC A02/MF A01 CSCL 01A

A design of a propeller pitch control mechanism is described that meets the demanding requirements of a high-power, advanced turboprop. In this application, blade twisting moment torque can be comparable to that of the main reduction gearbox output: precise pitch control, reliability and compactness are all at a premium. A key element in the design is a compact, high-ratio hybrid traction drive which offers low torque ripple and high torsional stiffness. The traction drive couples a high speed electric motor/alternator unit to a ball screw that actuates the blade control links. The technical merits of this arrangement and the performance characteristics of the traction drive are discussed. Comparisons are made to the more conventional pitch control mechanisms. Author

N84-25606*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL METHOD TO PREDICT EFFICIENCY OF AIRCRAFT GEARBOXES
N. E. ANDERSON, S. H. LOEWENTHAL, and J. D. BLACK (Allison Gas Turbine Operations) 1984 23 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83716; E2169; NAS 1.15:83716; USAAVSCOM-TR-84-C-8; AIAA-84-1500) Avail: NTIS HC A02/MF A01 CSCL 01A

A spur gear efficiency prediction method previously developed by the authors was extended to include power loss of planetary gearsets. A friction coefficient model was developed for MIL-L-7808 oil based on disc machine data. This combined with the recent capability of predicting losses in spur gears of nonstandard proportions allows the calculation of power loss for complete aircraft gearboxes that utilize spur gears. The method was applied to the T56/501 turboprop gearbox and compared with measured test data. Bearing losses were calculated with large scale computer programs. Breakdowns of the gearbox losses point out areas for possible improvement. Author

N84-25607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF AN OPTIMIZATION METHOD TO HIGH PERFORMANCE PROPELLER DESIGNS
K. C. LI (Purdue Univ.) and G. L. STEFKO 1984 11 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83710; E-2086; NAS 1.15:83710; AIAA-84-1203)
Avail: NTIS HC A02/MF A01 CSCL 01A

The application of an optimization method to determine the propeller blade twist distribution which maximizes propeller efficiency is presented. The optimization employs a previously developed method which has been improved to include the effects of blade drag, camber and thickness. Before the optimization portion of the computer code is used, comparisons of calculated propeller efficiencies and power coefficients are made with experimental data for one NACA propeller at Mach numbers in the range of 0.24 to 0.50 and another NACA propeller at a Mach number of 0.71 to validate the propeller aerodynamic analysis portion of the computer code. Then comparisons of calculated propeller efficiencies for the optimized and the original propellers show the benefits of the optimization method in improving propeller performance. This method can be applied to the aerodynamic design of propellers having straight, swept, or nonplanar propeller blades. Author

N84-25608# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Information und Dokumentation.
PROJECTS AND PROGRAMS AS A REFLECTION OF THE PERFORMANCES OF ENGINEERS IN AIRCRAFT MAKING BY HANS-WOCKE [PROJEKTE UND PROGRAMME ALS SPIEGEL DER LEISTUNGEN DES FLUGZEUGBAU-INGENIERS HANS WOCKE]
H. FLOSDORFF 1983 31 p In GERMAN Presented at VDI-Tech. Univ., Hamburg Kollog. zue Ehren von Herrn Senator E. H. Dipl.-Ing. Hans Wocke, Hamburg, Oct. 1983
(MBB-UT-24-83-O) Avail: NTIS HC A03/MF A01

Developments in the European Aerospace technology, and in particular the development of the European Airbus A300, are described. Progress in aerodynamics, wind tunnel tests, statics and construction progress in the industry are outlined. Transport aircraft design and development are examined. The organization of a team of aeronautic engineers which has gained experience in the areas of construction, research and development, and management of international projects is discussed. Transl. by E.A.K.

N84-25611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF AERONAUTICAL MATERIALS (SELECTED ARTICLES)
27 Mar. 1984 120 p Transl. into ENGLISH from Hangkong Cailiao (China), v. 3, no. 1 p 1-12; 17-45; 58-58
(AD-A140181; FTD-ID(RS)T-1870-83) Avail: NTIS HC A06/MF A01 CSCL 01C

The physical properties and mechanical behavior of various alloys and composite materials are discussed. Specific materials include titanium and other metal alloys, silicon carbide fiber reinforced aluminum composites, and glass fiber/epoxy resin composites; among the physical properties reviewed were superplasticity, notch strength, and tensile strength. The effect of various influences on such processes as solidifcation, curing, crack propagation, and thermal fatigue is presented. R.S.F.

N84-25612# Naval Postgraduate School, Monterey, Calif.
NAVAL AVIATION IMA REPAIR CAPABILITY: A READINESS TO RESOURCES APPROACH M.S. Thesis
D. R. MERRILL Dec. 1983 103 p
(AD-A140465) Avail: NTIS HC A06/MF A01 CSCL 05A

This thesis studies intermediate repair planning at the Naval Air Systems Command (NAVAIR) level. Maintenance information system initiatives (Naval Aviation Logistics Command Management Information System (NALCOMIS)/Naval Aviation Logistics Data Analysis (NALDA)/AIMD Performance Management System (APMS) and an analytical systems model (Analytic Hierarchy Process (AHP)) are examined. The study concludes that information system initiatives provide the performance measurement orientation and information processing base required in support of NAVAIR tactical planning. It further concludes that complex logistics problems can be modeled through the AHP. AHP is a promising technique for integrating performance information and expert opinion into a hierarchical, multiple objective planning structure. It provides a method for determining resource requirement priorities in support of readiness goals. The study recommends that research be expanded to include development of a NAVAIR decision support framework utilizing the AHP. GRA

N84-25613# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
WORKSHOP ON REQUIREMENTS FOR AIRCRAFT CORROSION CONTROL
W. M. IMRIE, ed. Mar. 1984 78 p refs Workshop held in London, 10-15 Apr. 1983
(AGARD-R-714; ISBN-92-835-1467-X) Avail: NTIS HC A05/MF A01
Conference proceedings on aircraft corrosion and corrosion prevention are given. A number of topics are discussed in the areas of design specifications, manufacturing, maintenance, and cost.

N84-25619# Atlantic Fleet, Norfolk, Va.
US NAVY CORROSION CONTROL MAINTENANCE
G. T. BROWNE *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 11 p Mar. 1984
Avail: NTIS HC A05/MF A01
The U.S. Navy Aircraft Corrosion Prevention/Control Maintenance Program is described. Program elements, present maintenance practice, maintenance control procedures and corrective actions from discovery, resolution and documentation are discussed. A system of checks and balances which are accomplished through a material condition audit program that assesses the quality of information provided for use by mechanics and the ability of the aircraft operator to maintain the aircraft are discussed. The training for personnel involved in the program is also discussed. R.J.F.

N84-25621# National Defence Headquarters, Ottawa (Ontario). Directorate of Aerospace Support Engineering.
CORROSION CONTROL MAINTENANCE PRACTICES FOR CANADIAN AIRCRAFT
R. SIMARD *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 7 p Mar. 1984
Avail: NTIS HC A09/MF A01
The corrosion control program for aircraft of the Canadian Armed Forces is reviewed. Documentation outlining general guidelines and policy is presented along with excerpts from a manual specific to one particular aircraft. The effects of the operational environment on the extent of the corrosion control program for an aircraft is discussed, with Sea King helicopters and CF-104 aircraft serving as examples. The equipment contained in a corrosion control first aid kit for CF aircraft is highlighted, along with instructions for its use. The training given to CF aviation tradesmen is also outlined. Finally, the protective coating system selected for all CF aircraft is described and its importance to the overall corrosion contol program is noted. R.J.F.

N84-25623# Naval Air Development Center, Warminster, Pa.
METHODOLOGY FOR ASSESSMENT OF CORROSION COSTS
I. S. SHAFFER *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 7 p Mar. 1984 refs
Avail: NTIS HC A05/MF A01
Corrosion has a significant impact on the life cycle costs of naval aircraft. Materials, energy, labor and technical expertise that would otherwise be available for alternative uses must be allocated for corrosion control. To help justify the added expense of designing more corrosion resistance in future Navy aircraft and spending more on corrosion research and technology, valid estimates of the magnitude of corrosion costs and the relative distribution of those costs among various aircraft types and aircraft systems are important. While many factors make up the Navy's cost of corrosion for aircraft ownership, the overwhelming one is the effort spent doing maintenance. The maintenance data collection system is discussed. Tables and graphs showing costs are given. R.J.F.

N84-25624# British Airways, Middlesex (England). Aircraft Engineering (Structures).
COST OF CORROSION FOR COMMERCIAL AVIATION
R. G. MITCHELL *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 1 p Mar. 1984
Avail: NTIS HC A05/MF A01
A preliminary analysis of aircraft corrosion costs based on the annual costs of scheduled maintenance, modification, and replacement is discussed. The results show the financial cost of the corrosion problem which can be expressed in several ways. The direct cost per flying hour, depending on operators and aircraft type (not including maintenance overhead) was $8-$12 in 1979 and $8-$20 in 1983. The percentage of direct airframe maintenance cost was between 6% and 8%. The total annual direct cost for International Transport Association member airlines was $100 M based on 1976 operations and $200 M based on 1982 operations. It should be noted that the values represent costs for a range of operators and aircraft types. The lowest value is very conservative and is largely based on one operators actual modification project costs only. The higher value is probably closer to the true cost since it is based upon a breakdown of actual modification, routine maintenance and inspection costs. Closer examination of these figures reveal that the major component in the cost values associated with corrosion prevention and control is due to labor costs. An additional cost not reflected in the above figures is the unscheduled downtime both at main base and route stations. R.J.F.

N84-25625# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SPECIAL COURSE ON V/STOL AERODYNAMICS
Loughton, England Apr. 1984 383 p refs Course held in Rhode-Saint-Genese, Belgium, 14-18 May 1984, and in Moffett Field, Calif., 4-8 Jun. 1984
(AGARD-R-710; ISBN-92-835-1472-6) Avail: NTIS HC A17/MF A01
The aim of the Special Course on V/STOL Aerodynamics was to outline and discuss the additional knowledge of aerodynamics needed to embark on the design of V/STOL aircraft. The influence of V/STOL features on wing design, layout considerations, engine and air intake considerations, effects of jet effluxes, wind tunnel and flight testing, maneuverability and control, performance assessment and special aspects of flight aerodynamics were discussed.

02

AERODYNAMICS

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

A84-33849
AN ADVANCED AEROSPIKE TO MINIMIZE NOSE DRAG
J. P. REDING and D. M. JECMEN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Lockheed Horizons, no. 15, 1984, p. 46-54.
The design of a hydrogen-burning aerospike for the nose of ballistic missiles is discussed, and some preliminary experimental results are summarized and illustrated with graphs and photographs. It is shown that the aerospike with combustion reduces overall drag by 75 percent relative to the smooth nose and by 50 percent relative to a nonburning aerospike. the techniques developed to scale the wind-tunnel test results to operational values and the system design factors are examined. Using solid propellants supplying 15 percent usable H2 by weight, it is estimated that a spike 1.5 nose diameters in length with H2 mass-flow ratio 0.0003 will give maximum range gain. Further study is recommended to determine whether combustion itself or the heat injected is the major factor in reducing drag. T.K.

A84-34172
EXHAUST SYSTEM FOR COMBAT AIRCRAFT OPTIMIZED FOR SUPERSONIC CRUISE [ENSEMBLE D'EJECTION POUR AVION DE COMBAT OPTIMISEEN CROISIERE SUPERSONIQUE]
J.-M. HARDY (S.N.E.C.M.A., Centre de Melun-Villaroche, Moissy-Cramayel, Seine-et-Marne, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 104, 1984, p. 16-28. In French. refs
The Concorde nozzle principle is described together with its calculation methods. Results from an optimization study of the internal structure of the Concorde ejector in supersonic cruise are analyzed, emphasizing the significance of the secondary pressure level in the selection of the primary ejector type and taking into consideration the hot gas effect during interpretation of wind tunnel data. Topics covered include techniques for supersonic cruise optimization; Mirage nozzles; calculations of the primary flow, of the flow in a two-flux ejector (short and long ejectors); the adaptation of the afterbody to subsonic flight conditions; the effect of external parameters on afterbody performance; long ejectors for a primary convergent-divergent nozzle; biconic nozzles; and optimization of the propulsion system. C.M.

A84-34342#
THEORY OF A THIN WING WITH A CIRCULAR MEAN LINE [THEORIE DE L'AILE MINCE ASQUELETTE CIRCULAIRE]
C. JACOB Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (ISSN 0035-4074), vol. 28, Sept.-Oct. 1983, p. 453-473. In French. refs
A thin wing with a circular nonnegligible curvature of the mean line and subjected to rotation in a plane ideal-fluid flow is investigated analytically, applying classical theory. The resulting Direchlet problem is solved for the complex plane having a circular arc as its boundary, and the solution is applied to cases with symmetric, asymmetric, or arbitrary rational parameters. General expressions for determining the complex velocity and direct methods for the case of a wing reduced to its circular mean line are derived. T.K.

A84-34347#
THE SUPERSONIC FLOW AROUND A CONIC NOZZLE [L'ECOULEMENT SUPERSONIQUE AUTOUR D'UN INJECTEUR]
H. DUMITRESCU (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Rumania) and E. CARAFOLI Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee (ISSN 0035-4074), vol. 29, Mar.-Apr. 1984, p. 107-118. In French.
Velocity and pressure fields are determined analytically for a porous cone in an inviscid uniform supersonic flow at zero incidence when a combustion mixture is injected through the wall and ignited, forming a combustion wave. The entire flow region from the shock wave to the cone surface is characterized, and a division into hot and cold zones is found at the flame front. The results are presented in graphs. T.K.

A84-34454#
COMPUTATION OF TRANSONIC FLOW AROUND AIRFOILS WITH TRAILING EDGE AND SHOCK/BOUNDARY LAYER INTERACTIONS
M. M. S. KHAN (Lockheed-Georgia Co., Marietta, GA), G. R. INGER (West Virginia, University, Morgantown, WV), and S. G. LEKOUDIS (Georgia Institute of Technology, Atlanta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 380-388. Research supported by the Lockheed-Georgia Co. refs
Previously cited in issue 18, p. 2841, Accession no. A82-37474

A84-34459*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO-DIMENSIONAL WIND-TUNNEL INTERFERENCE FROM MEASUREMENTS ON TWO CONTOURS
E. T. SCHAIRER (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 414-419. refs
This paper describes how wall-induced velocities near a model in a two-dimensional wind tunnel can be estimated from upwash distributions measured along two contours surrounding a model. The method is applicable to flows that can be represented by linear theory. It was derived by applying the Schwarz Integral Formula separately to the two contours and by exploiting the free-air relationship between upwashes along the contours. Advantages of the method are that only one flow quantity need by measured and no representation of the model is required. A weakness of the method is that it assumes streamwise interference velocity vanishes far upstream of the model. This method was applied to a simple theoretical model of flow in a solid-wall wind tunnel. The theoretical interference velocities and the velocities computed using the method were in excellent agreement. The method was then used to analyze experimental data acquired during adaptive-wall experiments at Ames Research Center. This analysis confirmed that the wall adjustments reduced wall-induced velocities near the model. Author

A84-34460*# Boeing Commercial Airplane Co., Renton, Wash.
ON THE CONVERGENCE OF UNSTEADY GENERALIZED AERODYNAMIC FORCES
W. S. ROWE (Boeing Commercial Airplane Co., Flutter Research Group, Renton, WA) and H. J. CUNNINGHAM (NASA, Langley Research Center, Unsteady Aerodynamics Branch, Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 22nd, Atlanta, GA., April 6-8, 1981, and AIAA Dynamics Specialists Conference, Atlanta, GA, April 9, 10, 1981, Technical Papers. Part 2, p. 699-708) Journal of Aircraft (ISSN 9921-8669), vol. 21, June 1984, p. 420-427. refs
Previously cited in issue 12, p. 1923, Accession no. A81-29500

A84-34461#
AERODYNAMICS OF POINTED FOREBODIES AT HIGH ANGLES OF ATTACK
V. J. MODI, T. RIES, A. KWAN (British Columbia, University, Vancouver, Canada), and E. LEUNG Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 428-432. Sponsorship: Natural Sciences and Engineering Research Council of Canada. refs
(Contract NSERC-A-2181)
Previously cited in issue 19, p. 2793, Accession no. A83-41942

A84-34462#
EFFICIENT METHOD FOR CALCULATING THE AXIAL VELOCITIES INDUCED ALONG ROTATING BLADES BY TRAILING HELICAL VORTICES
O. RAND and A. ROSEN (Technion - Israel Institute of Technology, Haifa, Israel) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 433-435. refs
An efficient method for the calculation of induced velocities in the axial component of the vortex filaments that are trailed by propeller blades is presented. Attention is given to the case of three equally spaced propeller blades which are rotating with constant velocity. The use of this approximate method is noted to reduce the region of integration in calculations by almost three orders of magnitude. O.C.

A84-34464#
CALCULATION OF POTENTIAL FLOW PAST SIMPLE BODIES USING AXIAL SOURCES AND A LEAST-SQUARES METHOD
G. S. CAMPBELL (Connecticut, University, Storrs, CT) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 437, 438. refs

Attention is given to results of a study employing systematic variations of the number of sources and control points in the potential flow of ellipsoids of varying fineness ratio. The stream function psi(x, y) is evaluated at a large number of points on the surface of the body. A small absolute value of psi at all points identifies an accurate position. O.C.

A84-34465#
UNSTEADY PRESSURES AND FORCES DURING TRANSONIC BUFFETING OF A SUPERCRITICAL AIRFOIL
B. H. K. LEE and L. H. OHMAN (National Aeronautical Establishment, High Speed Aerodynamics Laboratory, Ottawa, Canada) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 439-441; Abridged. refs
(AD-A133139; NAE-AN-14)

Previously announced in STAR as N84-15503

A84-34466#
MEASUREMENTS OF GROUND EFFECT FOR DELTA WINGS
J. KATZ and D. LEVIN (Technion - Israel Institute of Technology, Haifa, Israel) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 441-443. Research supported by the Technion - Israel Institute of Technology. refs

The effect of ground proximity on the aerodynamic performance of delta wings is investigated for wings with an aspect ratio of 0.71 at high angles of attack (up to 40 deg). The main conclusion of the study is that the ground effect increases the wing lift even in the case of the vortex-induced lift of delta wings. The lift increase is larger for positive angles of attack than for negative ones. This difference is attributed to the effect of a small displacement in the location of the leading-edge vortices trapped between the wing and the ground surface. V.L.

A84-34467#
PROFILE DRAG FROM LASER-DOPPLER VELOCIMETER MEASUREMENT
S. KOBAYASHI (ORI, Inc., Ship Systems Engineering Div., Silver Spring, MD) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 444-446. refs
(Contract N00014-76-C-0357)

The momentum theory and the hypothetical flow concept introduced by Betz (1979) are used to derive a formula for predicting the profile drag from laser-Doppler velocimetry data. The values of the profile drag computed from the measured velocity distributions at various streamwise locations are presented for two types of foil sections. The values obtained are found to be in good agreement with data in the literature. V.L.

A84-34468*# Maryland Univ., College Park.
ENGINEERING ANALYSIS OF DROOPED LEADING-EDGE WINGS NEAR STALL
J. D. ANDERSON, JR. (Maryland, University, College Park, MD) and T. H. CHO Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 446-448. refs
(Contract NSG-1570)

Numerical results obtained with a three-dimensional vortex panel computer program for the calculation of inviscid, incompressible (potential) flow over infinitely thin finite wings with camber are presented. The program, which is designed for wings with drooped leading edge discontinuities, is essentially a numerical representation of lifting surface theory, involving both spanwise and chordwise distributions of vorticity. The results also include two engineering approximations. First, the effect of the leading-edge discontinuities is modeled by assuming that the vortices emanating from the discontinuities aerodynamically divide the wing into three distinct sections of lower aspect ratio. Secondly, the effect of the separated flow at high angle of attack is modeled by applying rectangular vortex panels with a varying vortex strength over the portions of the wing with attached flow. V.L.

A84-34500
ON THE AERODYNAMIC OPTIMIZATION OF SUPERSONIC WINGS
H. J. BOS Delft, Technische Hogeschool, Doctor in de Technische Wetenschappen Thesis, 1984, 361 p. refs

Drag minimization for a wing of zero thickness and given lift is examined in the context of linearized supersonic wing theory. Planform variations are considered, and the curvature effect of subsonic leading edges is stressed. Topics covered include momentum flux methods, qualitative properties of optimum wings, and applications of the inverse and the direct optimization methods. It is shown that a disturbance velocity potential with a degree of one-half homogeneity is required, and a method that extends Germain's and Fenain's homogeneous flow theory to noninteger degrees of homogeneity is provided. C.M.

A84-34691
THE SEARS PROBLEM FOR A LIFTING AIRFOIL REVISITED - NEW RESULTS
H. M. ATASSI (Notre Dame, University, Notre Dame, IN) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 141, April 1984, p. 109-122. refs
(Contract AF-AFOSR-82-0269)

It is shown that for a thin airfoil with small camber and small angle of attack moving in a periodic gust pattern, the unsteady lift caused by the gust can be constructed by linear superposition to the Sears lift of three independent components accounting separately for the effects of airfoil thickness, airfoil camber and non-zero angle of attack to the mean flow. This is true in spite of the nonlinear dependence of the unsteady flow on the mean potential flow of the airfoil. Specific lift formulas are derived and analyzed to assess the importance of mean flow angle of attack and airfoil camber on the gust response. Author

A84-34695
PROGRESS TOWARDS A THEORY OF JET-FLAP THRUST RECOVERY
P. M. BEVILAQUA, E. F. SCHUM, and C. J. WOAN (Rockwell International Corp., Columbus, OH) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 141, April 1984, p. 347-364. refs
(Contract F49620-78-C-0069)

A combination of analysis and testing has been utilized to develop a theory of jet-flap thrust recovery at the low speeds and high deflection angles characteristic of V/STOL lift systems. The contribution of jet mixing to the loss of thrust recovery has been computed with a viscid/inviscid interaction analysis. The results of this computation are compared to surface pressure and wake survey measurements made with a two-dimensional jet-flapped airfoil model. It is concluded that the jet-mixing drag causes a small loss of recovery at small values of the jet-thrust coefficient and deflection angle. However, at larger values of either jet parameter, the mainstream separates from the airfoil, producing a large loss of recovery. The loss increases suddenly, since it is due to bursting of the leading-edge separation bubble. Author

A84-34719
COMPUTATION OF THE THRUST VECTOR OF OBLIQUELY CUT SUPERSONIC NOZZLES [BERECHNUNG DES SCHUBVEKTORS BEI SCHRAEG ABGESCHNITTENEN UEBERSCHALLDUESEN]
G. JUNGCLAUS (Messerschitt-Boelkow-Blohm GmbH, Munich, West Germany) (Deutsche Gesellschaft fuer Luft- und Raumfahrt, Sitzung, Ottobrunn, West Germany, Dec. 7, 8, 1982) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Mar.-Apr. 1984, p. 110-112. In German.

The axial and lateral thrust of supersonic nozzles with rotational symmetry and obliquely cut exits is calculated using a simplified approximation technique in stream-tube theory. The results are compared with those for side-deflected rotationally symmetric and obliquely cut plane nozzles and confirmed by experimental measurements. T.K.

A84-34832

MODELLING OF AN AIRFOIL EMPIRICAL FLOW FIELD BELOW AND THROUGH DYNAMIC STALL

D. FAVIER, C. MARESCA, and J. REBONT (Aix-Marseille II, Universite, Marseille, France) Journal de Mecanique Theorique et Appliquee (ISSN 0750-7240), vol. 3, no. 1, 1984, p. 15-39. Sponsorship: Direction Technique des Constructions Aeronautiques. refs

(Contract DTCA-78/98417)

Analytical models of the incompressible flow around a NACA 0012 airfoil below and during dynamic stall are developed. A potential-flowfield approach is employed, with provision for concentrated vorticity regions in the vicinity of the airfoil surface; the model for dynamic stall requires some empirical input. The results are presented in graphs and diagrams, and good agreement is obtained with published experimental measurements. T.K.

A84-35017#

EXPERIMENTAL INVESTIGATION OF WALL INTERFERENCE AND TWO-DIMENSIONALITY OF THE FLOW IN A TRANSONIC AIRFOIL WIND TUNNEL

TH. HOTTNER (Stuttgart, Universitaet, Stuttgart, West Germany) and N. ZHANG Northwestern Polytechnical University, Journal, vol. 2, April 1984, p. 151-162. In Chinese, with abstract in English. refs

An experimental investigation in an airfoil wind tunnel to determine the effect of the ratio of the half height of the test section (S) to the airfoil chord (L) on the flow around airfoils is reported. The results indicate that, for Mach number smaller than 0.75, the S/L ratio can be reduced to 1.25 without introducing significant model blockage interference effects. However, satisfactory results for the lift coefficient were not obtained for experiments involving angle of attack and S/L less than 1.5. The two-dimensionality of the flow around airfoils was studied in order to ascertain the effects of the side wall interference at the test section. The results indicate that, for angle of attack of 6 or 8 deg, the two-dimensionality is very inferior for S/L = 1.5 as compared to S/L = 2.0. C.D.

A84-35018#

A STUDY ON THE BETWEEN-STAGE FLOW PATTERN OF AN AXIAL-FLOW COMPRESSOR WITH INLET DISTORTION - CALCULATION METHOD FOR AND EXPERIMENTAL RESEARCH ON INLET DISTORTION TRANSMISSION

W. LI, M. CONG, and F. CHEN Northwestern Polytechnical University, Journal, vol. 2, April 1984, p. 163-174. In Chinese, with abstract in English. refs

A numerical method for calculating an unsymmetrical between-stage flow of a multistage axial-flow compressor with inlet distortion is presented. The effects of circumferential velocity fluctuation and of flow unsteadiness are taken into account. An actuator-disk/crossflow/hysteresis model is developed and experimentally verified using a turbojet engine with a nine-stage axial-flow compressor. The inlet distortion caused by the screen and the circumferential profiles of the total and static pressures and of the total temperature at the inlet, exit, and interstages of the compressor are measured for engine speeds of 98.9, 93.3, 90, and 87 percent of the engine design speed. Comparison of predicted results with the experimental data shows that the introduction of crossflow and unsteady effects into the model provides better prediction results. C.D.

A84-35023#

AN APPROXIMATE ANALYTICAL SOLUTION OF INCOMPRESSIBLE POTENTIAL FLOW AROUND A CIRCULAR CYLINDER BETWEEN TWO PARALLEL FLAT PLATES

C. Q. LIN (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) (Northwestern Polytechnical University, Journal, vol. 2, no. 2, 1984) Northwestern Polytechnical University, English Translation of Selected Papers, ET-11, April 1984, p. 1-9. Translation.

An approximate analytical solution of incompressible potential flow around a circular cylinder between two parallel flat plates is given in the present paper. The Joukowski transformation is first used by which the circular cylinder is mapped into a secant along the streamline, and the plates into walls of a channel with variable cross sections. Then the solution of the problem is obtained by using the asymptotic expansion of stream function for a slender channel. The accuracy of this approximate analytical solution is fairly good. Author

A84-35173#

COMPUTATIONAL DESIGN AND VALIDATION TESTS OF ADVANCED CONCEPT SUBSONIC INLETS

T. J. BARBER (United Technologies Research Center, East Hartford, CT), D. C. IVES, D. P. NELSON, and R. M. MILLER (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. refs

(AIAA PAPER 84-1329)

A NASA/industry cooperative program was established to develop new computational methodologies for subsonic inlet design, and to demonstrate them in the design of several configurations. The program produced three P and W designs that were tested at NASA Langley Research Center. The basic computational methods were corroborated by the test results through comparisons with the predicted surface pressure distributions as well as with the calculated total drag coefficient. Furthermore, the analysis and test program demonstrated that the use of laminar shock free concepts in combination with an inverse analysis can produce performance improvements over conventionally designed inlets. Author

A84-35175*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FLOW-FIELD INVESTIGATION OF A SUPERCRUISE FIGHTER MODEL

D. E. REUBUSH, E. A. BARE, S. F. YAROS (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA), and J. A. YETTER (NASA, Langley Research Center, Hampton, VA; Boeing Military Airplane Co., Seattle, WA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 13 p. refs

(AIAA PAPER 84-1331)

A NASA Langley investigation was conducted in the 16-foot Transonic Tunnel to survey the flow field around a model of a Supersonic cruise fighter configuration. In this investigation, a model of a supersonic cruise fighter configuration formerly utilized in afterbody-nozzle performance investigations was surveyed with a single, multiholed probe to determine local values of angle of attack, side flow, and Mach number. The investigation was conducted at Mach numbers of 0.6, 0.9, and 1.2 at angles of attack from 0 to 10 deg. The purpose of the investigation was to provide a data base of experimental data for use in verification of theoretical methods, and to compare the experimental data with predictions from currently available theoretical techniques. Results from this investigation show that local angles of attack were generally greater than free stream above the wing and generally less than free stream below the wing. Also there were large spanwise gradients above the wing at the higher angles of attack. The comparisons of experimental data with theoretical predictions show that the theoretical techniques give a qualitative estimate of the flow-field but will require much work to give good quantitative results. Author

A84-35190#

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

C. C. WU (California State University, Los Angeles, CA) and W. L. CHOW (Illinois, University, Urbana, IL) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. refs

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

(AIAA PAPER 84-1360)

The problem of compressible flow through an asymmetric 2-D convergent nozzle is solved by employing the method of hodograph

transformation, coupled with finite-difference computation. With the given appropriate flow parameters, the solution is first established in the hodograph domain. The corresponding nozzle configuration and local flowfield properties are subsequently obtained through direct integration. The vector-thrust performance and configuration design under certain constraints are also presented. Wind tunnel experiments are also conducted to obtain pressure data along the nozzle walls for verification purposes. The numerical results are found to be in good agreement with the measured data.
Author

A84-35192*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL SIMULATION OF FLOW THROUGH INLETS/DIFFUSERS WITH TERMINAL SHOCKS
N. A. TALCOTT, JR. and A. KUMAR (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, VA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p. refs
(AIAA PAPER 84-1362)

Two-dimensional Euler and Navier-Stokes solutions of the flow through three inlet/diffuser configurations with terminal shock systems are reported. Calculations without bleed indicate that the terminal shock location is very sensitive to the outflow back pressure. For cases where there are no available experimental results, it becomes difficult to estimate the back pressure that will result in a terminal shock. Estimates based on quasi-one-dimensional analysis are not found adequate for complex two-dimensional flows. It is found that since the flow downstream of the terminal shock is subsonic, and what happens at the outflow boundary affects the flow inside the inlet, enough of the subsonic diffuser must be modeled to accurately predict the terminal shock region. The diffuser portion should be fairly long with the outflow boundary occurring in a region of more or less uniform flow to be able to prescribe a uniform back pressure. The third configuration studied was investigated with and without incorporating bleed in the code. It is found that the use of bleed stabilizes the shock location and allows solutions which without bleed result in unstarting of the inlet. Comparisons are made with available experimental data.
Author

A84-35193#
NUMERICAL COMPUTATION OF THE REYNOLDS STRESS IN SUPERSONIC INLET FLOWS
Y. OBIKANE (Universe Research Co., Ltd., Tokyo, Japan) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. refs
(AIAA PAPER 84-1364)

The prediction of the Reynolds stress in an axisymmetric supersonic inlet flow is demonstrated. To predict the Reynolds stress a computational method and a second order turbulence model have been proposed. For the bench mark test of the turbulence model, a supersonic compression corner flow is computed. The bench mark results agree qualitatively with the experiment. The simple method is quite practical and useful for designers who treat properties related to turbulent kinetic energy, such as the flows in ramjet engines or the prediction of noise generated from the tips of the fan.
Author

A84-35234#
STEADY AND UNSTEADY DISTORTED INLET FLOW SIMULATION FOR ENGINE GROUND TESTS
J. R. BION (ONERA, Chatillon-sous-Bagneux, Hauts-de-Seine, France) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 7 p.
(AIAA PAPER 84-1490)

During the early stages of gas turbine engine compressor development, a designer must ascertain the surge margin reduction which can result from inlet flow distortions over the entire range of an aircraft's flight envelope. Since theoretical methods have yet to be developed for such surge margin determinations, ground test methods have become indispensable. Attention is given to the use of a bellmouth with various leading edges to simulate inlet flow distortions in a ground test apparatus. It is shown that airstream separations identical to those of a cylindrical duct at a high angle of attack are obtainable by this means.
O.C.

A84-35239#
A LINEAR MULTIVARIABLE DYNAMICAL MODEL OF SUPERSONIC INLET-ENGINE COMBINATION
Y. GUAN, S. YARNG (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China), and J. YARNG AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 12 p. refs
(AIAA PAPER 84-1496)

A linear multivariable dynamical model of supersonic inlet-engine combination, both in the form of state-space and frequency domain and its simulation, is presented. The inlet portion is modeled by applying and extending Willoh's method of inlet dynamical analysis with piecewise lumped-volumes of subsonic duct to the case both of downstream and upstream perturbations. The portion of engine is primarily modeled on the linearized one-dimensional channel flow with experimental data of engine components considering variable specific heat of gas. The steady-state flow matching of the inlet and the engine is carried out by varying the opening of the bypass doors. The stiff differential equations of the model are solved by the combined Newton-Raphson and Runge-Kutta methods with different time steps for different time intervals. Then, the dynamics of the NASA 48-cm inlet - J85 engine combination is digitally simulated.
Author

A84-35302* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL AERODYNAMICS AND DESIGN
W. F. BALLHAUS, JR. (NASA, Ames Research Center, Moffett Field, CA) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 1-20. refs

The role of computational aerodynamics in design is reviewed with attention given to the design process; the proper role of computations; the importance of calibration, interpretation, and verification; the usefulness of a given computational capability; and the marketing of new codes. Examples of computational aerodynamics in design are given with particular emphasis on the Highly Maneuverable Aircraft Technology. Finally, future prospects are noted, with consideration given to the role of advanced computers, advances in numerical solution techniques, turbulence models, complex geometries, and computational design procedures. Previously announced in STAR as N82-33348
B.J.

A84-35307
FLOW SIMULATION BY DISCRETE VORTEX METHOD
K. OSHIMA (Tokyo, University, Tokyo, Japan) and Y. OSHIMA (Ochanomizu University, Tokyo, Japan) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 94-106. refs

Applicability of discrete vortex approximation was tested experimentally for four types of flow conditions; an oscillating airfoil, roll-up of wake vortex layer originated from an oscillating plate, an impulsively started flat plate with an angle-of-attack and a two-dimensional rotating elliptic airfoil. Detailed flow visualization reveals the mechanism of creation, growth and migration of vortices and the comparison with those predicted by discrete vortex method has been done. It is concluded that this numerical simulation method is most useful to predict global feature of the flow fields and care must be taken not to excessively increase the spacial and time resolution.
Author

A84-35309* New York Univ., New York.
SIMULATION OF THE FLUCTUATING FIELD OF A FORCED JET
A. BAYLISS (New York University, NY), L. MAESTRELLO (NASA, Langley Research Center, Hampton, VA), and E. TURKEL (Tel Aviv University, Tel Aviv, Israel) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 131-137. refs
(Contract NAS1-14471; NAS1-16394; DE-AC02-76ER-03077; AF-AFOSR-76-2881)
The fluctuating field of a jet excited by transient mass injection is simulated numerically. The model is developed by expanding the state vector as a mean state plus a fluctuating state. Nonlinear terms are not neglected and the effect of nonlinearity is studied. The results show a significant spectral broadening in the flow field due to the nonlinearity. In addition, large scale structures are broken down into small scales. Previously announced in STAR as N82-34191 Author

A84-35311* United Technologies Research Center, East Hartford, Conn.
ANALYSIS OF SEPARATED BOUNDARY-LAYER FLOWS
J. E. CARTER and V. N. VATSA (United Technologies Research Center, East Hartford, CT) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 167-174. Army-NASA-Navy-supported research. refs
A method for predicting the strong interaction between the viscous and inviscid flows which occurs in flow separation is reviewed. An inverse boundary-layer procedure approximately accounts for normal pressure gradients that may be important in strongly interacting flows. Transformed boundary-layer equations are written in which the pressure gradient is set equal to the inviscid pressure gradient. As the boundary-layer edge is approached and the viscous shear and heat conduction terms vanish, the viscous flow solution is required to asymptotically approach the inviscid solution over the generalized displacement body. Attention is then focused on viscous-inviscid interacting flows with a first-order viscous formulation and constant pressure across the boundary layer. Results obtained with this procedure are presented for: (1) transitional separation bubbles near an airfoil leading edge, (2) subsonic boattail separated turbulent flow, and (3) transonic turbulent shock wave boundary-layer interaction on an axisymmetric bump configuration. J.N.

A84-35317
COMPUTATION OF INVISCID TRANSONIC INTERNAL FLOW
U. GIESE (Aachen, Reinisch-Westfalische Technische Hochschule, Aachen, West Germany) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 217-223. refs
Compressible internal flows are studied with an implicit finite difference solution of the full potential equation in conservative form. For numerical stability in supersonic regions an artificial compressibility formulation is introduced. Boundary fitted curvilinear coordinates are used which are stretched in order to cope with regions of strong gradients. The equations are solved by an approximate factorization technique. Results are presented for nozzle flow and for flows through valve inlets with different wall contours. Some results are compared with Mach-Zehnder Interferograms. Author

A84-35325* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC-FLOW COMPUTATION USING AN EXPLICIT-IMPLICIT METHOD
W. KORDULLA (NASA, Ames Research Center, Moffett Field, CA; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Theoretische Stroemungsmechanik, Goettingen, West Germany) and R. W. MACCORMACK (NASA, Ames Research Center, Moffett Field, CA; Washington, University, Seattle, WA) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 286-295. refs
The explicit-implicit predictor corrector method of MacCormack (1981) is applied to the analysis of flows past airfoils. By comparing results obtained with different methods and meshes, it is shown that the above method provides, after certain modifications, reasonably good predictions of inviscid and viscous flows about an airfoil. Good results are also obtained for the transonic regime if the free-stream conditions are correct and if a suitable mesh is used. V.L.

A84-35326
NUMERICAL SOLUTION OF TRANSONIC SHEAR FLOWS PAST THIN BODIES
K. KOZEL, J. POLASEK, and M. VAVRINCOVA (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 302-307. refs
A numerical solution method was developed for three-dimensional inviscid steady shear flows past thin bodies in a tunnel or through a cascade. A governing equation is derived from perturbation theory and the problem is solved by a finite-difference technique. The system of difference equations is then solved by a modification of the successive line relaxation method. Results are presented for transonic shear flows past a NACA 0012 profile in a tunnel with free-stream Mach number equal to 0, 73 + 0, and 6z/LZ with z between 0 and LZ. Results are also given for transonic shear flows through a cascade with stagger angle beta = pi/2, p/c = 2 and for flow past a system of bodies in a tunnel with cascade geometry. J.N.

A84-35328
MESH GENERATION STRATEGIES FOR CFD ON COMPLEX CONFIGURATIONS
S. LEICHER, W. FRITZ, J. GRASHOF, and J. LONGO (Dornier GmbH, Friedrichshafen, West Germany) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 329-334. refs
An overview of different mesh generation methods in use and under further development at Dornier will be given. Some presented examples (e.g. air intakes, fuselages, wings, wing-fuselage combinations and other related technical combinations) demonstrate the capability of mesh generation techniques to make possible complex three-dimensional flowfield computations. All methods described have in common contour-conformal meshes, i.e. the body surface is a coordinate surface. From the topological point of view two grid types are discerned: single block grids and multi-block structured grids. For both grid types different mesh types like H-H, C-H, O-O or C-O meshes can be used. Each mesh can be generated by one of the described methods. Author

A84-35330
FINITE DIFFERENCE COMPUTATION OF PRESSURE AND WAVE-DRAG OF SLENDER BODIES OF REVOLUTION AT TRANSONIC SPEEDS WITH ZERO-LIFT
S.-Y. LI and S.-J. LUO (Northwestern Polytechnical University, Xian, Shaanxi, People's Republic of China) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 350-356. refs

The pressure, the wave-drag and the positions of shock-wave of slender bodies of revolution at transonic speeds with zero-lift are obtained by solving the transonic axisymmetric potential equation with large disturbance in the free stream direction and small disturbance in the transverse direction, using the Murman-Cole schemes of finite differences. The computed results for three different configurations agree well with known wind tunnel test results. A linearized analysis of the stability and the convergence of line overrelaxation of the difference equations for steady axisymmetric small perturbation potential flow is made. The numerical experiences do agree with the theoretical conclusions. Author

A84-35334* Ohio State Univ., Columbus.
NONITERATIVE GRID GENERATION USING PARABOLIC DIFFERENCE EQUATIONS FOR FUSELAGE-WING FLOW CALCULATIONS
S. NAKAMURA (Ohio State University, Columbus, OH) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 396-401.
(Contract NCA2-OR-565-101)

A fast method for generating three-dimensional grids for fuselage-wing transonic flow calculations using parabolic difference equations is described. No iterative scheme is used in the three-dimensional sense; grids are generated from one grid surface to the next starting from the fuselage surface. The computational procedure is similar to the iterative solution of the two-dimensional heat conduction equation. The proposed method is at least 10 times faster than the elliptic grid generation method and has much smaller memory requirements. Results are presented for a fuselage and wing of NACA-0012 section and thickness ratio of 10 percent. Although only H-grids are demonstrated, the present technique should be applicable to C-grids and O-grids in three dimensions. J.N.

A84-35340
NUMERICAL SOLUTION OF VISCOUS FLOW AROUND ARBITRARY AIRFOILS IN A STRAIGHT CASCADE
M. ROSENFELD and M. WOLFSHTEIN (Technion - Israel Institute of Technology, Haifa, Israel) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 433-439. refs

A two-dimensional separated flow field around aribtrary airfoils arranged in a straight cascade is computed assuming isothermal and laminar flow. Only steady flow is considered, thus excluding the possibility of resolving unsteady separation which usually persists at high Reynolds numbers and is mostly turbulent. Finite difference solutions are obtained for the elliptic vorticity and stream function equations in nonorthogonal curvilinear coordinates. V.L.

A84-35344
EULER SOLUTIONS AS LIMIT OF INFINITE REYNOLDS NUMBER FOR SEPARATION FLOWS AND FLOWS WITH VORTICES
W. SCHMIDT and A. JAMESON (Dornier GmbH, Friedrichshafen, West Germany; Princeton University, Princeton, NJ) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 468-473. refs

A combination of a finite volume discretisation in conjunction with carefully designed dissipative terms of third order, and a fourth order Runge Kutta time stepping scheme, is shown to yield an efficient and accurate method for solving the time-dependent Euler equations in arbitrary geometric domains. Convergence to the steady state has been accelerated by the use of different techniques described briefly. The main attempt of the present paper however is the demonstration of inviscid compressible flow computations as solutions to the full time dependent Euler equations over two- and three-dimensional configurations with separation. It is clearly shown that in inviscid flow separation can occur on sharp corners as well as on smooth surfaces as a consequence of compressibility effects. Results for non-lifting and lifting two- and three-dimensional flows with separation from round and sharp corners are presented. Author

A84-35351
NUMERICAL SOLUTION OF THE PROBLEM OF SUPERSONIC FLOW PAST WINGS OF ARBITRARY FORM WITH A DETACHED SHOCK WAVE
G. P. VOSKRESENSKII (Akademiia Nauk SSSR, Institut Prikladnoi Matematiki, Moscow, USSR) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 513-518.

A numerical method has been developed to calculate supersonic inviscous gas flow around wings of arbitrary form with a shock wave detached from the leading edge. The solution domain is divided into three subdomains. A total algorithm is formed from the specific ones of each subdomains, depending on the wing configuration. For the front part of the wing where the flow is subsonic and supersonic the problem is solved by using the time-dependent stationary principle. The remaining parts of the wing including its tip side are treated as three-dimensional stationary cases. A number of test cases are computed for the flow around the wings of various configurations. Author

A84-35354
NUMERICAL SOLUTION OF THE EULER EQUATION FOR A COMPRESSIBLE FLOW PROBLEM
S. M. YEN and S. H. LEE (Illinois, University, Urbana, IL) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 539-545.

The objective of the present work is to find the numerical solution of the Euler equation for a triconic body in compressible flow. The implicit factored scheme which was developed by Beam and Warming (1977) was used to solve the Navier-Stokes equations. Computations were made using the version of the AIR3D Navier-Stokes Computer Program (developed at NASA/AMES) adapted by Nietubicz (1979) for an azimuthally invariant thin layer. The major effort was in developing a mesh system adaptable to the triconic body, as well as to the flow features encountered in the compressible flow regime. Also, the implementation of boundary conditions was studied very carefully. Author

A84-35497
LINEAR PROBLEM OF A VIBRATOR OSCILLATING HARMONICALLY AT SUPERCRITICAL FREQUENCIES IN A SUBSONIC BOUNDARY LAYER [LINEINAIA ZADACHA O VIBRATORE, SOVERSHAIUSHCHEM GARMONICHESKIE KOLEBANIIA NA ZAKRITICHESKIKH CHASTOTAKH V DOZVUKOVOM POGRANICHNOM SLOE]
E. D. TERENTEV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 48, Mar.-Apr. 1984, p. 264-272. In Russian. refs

An analysis is made of a subsonic flow past a flat plate with a triangular vibrator which commences to oscillate in an unperturbed boundary layer. The method used is based on the Fourier transformation with respect to the longitudinal coordinate and the Laplace transformation with respect to time. The pressure-oscillation amplitude dependent on the longitudinal coordinate is determined. When the vibrator frequency is less than the critical frequency, the amplitude is damped both upstream and downstream; when these two frequencies are equal, there is damping upstream but not downstream; when the vibrator frequency is greater than the critical frequency, the amplitude is damped upstream but increases downstream. With distance from the vibrator downstream, the perturbations degenerate into a Tollmein-Schlichting wave whose amplitude depends on the vibrator frequency. B.J.

A84-35653#

NUMERICAL PREDICTIONS OF INTERNAL FLOWS USING A DIAGONALIZED FLUX VECTOR SPLITTING ALGORITHM

E. VON LAVANTE and J. TREVINO (Texas A & M University, College Station, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 7 p. refs
(AIAA PAPER 84-1246)

A diagonal form of the flux vector splitting algorithm has been developed which is computationally more efficient than the standard form, yet retains its robustness and stability characteristics. The present algorithm has been applied to solutions of the Euler equations in general, body-fitted coordinates for several internal flow geometries. The results obtained indicate that although the algorithm's stability limit was 0(1), it exhibited fast convergence. Its strong natural dissipation may be advantageous in the presence of strong shocks. O.C.

A84-35682

HANG GLIDING [DEL'TAPLANERIZM]

V. G. OSTASHOV Novosibirsk, Izdatel'stvo Nauka, 1983, 112 p. In Russian. refs

An examination of the principles of flexible wing aerodynamics introduces formulas for calculating important aerodynamic characteristics and reviews the stability and controllability of hang gliders. Several means of improving aerodynamic characteristics are suggested, and attention is given to increased safety for flutter dive and flight in tow. A discussion of weather factors, air currents, and atmospheric turbulence with an application to hang gliding is also included. Equations are provided for determining the cut of a sail-wing of arbitrary form, calculating the geometry of a cylindrical wing, and selecting the load-bearing structure for a hang glider with an auxiliary motor. Attention is also given to safe construction techniques, parachutes, and pilot preparation. J.N.

A84-35730

FRICTION AND HEAT TRANSFER IN LAMINAR AND TURBULENT BOUNDARY LAYERS IN THE CASE OF NONUNIFORM SUPERSONIC FLOW PAST AXISYMMETRIC BODIES [TRENIE I TEPLOOBMEN V LAMINARNOM I TURBULENTNOM POGRANICHNYKH SLOIAKH PRI OBTEKANII OSESIMMETRICHNYKH TEL NEODNORODNYM SVERKHZVUKOVYM POTOKOM]

I. G. EREMEITSEV and N. N. PILIUGIN Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1984, p. 65-72. In Russian. refs

A theoretical study is made of the supersonic flow of a heated gas past an axisymmetric blunt body. General formulas are derived for heat fluxes and shear stress in laminar and turbulent boundary layers in cases of uniform and nonuniform flow past the body. As an example, a nonuniform gas flow past a spherically blunt body is examined in detail. B.J.

A84-35734

HYSTERESIS OF SUPERSONIC SEPARATED FLOWS [O GISTEREZISE SVERKHZVUKOVYKH OTRYVNYKH TECHENII]

A. I. GUZHAVIN and IA. P. KOROBOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1984, p. 116-125. In Russian. refs

Wind-tunnel-test results on the hysteresis of supersonic separated flows are examined. It is shown that various hysteresis phenomena in aerodynamics have a common nature, consisting in the spontaneous avalanche restructuring of the flow. The specific mechanisms of flow restructuring can vary widely. At supersonic velocities, an important role is played by the formation and disappearance of supercritical flow regions in zones of the reconnection of viscous mixing layers. At subsonic velocities, the hysteresis is similarly connected with flow instability and its spontaneous transition to a new stable state. B.J.

A84-35735

NUMERICAL ANALYSIS OF SEPARATED LAMINAR VISCOUS-GAS FLOWS IN THE CASE OF SUPERSONIC FLOW PAST BODIES WITH LEADING SPIKES [CHISLENNOE ISSLEDOVANIE OTRYVNYKH LAMINARNYKH TECHENII VIAZKOGO GAZA PRI SVERKHZVUKOVOM OBTEKANII TEL S PEREDNIMI IGLAMI]

V. M. PASKONOV and N. A. CHERANEVA Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1984, p. 126-131. In Russian. refs

The complete Navier-Stokes equations for a compressible viscous ideal heat-conducting gas are used to perform a numerical study of separated laminar flows in the case of supersonic axisymmetric flow past cylinders with a conical tip and a leading spike of finite thickness. The flow structure is analyzed in relation to spike length and the semi-angle of the conical tip of the cylinder. The existence of steady-state flow regimes is established for freestream Mach numbers of 2-6, freestream Reynolds numbers of 100-500, and spike lengths not exceeding the cylinder diameter. It is also shown that the presence of the spike in front of the body reduces the total drag of the body and the heat flux to the surface. B.J.

A84-35736

PROPULSIVE EFFICIENCY OF AN OSCILLATING WING IN SUPERSONIC FLOW [O PROPUL'SIVNOM K.P.D. VIBRIRUIUSHCHEGO KRYLA V SVERKHZVUKOVOM POTOKE]

M. N. KOGAN and M. V. USTINOV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1984, p. 132-139. In Russian.

A simplified approach is developed for the analysis of the propulsive efficiency of an oscillating wing in supersonic flow. Two problems are solved: (1) the problem of determining the minimum power necessary for obtaining prescribed lift and thrust forces; and (2) the problem of determining the maximum power acquired by the wing from the flow for a given drag. The analysis is carried out in the framework of linear supersonic-flow theory. B.J.

A84-35742

HYPERSONIC SIMILARITY IN THE FLOW PAST A COMBINATION OF A CIRCULAR CONE AND DELTA WING [O GIPERZVUKOVOM PODOBII PRI OBTEKANII KOMBINATSII KRUGOVOGO KONUSA I TREUGOL'NOGO KRYLA]

V. E. MAKAROV Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Mar.-Apr. 1984, p. 188-190. In Russian. refs

A stationary analog of the Godunov difference method is used to analyze flows past various configurations consisting of a circular cone and a delta wing with supersonic leading edges. Shocks and characteristic surfaces bounding the region of conical flow are identified. The validity of the hypersonic similarity law for such flows is confirmed with respect to both integral and local flow parameters. B.J.

A84-35876

FIRST EXPERIMENTAL EVIDENCE OF VORTEX SPLITTING

P. FREYMUTH, W. BANK, and M. PALMER (Colorado, University, Boulder, CO) Physics of Fluids (ISSN 0031-9171), vol. 27, May 1984, p. 1045, 1046. refs
(Contract AF-AFOSR-81-0037)

Attention is given to the smoke visualization of an accelerating airflow around a NACA 0015 airfoil after start from rest. A moving picture sequence is obtained for the vortex patterns generated by the airfoil in the smoke, which indicates the process of vortex splitting predicted by Moore and Saffman (1971) and by Christiansen and Zabuski (1973) for some flows. O.C.

A84-36460
INVESTIGATION OF TRANSITION FROM LAMINAR TO TURBULENT BOUNDARY LAYER FLOW BY MEANS OF A THERMAL IMAGING SYSTEM
M. A. GOLOVKIN, V. P. GORBAN, V. B. DOROKHOV, V. M. LUTOVINOV, V. S. PONOMAREVA, A. A. POSKACHEI, V. I. SUKHAREV, V. V. TROITSKII, and S. M. SHESTAEV (TsAGI, Uchenye Zapiski, vol. 14, no. 2, 1983, p. 48-57) Fluid Mechanics - Soviet Research (ISSN 0096-0764), vol. 12, Mar.-Apr. 1983, p. 110-120. Translation. refs
The potential of a thermal imaging system for investigating boundary-layer flow on a wing at low free-stream velocities is examined. Recording of thermal radiation from the surface of a rectangular wing makes it possible to define the position of transition from laminar to turbulent flow in the boundary layer at flow velocities between 10 and 30 m/sec. The results of this study are compared with those obtained by other methods.
Author

N84-24537*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UNSTEADY LAMINAR BOUNDARY-LAYER CALCULATIONS ON OSCILLATING CONFIGURATIONS INCLUDING BACKFLOW. PART 2: AIRFOIL IN HIGH-AMPLITUDE PITCHING MOTION. DYNAMIC STALL
W. GEISSLER Jul. 1983 58 p refs
(NASA-TM-84319-PT-2; A-9403; NAS 1.15:84319-PT-2) Avail: NTIS HC A04/MF A01 CSCL 01A
A previously developed finite-difference procedure for calculating unsteady, incompressible, laminar boundary layers on an oscillating flat plate is applied to a wing section undergoing high-amplitude pitching oscillations about various mean incidences. To start the entire boundary-layer calculation, appropriate initial conditions and outer boundary conditions are specified, using a stagnation-point fixed frame of reference. The breakdown of the numerical calculation procedure in the x,t-domain is interpreted to coincide with unsteady separation. Details of the boundary-layer behavior in the vicinity of separation are investigated, and a close analogy between the present results and those for a three-dimensional steady separation is found.
Author

N84-24538*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROPROPULSIVE CHARACTERISTICS OF NONAXISYMMETRIC-NOZZLE THRUST REVERSERS AT MACH NUMBERS FROM 0 TO 1.20
G. T. CARSON, JR., F. J. CAPONE, and M. L. MASON May 1984 126 p refs
(NASA-TP-2306; L-15724; NAS 1.60:2306) Avail: NTIS HC A07/MF A01 CSCL 01A
An investigation was conducted in the Langley 16-Foot Transonic Tunnel to determine the performance of nonaxisymmetric-nozzle thrust reversers installed on a generic twin-engine fighter aircraft model. Test data were obtained at static conditions and at Mach numbers from 0.15 to 1.20 with jet exhaust simulated by high pressure air. Results showed that reverse-thrust levels of greater than 50 percent at static conditions and greater than 30 percent at in-flight conditions could be achieved. Internal reverser-port passage length was found to be very important in improving reverser performance. Increasing the reverser-port passage length improved reverse-thrust performance by as much as 28 percent at static conditions and by as much as 17 percent at Mach 1.20.
Author

N84-24539*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATION OF TRANSONIC FLOW IN A LINEAR CASCADE
L. F. DONOVAN 1984 13 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83697; E-2155; NAS 1.15:83697) Avail: NTIS HC A02/MF A01 CSCL 01A
Turbomachinery blade designs are becoming more aggressive in order to achieve higher loading and greater range. New analysis tools are required to cope with these heavily loaded blades that may operate with a thin separated region near the trailing edge on the suction surface. An existing, viscous airfoil code was adapted to cascade conditions in an attempt to provide this capability. Comparisons with recently obtained data show that calculated and experimental surface Mach numbers were in good agreement but loss coefficients and outlet air angles were not.
Author

N84-24540*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NAVIER-STOKES CALCULATIONS FOR THE VORTEX OF A ROTOR IN HOVER
C. H. LIU, J. L. THOMAS (NASA Langley Research Center), and C. TUNG (Army Research and Technology Labs.) May 1984 11 p refs Previously announced in IAA as A83-37184
(NASA-TM-85894; A-9611; NAS 1.15:85894; USAAVSCOM-TR-4-A-3) Avail: NTIS HC A02/MF A01
An efficient finite-difference scheme for the solution of the incompressible Navier-Stokes equation is used to study the vortex wake of a rotor in hover. The solution Procedure uses a vorticity-stream function formulation and incorporates an asymptotic far-field boundary condition enabling the size of the computational domain to be reduced in comparison to other methods. The results from the present method are compared with experimental data obtained by smoke flow visualization and hot-wire measurements for several rotor blade configurations.
Author

N84-24541# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Flaechenflugzeuge.
FLIGHT MECHANICAL ANALYSIS OF DYNAMIC DERIVATIVES OF THE DORNIER VARIATION WIND TUNNEL MODEL
D. ALTENKIRCH Nov. 1983 119 p refs In GERMAN; ENGLISH summary Also announced as translation (ESA-TT-854)
(DFVLR-FM-83-38; ESA-TT-854) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 38
Wind-tunnel measurements with a principal fighter-type aircraft model on a dynamic balance are discussed. The principal fuselage with closed engine inlets could be combined with three wing configurations, swept back wing, rhombic wing and delta wing and additional horizontal and vertical stabilizer modifications. One more variation could be made by a strake. The aim of this investigation is measuring the influence of wing shape, stabilizer configuration and strake on the dynamic derivatives of the longitudinal and lateral motion and to compare these results with theoretical computations. This comparison made it obvious, that existing theoretical methods could not describe special physical phenomena, which occur at higher angles of attack.
R.J.F.

N84-24542# Bristol Univ. (England). Dept. of Aeronautical Engineering.
WAKE VISUALIZATION B.S. Thesis
S. N. EDLUND and P. D. LUCAS Jun. 1983 65 p refs Original contains color illustrations
(BU-282) Avail: NTIS HC A04/MF A01
The objective of this project was to design, build and test a Wake Imaging System, based on a scheme proposed by the Boeing Aircraft Company Aerodynamic Laboratories. A pitot probe, behind which were grouped three small colored light sources, was traversed in a plane behind a wind tunnel model. The lights were lit in regions of predefined pressure loss. A long exposure

photograph recorded the position of the lights, revealing total pressure contours in the wake. The Wake Imaging System was successful, resulting in a series of pictures of the flow behind three airfoils of varying planform. These yielded useful information about the extent of the wake and required much less time and computing effort than conventional methods. This report follows the progression towards the final system configuration. The effects of certain parameters are discussed, and recommendations are made for further development. Author

N84-24544# Bristol Univ. (England). Dept. of Aeronautical Engineering.
AN INVESTIGATION INTO THE NATURE AND CONTROL OF VORTEX FLOW ROUND HELICOPTER UPSWEEP B.S. Thesis
A. E. GIBSON and P. F. NEWRICK Jun. 1983 54 p refs
(BU-285) Avail: NTIS HC A04/MF A01

The nature of the vortex flow around a helicopter fuselage with a view to flow control is examined. Tests are carried out with a specific fuselage configuration known to exhibit the flow change. Wind tunnel tests are performed on a one fifth scale model of a Westland Lynx helicopter. The effects of adding strakes, spoilers and flow deflectors to the rear fuselage are studied in order to find an optimum method of controlling the vortex flow. The strakes and spoilers had only a marginal effect. The deflector prevents the flow change from occurring, at least within the incidence range investigated, at the expense of incurring flow instability at positive helicopter incidences. M.A.C.

N84-24545# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THE EFFECT OF PERFORATION ON THE AERODYNAMICS OF A SPOILER B.S. Thesis
M. L. LANGE-SMITH and N. MEADOWS Jun. 1983 61 p refs
(BU-286) Avail: NTIS HC A04/MF A01

The aerodynamic characteristics of perforated spoilers mounted on a flat plate are investigated. Various perforation patterns are tested, with the emphasis on recording the pressure response on spoiler opening, establishing the static pressure distribution on the plate either side of the spoiler, as well as attempts at flow visualization. Measurement of the static pressures enabled the calculation of a force coefficient, which served as a measure of the influence of each spoiler on the overall pressure field. Perforation which gives a simple throughflow of air is not sufficiently effective. Significant improvements are achieved with a design for aeration of the spoiler which gives a preferred direction to the throughflow of air. The penalty in introducing perforation to a spoiler is a reduction in its spoiling effectiveness. M.A.C.

N84-24547# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THE AERODYNAMIC EFFECTS OF CAVITIES IN A BODY B.S. Thesis
A. L. MOONEY and J. G. C. POWELL Jun. 1983 29 p refs
(BU-289) Avail: NTIS HC A03/MF A01

The aerodynamic effects of cavities in a fuselage body were investigated. The tests were carried out for an incidence range of - 5 deg to 12 deg and for three fuselage/cavity configurations. The Reynolds number, based on model length, was 1 million. Overall force and moment coefficients were obtained which showed little change in pitching moment due to the presence of cavities, but increased in lift and drag. Pressure coefficients showed the flow in a cavity to be largely independent of the other cavities present. R.J.F.

N84-24549# Bristol Univ. (England). Dept. of Aeronautical Engineering.
AN INVESTIGATION INTO ANTI-SWIRL DEVICES FOR S-SHAPED AIR INTAKES B.S. Thesis
L. D. BACON and J. M. MAGOWAN Jun. 1983 49 p refs
(BU-293) Avail: NTIS HC A03/MF A01

The paper presents the results of an investigation into the effectiveness of streamwise fences as anti-swirl devices for use in an S-shaped duct of typical air intake proportions. Fences were positioded in the first bend of the duct on the lower and outside walls. The effects of twelve configurations of such fences of varying heights have been studied. The swirl characteristics over an incidence range of 10 deg to 30 deg were measured in terms of swirl coefficient (SC sub 60), distortion coefficient (DC sub 60) and pressure recovery. In addition static pressures at the wall were measured either side of the fences. It was found that all fence configurations tested improved the swirl characteristics of the duct (by arresting rotational flow in the first bend), and indeed the swirl direction could be reversed. The configuration consisting of a lower and side fence meeting on the center-line of the duct was found to possess the most favorable characteristics of the configurations tested. B.W.

N84-24551# Bristol Univ. (England). Dept. of Aeronautical Engineering.
A CIRCULATION METER FOR THE MEASUREMENT OF DISCRETE VORTICES B.S. Thesis
L. W. MOLLAN and C. A. WREN Jun. 1983 39 p refs
(BU-300) Avail: NTIS HC A03/MF A01

An instrument was designed and tested to locate, and to measure, the circulation in a discrete vortex. The circulation meter consists of three Conrad type yawmeters, with the facility for radial movement, positioned equally, at 120 deg separation, around a central sphere-static probe. This instrument was shown to produce accurate and consistent results when measuring vortices in low speed flow. R.J.F.

N84-24553# Glasgow Univ. (Scotland). Faculty of Engineering.
AN ALGORITHM FOR THE PREDICTION OF UNSTEADY POTENTIAL FLOW ABOUT AN ARBITRARY AEROFOIL
M. VEZZA and R. A. M. GALBRAITH Oct. 1983 36 p refs
(GU-AERO-8306) Avail: NTIS HC A03/MF A01

A new model is presented for the calculation of the incompressible, inviscid flow around an arbitrary aerofoil undergoing unsteady motion. The numerical algorithm was developed from the steady flow model of Leishman and Galbraith, in which use was made of a linear distribution of panel vorticity, and also using a technique similar to that proposed by Basu and Hancock. A brief history of unsteady flow modelling is given in the introduction, followed by the mathematical details of the current method. Results are presented and discussed for a number of cases which clearly illustrate certain characteristics of unsteady flow. Author

N84-24554# Glasgow Univ. (Scotland). Faculty of Engineering.
AN INVESTIGATION OF THREE-DIMENSIONAL STALL DEVELOPMENT ON NACA 23012 AND NACA 0012 AEROFOILS
L. Y. SETO, J. G. LEISHMANN, and R. A. M. GALBRAITH Jan. 1983 30 p refs
(Contract SERC-E.3131; MOD-2048/026XR/STR)
(GU-AERO-8300) Avail: NTIS HC A03/MF A01

Two airfoil sections, NACA 23012 and NACA 0012 were tested, one (23012) in a subsonic wind tunnel and the other (0012) in a 0.84 m x 1.14 m low speed wind tunnel. Both sections are problematic in respect of their stalling characteristics as they lie on the boundary between two types. Over a range of Reynolds number, the airfoil might have a trailing edge with a gradual forward movement of the point of separation as incidence is increased, or, at some higher Reynolds number, it may exhibit a combined leading and trailing edge type stall. For the latter case the airfoil starts to stall with evident turbulent boundary layer separation moving forward from the trailing edge and the flow breakdown being completed by the bursting of the laminar separation bubble; i.e., the laminar separation of the flow in the leading edge region failing to reattach after transition of the free shear layer to a turbulent one. R.J.F.

N84-24557# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).
STUDY OF AEROSPACE MATERIALS, COATINGS, ADHESIONS AND PROCESSES. AIRCRAFT ICING PROCESSES Final Scientific Report, 15 Jul. 1982 - 14 Sep. 1983
E. M. RODRIGUEZ 14 Sep. 1983 182 p
(Contract AF-AFOSR-0316-82; AF PROJ. 2301)
(AD-A139743; EOARD-TR-84-11-1) Avail: NTIS HC A09/MF A01 CSCL 01D

INTA has been provided with a versatile and powerful FORTRAN Program that permits a full analysis of the trajectories described by the droplets of a cloud with respect to an infinitely long cylinder moving inside it normally to its longitudinal axis. Author (GRA)

N84-24559# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
THE STUDY OF AN IDEALIZED WING/BODY JUNCTION Final Scientific Report, 30 Apr. 1983 - 31 Jan. 1984
G. STRINGFIELD 31 Mar. 1984 61 p
(Contract AF-AFOSR-0127-83; AF PROJ. 2301)
(AD-A139933; VKI-PR-1983-28; EOARD-TR-84-13) Avail: NTIS HC A04/MF A01 CSCL 20D

An experimental study was performed to determine the influence of fairings on the reduction of drag which is produced by the wing-body junction. The wing-body junction was represented by a wing mounted on a flat plate and the junction was contoured by placing different fairing sizes at the wing leading edge and wing trailing edge. The purpose of the experiment was to observe the effect of the different fairing sizes on the wing-body junction aerodynamics. Author (GRA)

N84-24561# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Plasma Dynamics Lab.
ON THE STABILITY OF FLIGHT VEHICLES IN THE LOW REYNOLDS NUMBER NON-LINEAR REGIME Final Report
E. E. COVERT, O. W. K. LEE, and C. M. VACZY Feb. 1984 4 p
(Contract N00014-82-K-0310)
(AD-A140008) Avail: NTIS HC A02/MF A01 CSCL 20D

The first part consists of a literature survey in external fluid mechanics, (i.e., flow over wings and bodies) in the Reynolds number range of 20,000 to 200,000. The second part was a technical review of the material presented at Low Reynolds Number Flow. The third part was a trajectory study for a vehicle flying in the low Reynolds number regime. The trajectory study was initiated as a means of accessing the stability of a vehicle flying under circumstances where: (1) the aerodynamic characteristics are non-linear, and (2) there is coupling between lateral motion (which can induced local stalling) and pitching motion. It is found that for the case studied a modified from of the Liapunov Stability Criteria using a phase-plane, provided a suitable description of the motion. The unstable lateral motion of the vehicle chosen for analysis is shown. The instability is indicated by steady growth of the curve away from any particular point shown on the plane. This work is incomplete in that time did not permit study of reverse interesting features; like the effect of lift curves hysteresis on the motion. GRA

N84-24562# California Univ., Livermore. Lawrence Livermore Lab. Systems, Microwave Measurements and Effects Group.
F-14 SCALE MODEL MEASUREMENTS. PART 1: EXTERNAL RESPONSE
H. G. HUDSON and D. M. WYTHE Jul. 1983 277 p refs
Sponsored in part by Defense Nuclear Agency
(Contract W-7405-ENG-48)
(DE84-008201; AD-B081776; UCID-19944-PT-1) Avail: NTIS HC A13/MF A01

This report documents the work accomplished on the scale model F-14 (referred to hereafter as the model) aircraft and only includes measurements taken to data on the external portions of the model. These measurements are intended to simulate the measurements taken on a full scale F-14 aircraft (referred to hereafter as the F-14) at the Air Force Weapons Laboratory (AFWL). The model was tested in eight different configurations of wing position and field incidence. The various model configurations are detailed for which data were taken. All data are presented and include the impulse responses and their Fourier transforms, the estimated model responses to the incident fields of the AFWL Vertically Polarized Dipole (VPD) and the AFWL Horizontally Polarized Dipole (HPD) simulators compared with the F-14 measurements taken at these simulators and a comparison of our transfer functions with CW measurements taken at the same points at the University of Michigans' anechoic measurement facility. DOE

N84-24563# Sandia Labs., Albuquerque, N. Mex. Aerodynamics Dept.
IMPROVED PREDICTION OF PARACHUTE LINE SAIL DURING LINES-FIRST DEPLOYMENT
J. W. PURVIS Apr. 1984 10 p refs Presented at the 8th AIAA Aerodyn. Declerator and Balloon Technol. Conf., Hyannis, Mass., 2 Apr. 1984
(Contract DE-AC04-76DP-00789)
(DE84-007340; SAND-84-0348C; CONF-840496-9) Avail: NTIS HC A02/MF A01

A numerical deployment simulation with the capability to predict line sail is presented. A finite element approach is used in which both canopy and suspension lines are modeled as flexible, distributed-mass structures connected to a finite-mass forebody. Translation and rotation of both the forebody and the deployment bag are determined from three-degree-of-freedom flight mechanics equations. The model includes all aspects of the deployment problem, such as suspension line aerodynamics, line ties, and canopy/deployment bag friction. The model was verified by comparison with experimental data and used to investigate proposed solutions for a system with a line sail problem. DOE

N84-25631*# McDonnell Aircraft Co., St. Louis, Mo.
JET FLOWFIELDS
D. R. KOTANSKY *In* AGARD Spec. Course on V/STOL Aerodyn. 48 p Apr. 1984 refs
(Contract NAS2-9646; NAS2-10184; NAS2-11161; N62269-76-C-0086; N62269-81-C-0717; N00014-79-C-0130)
Avail: NTIS HC A17/MF A01 CSCL 01A

The unique aero/fluid mechanics of V/STOL jet flowfields both in and out of ground effect and how they influence and may be accommodated in the aircraft design process are described. Key topics addressed include the following: jet development in static and cross-flow conditions, jet impingement (round jets/rectangular jets including nozzle pressure ratio and temperature effects), multiple jet impingement and fountain upwash formation and development (ground surface flows, stagnation lines, fountain characteristics), fountain impingement on the airframe, jet induced effects on the airframe in and out of ground effect including trim and stability considerations, effects of forward (STOL) and cross-wind velocities, and exhaust gas ingestion (VTOL, STOL). Discussion of the above items will include their influence on vehicle design and system performance and their quantification and prediction via theoretical and empirical predictions, and small and large scale wind tunnel tests. Aero/propulsion devices discussed include V/STOL multiple jet lift systems (low and high pressure ratio) and STOL thrust vectoring/reversing nozzles. R.J.F.

N84-25633*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL WIND-TUNNEL TESTING
D. G. KOENIG *In* AGARD Spec. Course on V/STOL Aerodyn. 71 p Apr. 1984 refs
Avail: NTIS HC A17/MF A01 CSCL 01A

Factors influencing effective program planning for V/STOL wind-tunnel testing are discussed. The planning sequence itself, which includes a short checklist of considerations that could enhance the value of the tests, is also described. Each of the considerations, choice of wind tunnel, type of model installation, model development and test operations is discussed, and examples of appropriate past and current V/STOL test programs are provided.

A short survey of the moderate to large subsonic wind tunnels is followed by a review of several model installations, from dimensional to large-scale models of complete aircraft configurations. Model sizing, power simulation, and planning are treated, including three areas in test operations: data acquisition systems, acoustic measurements in wind tunnels, and flow surveying. Author

N84-25635# British Aerospace Public Ltd. Co., Preston (England).
AERODYNAMICS OF V/STOL AIRCRAFT: PERFORMANCE ASSESSMENT
D. C. LEYLAND *In* AGARD Spec. Course on V/STOL Aerodyn. 26 p Apr. 1984 refs
Avail: NTIS HC A17/MF A01

Combat performance assessment of jet-borne V/STOL aircraft of the Harrier/AV8B family is discussed. Performance requirements for vertical takeoff and short takeoff are outlined and reviewed. Parameters considered for vertical operation include: margin for acceleration and maneuver, jet-induced lift losses, hot gas reingestion, and reaction control air bleed. Cruise, vectored thrust, jet lift enhancement, and the accelerating transition maneuver from jet-borne flight to aerodynamic lift are also discussed. R.S.F.

N84-25636*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASSESSMENT OF AERODYNAMIC PERFORMANCE OF V/STOL AND STOVL FIGHTER AIRCRAFT
W. P. NELMS *In* AGARD Spec. Course on V/STOL Aerodyn. 35 p Apr. 1984 refs Previously announced as N84-22536
Avail: NTIS HC A17/MF A01 CSCL 01C

The aerodynamic performance of V/STOL and STOVL fighter/attack aircraft was assessed. Aerodynamic and propulsion/airframe integration activities are described and small-and large-scale research programs are considered. Uncertainties affecting aerodynamic performance that are associated with special configuration features resulting from the V/STOL requirement are addressed. Example uncertainties related to minimum drag, wave drag, high angle of attack characteristics, and power-induced effects. Engine design configurations from several aircraft manufacturers are reviewed. Author

N84-25638 Dayton Univ., Ohio.
ACTIVE SUPPRESSION OF AEROELASTIC INSTABILITIES FOR FORWARD SWEPT WINGS Ph.D. Thesis
T. E. NOLL 1983 127 p Previously announced in IAA as A83-29869
Avail: Univ. Microfilms Order No. DA8404707

The potential of applying active feedback principles for controlling aeroelastic instabilities on a forward swept wing was investigated. Control laws were developed for a cantilever flexible wing and for the wing/fuselage model free in pitch. Design philosophy consisted of using a leading edge surface with displacement feedback to prevent the lower frequency instability of the wing and using a trailing edge surface commanded by angular acceleration feedback to increase the flutter speed of a higher frequency mode involving coupling of 2nd bending and torsion. The blended system successfully controlled the instabilities of both wind configurations up to a significantly higher airspeed. The design provided respectable gain margins. However, phase margins were low and would require tradeoffs with airspeed improvement to obtain more desirable values. E.A.K.

N84-25639*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
AN INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF WINGS HAVING VORTEX FLOW USING DIFFERENT NUMERICAL CODES Final Report, period ending 31 Mar. 1984
S. CHATURVEDI and F. GHAFFARI Apr. 1984 30 p
(Contract NSG-1561)
(NASA-CR-173596; NAS 1.26:173596) Avail: NTIS HC A03/MF A01 CSCL 01A

Three different numerical codes are employed to determine the aerodynamic characteristics of wings with separation induced vortex flows. Both flat as well as cambered wings of various planform shapes are studied. The effects of wing thickness, fuselage, notch ratio and multiple vortex modeling on aerodynamic performance of the wing are also examined. The theoretically predicted results are compared with experimental results to validate the various computer codes used in this study. An analytical procedure for designing aerodynamically effective leading edge extension (LEE) for a thick delta wing is also presented. M.A.C.

N84-25640# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautcal Engineering.
CALCULATION OF AERODYNAMIC CHARACTERISTICS OF WINGS WITH THICKNESS AND CAMBER BY A NEW METHOD BASED ON THE MODIFIED VORTEX LATTICE METHOD
R. GORDON and J. ROM Jul. 1982 88 p refs Sponsored in part by Army
(Contract AF-AFOSR-0064-80)
(TAE-493) Avail: NTIS HC A05/MF A01

A 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. A method, based on the combination of the vortex lattice and the panel source singularities, is applied to the calculations of aerodynamic characteristics of thick wings having sharp leading edges. The calculated results are in a very good agreement with experimental data. A parametric study of the numerical model and some numerical considerations which enable considerable reduction of the computer time are also discussed. Author

N84-25641*# Bihrle Applied Research, Inc., Jericho, N. Y.
ROTARY BALANCE DATA FOR A TYPICAL SINGLE-ENGINE GENERAL AVIATION DESIGN FOR AN ANGLE-OF-ATTACK RANGE OF 20 TO 90 DEG. 3: INFLUENCE OF CONTROL DEFLECTION ON PREDICTED MODEL D SPIN MODES
J. N. RALSTON and B. P. BARNHART Jun. 1984 338 p refs
(Contract NAS1-16205)
(NASA-CR-3248; NAS 1.26:3248) Avail: NTIS HC A15/MF A01 CSCL 01A

The influence of control deflections on the rotational flow aerodynamics and on predicted spin modes is discussed for a 1/6-scale general aviation airplane model. The model was tested for various control settings at both zero and ten degree sideslip angles. Data were measured, using a rotary balance, over an angle-of-attack range of 30 deg to 90 deg, and for clockwise and counter-clockwise rotations covering an omegab/2V range of 0 to 0.5. Author

N84-25642*# Washington Univ., Seattle.
A NUMERICAL STUDY OF THE CONTROLLED FLOW TUNNEL FOR A HIGH LIFT MODEL
P. C. PARIKH 1984 120 p refs
(Contract NSG-2260)
(NASA-CR-166572; NAS 1.26:166572) Avail: NTIS HC A06/MF A01 CSCL 01A

A controlled flow tunnel employs active control of flow through the walls of the wind tunnel so that the model is in approximately free air conditions during the test. This improves the wind tunnel test environment, enhancing the validity of the experimentally obtained test data. This concept is applied to a three dimensional jet flapped wing with full span jet flap. It is shown that a special treatment is required for the high energy wake associated with this and other V/STOL models. An iterative numerical scheme is developed to describe the working of an actual controlled flow tunnel and comparisons are shown with other available results. It is shown that control need be exerted over only part of the tunnel walls to closely approximate free air flow conditions. It is concluded that such a tunnel is able to produce a nearly interference free test environment even with a high lift model in the tunnel. M.G.

N84-25643# Cranfield Inst. of Tech., Bedfordshire (England). Dept. of Aerodynamics.

FULL SCALE WIND TUNNEL TESTS ON HANG GLIDER PILOTS

E. A. KILKENNY Apr. 1984 66 p refs

(CA-8416) Avail: NTIS HC A04/MF A01

The weight shift control of hang gliders and the position of the pilot makes the aerodynamic characteristics of hang glider pilots an integral part of hang glider stability and performance calculations. Full scale mobile facilities were developed to measure the characteristics of the wings but very little information is available about the pilot. A series of full scale wind tunnel measurements were carried out to investigate the aerodynamic characteristics of hang glider pilots. Five pilots were tested over a range of positions and wind speeds with various types of pilots harnesses. The results are strongly dependent on each pilot and the flying position he adopts. A range of pilot drag figures should be used in stability calculations rather than just one mean value. Author

N84-25644*# National Aeronautics and Space Administration, Washington, D. C.

COLD-AIR PERFORMANCE OF COMPRESSOR-DRIVE TURBINE OF DEPARTMENT OF ENERGY UPGRADED AUTOMOBILE GAS TURBINE ENGINE. 3: PERFORMANCE OF REDESIGNED TURBINE

R. J. ROELKE and J. E. HAAS Jan. 1984 40 p refs Prepared in cooperation with Army Research and Technology Labs.

(Contract DE-AI01-80CS-50194)

(NASA-TM-83627; E-2044; DOE/NASA/50194-39; NAS 1.15:83627; USAAVSCOM-TR-84-C-7) Avail: NTIS HC A03/MF A01 CSCL 21A

The aerodynamic performance of a redesigned compressor drive turbine of the gas turbine engine is determined in air at nominal inlet conditions of 325 K and 0.8 bar absolute. The turbine is designed with a lower flow factor, higher rotor reaction and a redesigned inlet volute compared to the first turbine. Comparisons between this turbine and the originally designed turbine show about 2.3 percentage points improvement in efficiency at the same rotor tip clearance. Two versions of the same rotor are tested: (1) an as cast rotor, and (2) the same rotor with reduced surface roughness. The effect of reducing surface roughness is about one half percentage point improvement in efficiency. Tests made to determine the effect of Reynolds number on the turbine performance show no effect for the range from 100,000 to 500,000. M.A.C.

N84-25645*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

REYNOLDS NUMBER EFFECTS ON PRESSURE LOSS AND TURBULENCE CHARACTERISTICS OF FOUR TUBE-BUNDLE HEAT EXCHANGERS

W. B. IGOE and C. L. GENTRY, JR. Jun. 1983 28 p refs

(NASA-TM-85807; L-15721; NAS 1.15:85807) Avail: NTIS HC A03/MF A01 CSCL 01A

The aerodynamic characteristics of pressure loss and turbulence on four tube-bundle configurations representing heat-exchanger geometries with nominally the same heat capacity were measured as a function of Reynolds numbers from about 4000 to 400,000 based on tube hydraulic diameter. Two configurations had elliptical tubes, the other two had round tubes, and all four had plate fins. The elliptical-tube configurations had lower pressure loss and turbulence characteristics than the round-tube configurations over the entire Reynolds number range. Author

N84-25646*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.

MEASUREMENT OF LOCAL CONNECTIVE HEAT TRANSFER COEFFICIENTS OF FOUR ICE ACCRETION SHAPES Final Report

M. E. SMITH, R. V. ARMILLI, and E. G. KESHOCK May 1984 97 p refs

(Contract NAG3-83)

(NASA-CR-174680; NAS 1.26:174680) Avail: NTIS HC A05/MF A01 CSCL 20D

In the analytical study of ice accretions that form on aerodynamic surfaces (airfoils, engine inlets, etc.) it is often necessary to be able to calculate convective heat transfer rates. In order to do this, local convective heat transfer coefficients for the ice accretion shapes must be known. In the past, coefficients obtained for circular cylinders were used as an approximation to the actual coefficients since no better information existed. The purpose of this experimental study was to provide local convective heat transfer coefficients for four shapes that represent ice accretions. The shapes were tested with smooth and rough surfaces. The experimental method chosen was the thin-skin heat rate technique. Using this method local Nusselt numbers were determined for the ice shapes. In general it was found that the convective heat transfer was higher in regions where the model's surfaces were convex and lower in regions where the model's surfaces were concave. The effect of roughness was to increase the heat transfer in the high heat transfer regions by approximately 100% while little change was apparent in the low heat transfer regions. Author

N84-25647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF A QUASI-3D INVISCID FLOW AND BOUNDARY LAYER ANALYSIS TO THE HUB-SHROUD CONTOURING OF A RADIAL TURBINE

K. C. CIVINSKAS and L. A. POVINELLI 1984 21 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by the AIAA, SAE and ASME

(Contract DA PROJ. 1L1-61102-AH-45)

(NASA-TM-83669; E-2112; NAS 1.15:83669; USAAVSCOM-TR-84-C-1; AIAA-84-1297) Avail: NTIS HC A02/MF A01 CSCL 21E

Application of a quasi-3D approach to the aerodynamic analysis of several radial turbine configurations is described. The objective was to improve the rotor aerodynamic characteristics by hub-shroud contouring. The approach relies on available 2D inviscid methods coupled with boundary layer analysis to calculate profile, mixing, and endwall losses. Windage, tip clearance, incidence, and secondary flow losses are estimated from correlations. To eliminate separation along the hub and blade suction surfaces of a baseline rotor, the analysis was also applied to three alternate hub-shroud geometries. Emphasis was on elimination an inducer velocity overshoot as well as increasing hub velocities. While separation was never eliminated, the extent of the separated area was progressively reduced. Results are presented in terms of mid-channel and blade surface velocities; kinetic energy loss coefficients; and efficiency. The calculation demonstrates a first step for a systematic approach to radial turbine design that can be used to identify and control aerodynamic characteristics that ultimately determine heat transfer and component life. Experimentation will be required to assess the extent to which flow and boundary layer behavior were predicted correctly. M.G.

N84-25648*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NONLINEAR PROBLEMS IN FLIGHT DYNAMICS

G. T. CHAPMAN and M. TOBAK May 1984 79 p refs Presented at the Berkeley-Ames Conf. on Nonlinear Probl. in Control and Fluid Dyn., Berkeley, Calif., 31 May - 10 Jun. 1983

(NASA-TM-85940; A-9707; NAS 1.15:85940) Avail: NTIS HC A05/MF A01 CSCL 01A

A comprehensive framework is proposed for the description and analysis of nonlinear problems in flight dynamics. Emphasis is placed on the aerodynamic component as the major source of nonlinearities in the flight dynamic system. Four aerodynamic flows are examined to illustrate the richness and regularity of the flow structures and the nature of the flow structures and the nature of the resulting nonlinear aerodynamic forces and moments. A framework to facilitate the study of the aerodynamic system is proposed having parallel observational and mathematical components. The observational component, structure is described in the language of topology. Changes in flow structure are described via bifurcation theory. Chaos or turbulence is related to the analogous chaotic behavior of nonlinear dynamical systems characterized by the existence of strange attractors having fractal dimensionality. Scales of the flow are considered in the light of ideas from group theory. Several one and two degree of freedom dynamical systems with various mathematical models of the nonlinear aerodynamic forces and moments are examined to illustrate the resulting types of dynamical behavior. The mathematical ideas that proved useful in the description of fluid flows are shown to be similarly useful in the description of flight dynamic behavior. M.G.

N84-25649# National Aerospace Lab., Tokyo (Japan).
DOUBLET POINT METHOD FOR CALCULATIONS ON OSCILLATORY LIFTING SURFACES. PART 2: SUPERSONIC FLOW
T. UEDA 1983 15 p refs
(NAL-TR-785-PT-2; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A method to predict unsteady aerodynamic forces on lifting surfaces in supersonic flow is presented. The wing is divided into small segments in which the lift force is expressed by a single point doublet of the acceleration potential. This is the same concept as the doublet point method developed by the authors for subsonic flows. In order to avoid sensitiveness to the Mach number, the upwash due to the point doublet is calculated by averaging over small areas. The integration is done analytically so that it requires no numerical quadrature. Pressure distributions are directly obtained as the unknowns of an algebraic equation. The results are compared with those obtained by other methods for various wing geometries including the AGARD Wing-tail configuration. Author

N84-25650# National Aerospace Lab., Tokyo (Japan).
WIND TUNNEL INVESTIGATION OF THE ROLLING MOMENT OF A RECTANGULAR WIND WITH SOME WINGLETS ON THE LEFT UPPER TIP
A. IWASAKI, N. TAKIZAWA, and N. KAWAHATA Nov. 1983 29 p refs In JAPANESE; ENGLISH summary
(NAL-TR-788; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Wind tunnel tests were conducted to investigate the increment of rolling moment due to a winglet mounted on the left upper tip of a rectangular wing of aspect ratio of 5.2 with a NACA 0012 section. Two planforms of winglets, rectangular and swept back forms, were tested. Both winglets are equipped with plain flaps to control their side forces. The winglets were canted outboard 90 deg or 75 deg dihedral and toed in or out up to 20 deg relative to the wind chord. The flaps of the winglets were also deflected up to + or - 30 deg. The low speed (Reynold's number based on wing chord 5 x 10 to the 5th power) data were obtained over angles of attack of approximately + or - 15 deg and at the angles of sideslip of 0 deg and + or - 10 deg. The results indicated that a single winglet produce a relatively large rolling moment with side force, but when left upper and right lower winglets were combined at a time the two rolling moments cancelled each other out. It was also found that the incremental rolling moment by a single winglet of 75 deg dihedral is about 40% larger than that of 90 deg dihedral. B.W.

N84-25651# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC CHARACTERISTICS OF FAN-JET STOL AIRCRAFT
N. INUMARU, H. TAKAHASHI, K. HIROSUE, N. TODA, and N. KUWANO 1983 102 p refs In JAPANESE; In JAPANESE; ENGLISH summary
(NAL-TR-790; ISSN-0389-4010) Avail: NTIS HC A06/MF A01

Research on Fan-Jet STOL aircraft was initiated by NAL in 1975 as a wind-tunnel-based program aimed at the design study of experimental STOL aircraft. Aerodynamic characteristics of the Augmentor Wing type model and the Upper Surface Blowing type models are examined by a series of wind-tunnel tests. Three-component longitudinal data of each model are presented. Six-component lateral data of a USB type model are also presented with four engines operating and with one engine out. The general aerodynamic trends of Powered-Lift systems are discussed through comparison with existing data. Discussions concerning the test-techniques are also included. The research was concluded in 1979, making direct contributions to the basic design of NAL Quiet STOL Experimental Aircraft. Author

N84-25652# European Space Agency, Paris (France).
WIND TUNNEL INVESTIGATIONS ON THIN SUPERCRITICAL AIRFOILS IN THE HIGH SUBSONIC FLOW REGIME
H. KOERNER and W. PUFFERT-MEISSNER May 1983 65 p refs Transl. into ENGLISH of "Windkanaluntersuchungen an duennen superkritischen profilen im hohen unterschall" rept. DFVLR-FB-82-06 DFVLR, Brunswick, Feb. 1982
(ESA-TT-774; DFVLR-FB-82-06) Avail: NTIS HC A04/MF A01; Original German report available from DFVLR, Cologne DM 19,30

This report deals with experimental investigations on four thin airfoils (d/1 = 0.05 - see list of symbols), three supercritical airfoils being compared with a conventional one with reference to aerodynamic efficiency. The investigations, conducted in the DFVLR's Brunswick transonic wind tunnel, at Mach numbers ranging from 0.6 to 0.95 and at a Reynolds number 4.10 to the 6th power (6.10 to the 6th power) show the superiority of supercritical airfoil design. This is demonstrated in terms of overall coefficients, efficiency limits and, in particular cases, pressure distributions. Author

N84-25654# European Space Agency, Paris (France).
THE GENERATION OF HIGHER LEVELS OF TURBULENCE IN THE TEST SECTION OF THE HIGH SPEED CASCADE WIND TUNNEL AT BRUNSWICK FOR SIMULATION OF TURBOMACHINERY CONDITIONS
R. KIOCK, G. LASKOWSKI, and H. HOHEISEL Jul. 1983 52 p refs Transl. into ENGLISH of "Die erzeugung hoeherer turbulenzgrade in der messstreckl des hochgeschwindigkeits-gitterwindkanals, Braunschweig, zur simulation turbomaschinenaehnlicher bedingungen" rept. DFVLR-FB-82-25 DFVLR, Brunswick, Mar. 1982
(ESA-TT-815; DFVLR-FB-82-25) Avail: NTIS HC A04/MF A01; original German report available from DFVLR, Cologne DM 19,50

The flow through a turbomachine is characterized by strong turbulence. Periodic velocity changes are superposed by stochastic velocity fluctuations, and the degree of turbulence achieves values up to 20%. Similar turbulence should be simulated at the investigation of cascades in the wind tunnel. For this purpose, turbulence was generated by grids of crossed bars in a high speed cascade wind tunnel. Now a turbine cascade can be investigated at its design point with a degree of turbulence of Tu sub 1 0.8%, 3.1%, 5.6%, and 7.9% defined in the cascade inlet plane. Considerably higher values are achieved only in the case of increasing inhomogeneous distribution of dynamic head and turbulence across the test section. Author

N84-25655# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
EXPERIMENTAL MODAL ANALYSIS
TROUVE and CHABASSIEU 1983 8 p Presented at the AAAF 8th European Rotorcraft and Powered Lift Aircraft Forum, Aix-en-Provence, France, 31 Aug. - 3 Sep. 1982
(SNIAS-832-210-110) Avail: NTIS HC A02/MF A01
The development of an experimental software program that analyzes the dynamic behavior of structural vibration is examined. Helicopter rotor vibrations are analyzed for shape animation, damping methods, and general model refinement. M.A.C.

N84-25656# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
HYPERSONIC AEROTHERMODYNAMICS
1984 587 p refs Lecture Ser. held at Rhode-Saint-Genese, Belgium, 6-10 Feb. 1984
(VKI-LS-1984-01; D/1984/0238/293) Avail: NTIS HC A25/MF A01
The fundamentals of hypersonic flow are reviewed. Following a review of hypersonic flow theory and a summary of facility and computational requirements, two important aspects of hypersonic vehicle design were stressed: stability and heat transfer. Much valuable information on lifting reentry was recently made available from an analysis of the performance of the US space shuttle; comparison of the flight test results with predictions and a summary of those areas of hypersonics requiring greater understanding are presented. A thorough examination of one possible candidate configuration for lifting reentry and tactical missiles, the waverider concept, was made, emphasizing the trade-offs necessary for a successful design.

N84-25670# George Washington Univ., Washington, D.C.
THE COMPRESSIBLE AERODYNAMICS OF ROTATING BLADES USING AN ACOUSTIC FORMULATION Ph.D. Thesis
L. N. LONG 1983 126 p
Avail: Univ. Microfilms Order No. DA8324481
This work develops a theoretical formulation for the pressure on the surface of an arbitrary body moving subsonically through a compressible fluid. It also describes a method for solving the resulting integral equation numerically. Important applications exist in the areas of propeller, helicopter, and wing theory. Farassat's integral representation of the linearized conservation of mass and momentum equations describes the pressure due to an arbitrary body in motion. This has been very useful in calculating noise due to propellers and helicopters. As is typical of integral solutions formulated using a Green's function, the solution developed by Farassat is only valid on the surface in the limit as the observer goes to the surface. The present paper performs this limiting process and thus derives the governing equation for the surface pressure. This analysis is nontrivial because the integral is over a surface in three dimensional space and time. Dissert. Abstr.

N84-25671# Minnesota Univ., Minneapolis.
A THEORETICAL ANALYSIS OF THE AERODYNAMIC AND STRUCTURAL FORCES ASSOCIATED WITH A RIBBON PARACHUTE CANOPY IN STEADY DESCENT Ph.D. Thesis
K. K. MURAMOTO 1983 314 p
Avail: Univ. Microifilms Order No. DA8404210
A computational procedure for predicting the performance of a ribbon parachute canopy in steady descent is presented. The structural integrity of the canopy is established through the finite element code CANO 2. The efficiency of CANO 2 has been improved by implementing a Newton-Raphson procedure in the bulge half angle calculation. This scheme not only reduces the computational time but also results in convergence for cases in which the earlier version does not converge. Numerical results obtained from this improved version are presented and compared with existing experimental data. Although there is a considerable variation in the magnitudes of the calculated and measured local distributions, the general trends predicted by CANO 2 are consistent with the experimental results. The theoretical framework needed for optimal canopy design is provided by the coupling of the CANO 2 structural code with an inviscid flow field analysis. The aerodynamic problem is analyzed by treating the parachute as a finite sized porous screen placed in an approaching uniform flow. Dissert. Abstr.

N84-25987# National Aerospace Lab., Amsterdam (Netherlands).
NUMERICAL COMPUTATION OF VORTICAL FLOWS ABOUT WINGS
H. W. M. HOEIJMAKERS *In* Von Karman Inst. for Fluid Dynamics Computational Fluid Dyn., Vol. 2 142 p 1984 refs
Avail: NTIS HC A17/MF A01
Computational methods for vortex wakes and flow predictions of vortical type configurations are investigated. Vortex flow computation associated with separation from the leading, side, and trailing edges is discussed. These methods are directed toward three dimensional subsonic steady flow applications. M.A.C.

N84-26435 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
VORTEX FLAP SYSTEM FOR THIN WINGS [VORDERKANTEN-KLAPPENSYSTEME FUER SCHLANKT FLUEGEL: VORTEX FLAPS]
W. STAUDACHER *In its* Tech. and Sci. Publ. 1983 p 61-84 1983 refs In GERMAN Presented at DGLR Symp.: Leistungssteigerungen bei Flaechenflugzeugen, Frankfurt, 11-12 Nov. 1982
(MBB-FE-122/S/PUB/102) Avail: Issuing Activity
Vortex flap systems for thin wings are discussed. The aerodynamic characteristics of mechanical vortex flap systems are examined. Whether the formation of stabile, rolled vortex flap turbulence is eliminated by thin wings, vortex flap and whether the vortex flaps are the right solution for the low induced resistance in far reachin use of nonlinear booster aerodynamic lift is investigated. Transl. by E.A.K.

03

AIR TRANSPORTATION AND SAFETY

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

A84-33525
CLOUDS AND FLIGHT SAFETY [OBLAKA I BEZOPASNOST' POLETOV]
A. M. BARANOV Leningrad, Gidrometeoizdat, 1983, 232 p. In Russian. refs
Data from the literature, together with information obtained from meteorological radars and satellites, are used in discussing the spatial and microphysical structure of frontal and air-mass clouds, including cumulonimbus and thunderstorm clouds. The effects of clouds, precipitation, and thunderstorms on costs, flight schedules, and the safety of flight are analyzed. Data on accidents throughout the world are presented, along with the circumstances surrounding these accidents that have to do with clouds, precipitation, thunderstorms, and wind shears. The equipment that airports and aircraft should have to ensure flight safety in clouds is described. Special attention is given to flight safety in the presence of thunderstorms. C.R.

A84-34456#
WORLDWIDE AVIATION OUTLOOK
B. ELLE (International Civil Aviation Organization, Montreal, Canada) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 397-400.
Previously cited in issue 16, p. 2297, Accession no. A83-36952

A84-35359
CHINOOK'S TRIAL BY ICE
I. PARKER Flight International (ISSN 0015-3710), vol. 125, April 28, 1984, p. 1160-1163.

Icing poses a special problem for helicopters because few deicing and antiicing systems have been developed or incorporated to date. Attention is presently given to a Chinook helicopter that has been converted by the RAF into an airborne deicing laboratory. A computer-integrated onboard data collection and analysis system permits the evaluation of icing effects without telemetry to ground stations. Data are being gathered on such basic aircraft performance parameters as airspeed, altitude, stress, and torque, in addition to specific deicing system data, which include rotor blade heater power density and sequencing. The composite rotor blades are noted to have sustained no damage as a result of the heating system used. O.C.

A84-35360
CRASH FOR SAFETY
J. MOXON Flight International (ISSN 0015-3710), vol. 125, May 12, 1984, p. 1270, 1271, 1274.

In July 1984, NASA plans to conduct the first deliberate crash of a large radio-controlled airliner in order to obtain general test data on structural behavior and, in particular, on the flammability of a novel fuel formulation. This fuel will be an 'antimisting kerosene' treated with FM-9 antimisting additive. The crash will represent one in which the majority of passengers would have survived if there had not been a fireball. Fuselage integrity will be maintained, so that the ripples traveling along the airframe after impact can be measured. This test is prompted by the 'fireball' effect which follows the combustion of misting kerosene from ruptured fuel tanks in many airliner crashes, with catastrophic loss of life resulting. O.C.

A84-35361
DASH 8 - DE HAVILLAND CANADA'S QUIET PERFORMER
H. HOPKINS Flight International (ISSN 0015-3710), vol. 125, May 12, 1984, p. 1275-1278.

A flight test assessment is made of the DHC-8 commuter airliner, which has already accumulated 650 hr of evaluation flying. Attention is given to this two-engined turboprop aircraft's takeoff, landing, and handling characteristics, its cockpit visibility and instrumentation effectiveness, avionics performance, and auxiliary systems operations. Payload/range and performance data are given, together with a tabular comparison of DHC-8 specifications with those of its current competitors on the world market. O.C.

N84-24564# Naval Postgraduate School, Monterey, Calif.
SYSTEM SAFETY AND THE COAST GUARD LIGHTER-THAN-AIR SYSTEM PROJECT M.S. Thesis
P. J. DANAHER Dec. 1983 85 p
(AD-A139807) Avail: NTIS HC A05/MF A01 CSCL 13L

The Coast Guard is evaluating the potential of Lighter-Than-air (LTA) vehicles for possible future Coast Guard utilization. Progress of the project is explored. Safety science is an emerging field particularly of value in the historically hazardous realm of aviation. The System Safety Concept as applicable to major project development is examined. One of the fundamental tasks of system safety management is to identify possible hazards early in the conceptual phase of product development. If the concept is not without historical precedence, part of this task is accomplished by examining historical safety records to identify potential hazards. To this end, records of Navy LTA mishaps are examined and comparisons are made to Coast Guard aircraft mishap records. Author (GRA)

N84-24565# Naval Weapons Center, China Lake, Calif.
AIRCREW GLIDING ESCAPE SYSTEM (AGES) EXPLORATORY DEVELOPMENT INVESTIGATION OF AIRCREW EMERGENCY ESCAPE RAM-AIR INFLATED, FLEXIBLE WING Summary Report, Aug. 1975 - Jun. 1983
J. T. MATSUO and M. C. J. BUTLER Sep. 1983 38 p
(Contract F41-451)
(AD-A139928; AD-E900306; NWC-TP-6098) Avail: NTIS HC A03/MF A01 CSCL 01C

This report describes the research, development, fabrication, and testing of the AGES ram-air inflated parachute wings. The primary focus of the investigation to date was on high-airspeed tests in order to obtain data on the structural integrity of the parachute wing and reefing system design and performance. GRA

N84-25672# National Transportation Safety Board, Washington, D. C. Bureau of Safety Programs.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US GENERAL AVIATION, 1980
12 Apr. 1984 152 p refs
(PB84-182914; NTS/ARG-84/01) Avail: NTIS HC A07/MF A01 CSCL 01C

The record of general aviation accidents for calendar year 1980 is given. Statistics which describe the 3,597 general aviation accidents which occurred in 1980 are given. Eight sections report on subsets of the accidents defined by the type of aircraft involved. Six sections contain statistics on subsets defined by the kind of flying involved (e.g., personal, business, instruction). R.J.F.

N84-25673# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATIONS A-84-1 THROUGH -3
6 Jan. 1984 2 p
Avail: NTIS HC A02/MF A01

A Bellanca Model crashed after the right wing separated in flight; both occupants were killed. Extensive deterioration (wood decay) of the inboard lower portion of the airplane's right wing front spar was noted. Normally, wing strap fittings are bolted to the wood spar, however, because of the decay, this portion of the spar was disconnected from the wing straps. The straps themselves, with the wing through bolts in place, remained attached to the fuselage. The bolts were corroded. A similar accident was also caused by undetected wing spar deterioration and prompted the Federal Aviation Administration (FAA) to issue an airworthiness directive requiring compliance with a Bellanca service letter. The decay was obscured visually because it was behind the wing straps and was covered by the straps and the spar's forward face plate. Additionally, since the wing strap to fuselage attaching bolt is located in this area, a probe inspection of the lower root end of the spar cannot be performed. In order to provide for an immediate, reliable inspection of the wing structure, required remedial actions should include measures beyond the scope of previous directives such as wing removal/disassembly and/or removal of lower wing straps and bolts. M.A.C.

N84-25674# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION A-84-7
21 Feb. 1984 2 p
Avail: NTIS HC A02/MF A01

A Grumman G 159 Gulfstream I was operating as an all cargo flight. At about 4000 feet altitude above ground level, an inflight fire occurred in the area of the right engine and engine cowl. The flightcrew secured the engine and discharged both fire extinguishers. The crew declared an emergency and returned the airplane to the airport without further incident. The inflight fire was caused by a failure of the No. 5 combustion chamber flame tube suspension pin, which allowed a flame breakout through the No.5 combustion chamber. Following several flame breakout incidents, the engine manufacturer issued a Service Bulletin. The Federal Aviation Administration (FAA) responded by issuing an airworthiness directive. M.A.C.

N84-25675# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATIONS A-84-8 AND -9, AND A-84-17 THROUGH -20
29 Mar. 1984 6 p refs
Avail: NTIS HC A02/MF A01

A Lockheed L-1011 airplane, was en route from Miami, Florida, to Nassau, Grand Bahama Island, when the flightcrew noted an indication of loss of oil pressure on the No. 2 engine and shut it down. The captain decided to return to Miami because of better weather and terminal approach aids there. However, after the airplane's course was reversed, the No. 3 engine flamed out; about 5 minutes later, the No. 1 engine flamed out. The flightcrew considered it probable that they would be forced to ditch the airplane and the flight engineer told the senior flight attendant to prepare the cabin for imminent ditching. The flightcrew succeeded in restarting the No. 2 engine, and subsequently landed the airplane safely in Miami. The O ring seals were missing from the master chip detector on each of the airplane's three engines, and that the lack of seals permitted the lubricating oil to leak from each of the engines. The Nos. 1 and 3 engines stopped operating because of damage to the internal gearboxes which interrupted operation of the fuel pumps. M.A.C.

N84-25676# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S) A-84-10 AND -11
J. BURNETT 8 Feb. 1984 2 p
Avail: NTIS HC A02/MF A01

About 17 minutes after takeoff on February 2, 1981, a Piper PA-28R-210, N4542Q, crashed near the Houghton County Airport in Michigan. The pilot and two of the passengers were seriously injured. One other passenger received minor injuries and the plane was destroyed. The investigation showed that engine stoppage during flight was the consequence of oil starvation. The front crankcase oil seal was displaced outward and the crankcase breather line contained several of 1/2 inch-diameter pieces of ice. The engine was not equipped with any winterization devices to prevent ice from blocking the crankcase breather line. From January 1, 1977 to September 30, 1983, there were five recorded entries of frozen crankcase breather lines on Piper model PA-28 airplanes recommended that operators of such aircraft be advised of the hazard of operating high-time engines in very cold weather conditions without winterization kits on crankcase breather lines and the design of these line installations be evaluated to determine the need to provide icing protection, and that retrofitting be initiated if necessary. A.R.H.

N84-25678# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATIONS A-84-14 AND -15
14 Mar. 1984 4 p refs
Avail: NTIS HC A02/MF A01

A DHC 6, crashed during its final landing approach. Of the eight persons aboard the airplane, seven received serious injuries and the other received minor injuries. The airplane was destroyed. Pitch control of the airplane was lost because an elevator control linkage separated. An improper and unsecured bolt was used in the linkage connection, and the bolt had backed out of the linkage. Further investigation into the origin of the improper bolt and the maintenance performed on the airplane disclosed deficiencies in maintenance and inspection organization and procedures. M.A.C.

N84-25679# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION(S) A-84-16
J. BURNETT 9 Mar. 1984 3 p refs
Avail: NTIS HC A02/MF A01

On July 23, 1982, at 0220 Pacific daylight time, a Bell UH-1B helicopter, N87701, crashed during the filming of a movie in Valencia, California. The helicopter hovered about 25 ft above a motion picture set showing a typical Vietnam village under attack from heavy ordinance. As the pilot turned to facilitate camera coverage, the tail section was engulfed in a fireball created by the detonation of special effects explosives. The tail rotor assembly separated and the helicopter descended out of control. The main rotor blade fatally injured three actors on the ground. Six occupants on the aircraft sustained minor injuries and the aircraft was damaged substantially. The facts, conditions, and circumstances of this accident amply demonstrate the need for a requirement that helicopter operators prepare a manual and carry out its provisions as a prerequisite for the use of a helicopter in movie and television film production. The manual should contain provisions for pilot qualification, mandatory briefings of film production personnel on the risks involved, safeguards needed during operations, a plan for communications among all participating personnel, and a provision confirming the pilot-in-command's ultimate authority to control all flight regimes relative to this type of operation. A.R.H.

N84-25680# National Transportation Safety Board, Washington, D. C.
SAFETY RECOMMENDATION: CESSNA MODEL 402C AIRPLANE, SEPTEMBER 5, 1983, TAMPA INTERNATIONAL AIRPORT, TAMPA, FLORIDA
1 Feb. 1984 2 p
Avail: NTIS HC A02/MF A01

On September 5, 1983, a Cessna Model 402C airplane, N29PB, was involved in an accident at the Tampa International Airport, Tampa, Florida. Upon touchdown, the nose landing gear collapsed as a result of a fatigue failure of the bearing (part No. MS-21242S-4K) in the rod end of the hydraulic actuator. Similarly caused accidents in the Cessna Model 400 series occurred elsewhere. Until recently, the bearings installed in the actuator rod end were produced for Cessna by several vendors. The original specifications and standards for their design and manufacture were those contained in Military Standard MS-21242. On January 31, 1978, they were superseded by those in Military Specification MIL-B-81935. Investigations of the accidents at Tampa and Gainesville disclosed that the bearings did not conform to either. The slope of each of the respective bearing housings, measured relative to the bearing's longitudinal axis, exceeded the maximum specified angle of 35. This resulted in a reduction in the size and strength of the bearing housings which, the Safety Board concluded, contributed to the structural fatigue of these parts. Recommendations to the Federal Aviation Administration on performance testing, engineering analysis, and the issuance of directives are given. R.J.F.

N84-25681# National Transportation Safety Board, Washington, D. C.
STATISTICAL REVIEW OF ALCOHOL-INVOLVED AVIATION ACCIDENTS Safety Study, 1975 - 1981
1 May 1984 28 p
(NTSB/SS-84/03) Avail: NTIS HC A03/MF A01

During the years 1975-1981, more than 10 percent of the toxicological tests on deceased pilots were positive for alcohol. However, no pilot of a U.S. certificated air carrier operated under 14 CFR 121 was found to have a positive alcohol test since at least 1964. Toxicological tests were positive for alcohol in 6.4 percent of the tests taken from fatally injured scheduled 14 CFR 135 (commuter) pilots and in 7.4 percent of fatally injured pilots in nonscheduled 14 CFR 135 (on demand air taxi) operations. In general aviation, 10.5 percent of toxicological tests on fatally injured pilots were positive for alcohol. The extent of which alcohol is involved in nonfatal accidents is not known because there is no Federal authority to test surviving pilots for alcohol. Positive toxicological tests were obtained from pilots of all certificate levels and all levels of flight-time, indicating that experience cannot and does not compensate for the performance degradation caused by alcohol. Author

N84-25682# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
HELICOPTER PILOT/COPILOT SURVIVAL SYSTEM
G. P. GILLESPIE Jun. 1983 8 p
(AD-A140358; NADC-83098-60) Avail: NTIS HC A02/MF A01 CSCL 06G

The Helicopter Pilot/Copilot Survival System described in this report is designed for pilots, copilots and other aircrewmen who perform similar functions as stationary aircrewmen. They require a survival system designed to provide the necessary survival capabilities to cover a wide range of emergencies when escaping from a downed helicopter. The Helicopter Pilot/Copilot Survival System was designed to be worn constantly during missions over land or water; and to provide armor protection, flotation capability, lift compatibility, and use of survival items. The system and its subsystems are compatible with current aircrew requirements and do not interfere with the standard duties of the wearer. The purpose of this report is to document the development to-date, of this Helicopter Pilot/Copilot Survival System. Due to this system's present unfunded status, development has been curtailed. Upon resumption of development, this report will be utilized to assist those involved in future development of this system. GRA

N84-25683# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
CABIN SAFETY SUBJECT INDEX
D. W. POLLARD, J. A. STEEN, W. J. BIRON, and R. L. CREMER Jan. 1984 17 p
(AD-A140409; FAA-AM-84-1) Avail: NTIS HC A02/MF A01 CSCL 05B

The most frequently used Federal Aviation Administration published cabin safety information is indexed and cross referenced. This includes Federal Aviation Regulations numbers, Air Carrier Operations Bulletin numbers, Advisory Circular numbers, and Office of Aviation Medicine report numbers. Author (GRA)

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A84-34648
EAST-WEST NONRECIPROCAL PROPAGATION OF OMEGA NAVIGATIONAL VLF WAVES ON THE LOW LATITUDE AND TRANSEQUATORIAL PATHS
T. KIKUCHI, A. OHTANI, K. NOZAKI, N. KURIHARE, Y. KURATANI, and M. OHSE Radio Research Laboratories, Journal (ISSN 0033-8001), vol. 30, July-Nov. 1983, p. 151-173. refs

The east-west nonreciprocities of the diurnal phase shift and field intensity change and their latitudinal dependence near the geomagnetic equator are clarified, and the anomalous E-W nonreciprocities are interpreted in terms of single mode propagation by making use of conventional anisotropic waveguide models. Measurements taken in Japan and aboard ship between Japan and Australia show that the diurnal phase shift on the transequatorial path is 35 percent less for E-W propagation than in the opposite direction, while the shift on the low latitude path is 30-40 percent greater for E-W propagation than in the W-E direction. Short-term fluctuations of the phase and field intensity and phase cycle slippage occur on the HAIKU (13.6 KHz) signal propagating E-W at the geomagnetic equator. These results can be explained by single mode propagation in the anisotropic models of Galejs (1972) and Gallenberger and Swanson (1971). C.D.

A84-35589
PROBLEMS IN AIR NAVIGATION AT THE NORTH POLE. II [PROBLEMES DE NAVIGATION AERIENNE AU POLE NORD. II]
J. F. FOURNIER and J. HAMELIN Navigation (Paris) (ISSN 0028-1530), vol. 32, April 1984, p. 179-182; 187-201. In French.

The procedures used by aircraft equipped with inertial navigation systems (INS) when operating at latitudes above 75 deg N are reviewed. The operation of a typical INS is explained, and the transformation of grid headings to true headings is described. A technique used by Air France to determine the heading in case of failure of both INS units is illustrated, and the importance of precise navigation is emphasized in view of increasing polar-region commercial traffic. T.K.

A84-35590
AIR NAVIGATION 1973-1983 [NAVIGATION AERIENNE 1973-1983]
P. FOMBONNE Navigation (Paris) (ISSN 0028-1530), vol. 32, April 1984, p. 202-222. In French. refs

The development of air traffic and of air navigation systems during the period 1973-1983 is reviewed. The slow growth of commercial and general-aviation traffic during the period is attributed to increases in fuel prices and to global economic stagnation. The current use and planned further development of navigation systems for long and intermediate distances and for approach and landing are then discussed, including loran-C, Omega, Navstar/GPS, VOR/DME and precision DME, anticollision and traffic-control systems, integrated communication/navigation/surveillance/anticollision systems, MLS (in its various proposed versions), onboard equipment, and control-center equipment. T.K.

A84-35694
IMPROVEMENT OF THE ACCURACY OF DOPPLER DIRECTION FINDERS FOR GENERAL AVIATION BY SPECTRAL SIGNAL ANALYSIS [VERBESSERUNG DER GENAUIGKEIT VON DOPPLERPEILERN ZUR KONTROLLE DER ALLGEMEINEN LUFTFAHRT DURCH SPEKTRALE SIGNALAUSWERTUNG]
R. SPRINGER Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1983, 157 p. In German. refs

An improved Doppler direction finder (DDF) based on the analysis of the modulation phase is developed, simulated numerically, and tested in a laboratory version. The direction-finding requirements of general aviation are reviewed; the principles of DDFs are explained; and problems arising in conventional DDFs (scattering, diffraction, attenuation, noise, and reflection) are analyzed. The proposed DDF employs a following superhet with an FM auxiliary oscillator and a narrowband IF filter to analyze the entire output spectrum including both carrier and sidebands. Comparison of a computer simulation and laboratory measurements demonstrates the greatly increased precision attainable with this device. Graphs, diagrams, and sample spectra are provided. T.K.

A84-35862
AN ELECTRONIC UMBRELLA - THE B-1B DEFENSIVE AVIONICS SYSTEM
H. PEOT (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) Defense Systems Review and Military Communications, vol. 2, May 1984, p. 15-18.

The design features and operational capabilities of the AN/ALQ-161 defensive avionics system for the B-1B bomber, which has been optimized for low altitude penetration of hostile airspace at high subsonic speed, are discussed. The AN/ALQ-161 system consists of (1) a receiver system that supplies directional data on detected signals; (2) a digital processor which employs digital LRUs and interfaces with a general purpose AP-101F computer that directs enemy radar tracking and jamming operations; (3) transmitters and antennas; and (4) a tail-mounted signal receiver warning system. The modularity and digital bus structure employed by the AN/ALQ-161 system ensures that it will be able to incorporate novel and improved technology, effectively precluding obsolescence. O.C.

A84-35863
TACTICAL BATTLEFIELD AIRCRAFT STILL LACK ALL WEATHER LANDING SYSTEMS
F. B. POGUST (Eaton Corp., AIL Div., Deer Park, NY) Defense Systems Review and Military Communications, vol. 2, May 1984, p. 19-21.
The ICAO and FAA have standardized on a microwave landing system (MLS) that operates in C-band and uses a Time Reference Scanning Beam signal format. The U.S. military services have developed a strong interest in the adoption of such a system, in order to achieve civil/military compatibility in landing guidance techniques. The Air Force has been designated 'lead service' for the development of a tactical version of the MLS, which will be used at locations where it is impractical to site the type of equipment under development by the FAA for civilian airports. The degree of tactical mobility that can be achieved must be traded off against the desire for compatibility with the civilian system. O.C.

A84-36229
IS THERE A FUTURE FOR INFRA-RED MISSILE SYSTEMS?
A. R. NEWBERY (Royal Aircraft Establishment, Attack Weapons Dept., Farnborough, Hants., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 21-26. refs
This paper traces the history of IR missile seekers, from the early days of single element reticle systems to the modern multi-element imaging homing heads. It compares IR and radar homing, and suggests how the relative merits of the two technologies may be changed by the development of millimetric-wave systems. Author

A84-36230#
ELECTRONICALLY STEERABLE SATCOM TERMINALS FOR AIRBORNE USE
R. J. MAILLOUX (USAF, Electromagnetic Sciences Div., Bedford, MA) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 31-36.
This paper describes several classes of aircraft array antennas for satellite communication. At SHF frequencies candidate arrays include hybrid mechanical electronic scanned systems, fully conformal flush mounted and low profile arrays, and various multi-face arrays. At EHF frequencies the technology does not now support arrays with electronic scan in both planes, but hybrid electronic-mechanical scanned arrays offer viable technological options. Author

A84-36232
A CW CO2 LASER RANGEFINDER/VELOCIMETER USING HETERODYNE DETECTION
K. F. HULME and B. S. COLLINS (Royal Signals and Radar Establishment, Malvern, Worcs., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 59-65. refs
An examination is made of ways in which system design problems are overcome in the RSRE chirp system based on a CW CO2 laser externally modulated by an acoustooptic device. These problems arise from the use of heterodyne detection at an IR frequency 10,000 times higher than conventional microwave frequencies. Particular consideration is given to the factors governing the choice of the transmitter signal; the technique for processing the received signal using a SAW device; and a method for increasing the SNR by the digital integration of extremely large numbers (e.g., 100,000) of pulses. B.J.

A84-36240#
DESIGN CONSIDERATIONS AND TRADE-OFFS IN RPV COMMUNICATION LINKS
P. K. BLAIR (Standard Telecommunications Laboratories, Ltd., Harlow, Essex, England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 148-156. refs
The essentially microwave aspects of RPV communication links are reviewed and their functions are outlined with the aim of informing designers of device, circuit, and subsystem requirements. Particular attention is given to frequency band choice, the air vehicle antenna requirements, the ground station, ECCM by the antenna, the airborne and ground receivers, and transmitters. B.J.

A84-36263#
POSITION UPDATING USING A PASSIVE MILLIMETER WAVE SENSOR
M. EIBERT and H. P. NIEMITZ (Dornier GmbH, Friedrichshafen, West Germany) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 352-362.
Low altitude 90 GHz radiometric images of man-made and natural objects were analyzed to determine the feasibility of position updating for pre-planned low altitude flights with passive millimeter wave sensors. The aim of the investigations was to determine constant or reproducible radiometric characteristics of objects for classification and reference generation. The analysis consisted of a comparison of images with maps, computation of gray value distributions (i.e., histograms) with respect to objects, calculation of standard deviation and mean, comparison of histograms with normalized Gaussian distribution functions and the definition of a 'relative contrast' to group objects into gray level classes. A method is proposed allowing the assignment of current and sensor compatible gray values to objects in the reference map. Author

A84-36264#
DESIGN AND PERFORMANCE EVALUATION OF A FIVE CHANNEL NAVSTAR RECEIVER
J. P. SUDWORTH (Royal Aircraft Establishment, Farnborough, Hants., England), P. J. HARGRAVE, R. E. HALL, and P. E. JONES (Standard Telecommunications Laboratories, Ltd., Harlow, Essex, England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 363-372. Research supported by the Ministry of Defence (Procurement Executive).
The satellite navigation system Navstar is planned to consist of 18 satellites, each transmitting two navigation signals, designated L1 and L2, centered at 1575 and 1228 MHz, respectively. A high performance Navstar receiver might contain up to five code/carrier channels; four would be dedicated to L1 reception from each of four satellites and the fifth would sequentially sample the satellites at the L2 frequency to provide ionospheric correction measurements. An experimental receiver designed for the purpose of experimental evaluation on both air- and sea-borne platforms is described. The receiver operates from both C/A and P codes and consists of: (1) an RF unit containing two separate RF and IF channels, (2) a channel unit with five interchangeable correlator channels, (3) a processor unit with an 11-state Kalman filter, and (4) a control and display unit. Results from an early flight trial are presented. J.N.

A84-36265#
GPS GUIDANCE CONCEPTS
S. ROEMERMAN (Texas Instruments, Inc., Lewisville, TX) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 373-378. refs
Significant improvements afforded by the use of NAVSTAR GPS in several areas of weapons guidance have demonstrated

the potential to profoundly affect the nature of deployment, targeting, and tactics of guided-weapon use. This paper gives examples of GPS-equipped weapon concepts and describes results from GPS tests. In a comparison with Omega, LORAN, TACAN, and TERCON, GPS demonstrated strong advantages in ECM resistance, coverage, and update rate. The use of GPS with time domain multiplexing is reviewed. J.N.

A84-36266#
AIRBORNE SELF PROTECTION JAMMER - ASPJ/ALQ-165
D. J. RICE (Westinghouse Electric Corp., Electronic Warfare Div., Baltimore, MD) and A. S. KAUFMAN (ITT, ITT Avionics Div., Nutley, NJ) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 389-399.

The AN/ALQ-165 Airborne Self-Protection Jammer (ASPJ) for new U.S.-built tactical aircraft will be installed in F-16s, F-18s, F-14s, AV-8Bs, A-6Es, and EA-6Bs (1700-3000 aircraft). The ASPJ's development has been jointly undertaken by the Navy and Air Force. First production units are expected to be delivered in late 1985. The ASPJ's function is to degrade and deceive all radar-guided weapons systems used by the enemy, automatically selecting the best technique for the identified threat. Multiple threats can be countered simultaneously. O.C.

A84-36281#
DEPOLARISATION PROPERTIES OF AIRBORNE RADOMES
A. HIZAL, N. ADATIA, and G. S. GUPTA (ERA Technology, Ltd., Leatherhead, Surrey, England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 493-499. Research supported by the Ministry of Defence (Procurement Executive).

Vector diffraction analysis is employed to study the depolarization properties of airborne radomes. The model developed is then used to study the depolarization properties of two typical aircraft radome geometries (a half-wave solid ogive and an A-sandwich ogive) and to establish their characteristics in linear and circular polarization. Measurements on a high-performance corrugated conical horn enclosed by a conical radome validate the theoretical predictions. J.N.

A84-36291
AN ADAPTIVE ARRAY PROCESSOR WITH A PERTURBATION ALGORITHM
J. KILVINGTON (Royal Aircraft Establishment, Farnborough, Hants., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 563-568.

An adaptive aerial array processor using a perturbation algorithm has been developed, based on an 8-bit microprocessor and using Walsh functions as the perturbing sequences. The great advantage of this processor is its low cost, due mainly to the absence of dedicated receiver circuitry for each loop, and the consequent flexibility of application to many systems. The major features of the algorithm are described, followed by details of the hardware interface to the protected receiver, the RF weighting network and the associated linearising circuit. Author

A84-36292#
AN ADAPTIVE ANTENNA FOR MILITARY AIRCRAFT COMMUNICATIONS
E. M. DAVENPORT (British Aerospace, PLC, Dynamics Group, Bristol, England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 569-574. Research supported by the Ministry of Defence (Procurement Executive).

The development of an adaptive antenna for a military aircraft communications system will be described. The antenna is designed as a retro-fitted option which will improve the desired signal to noise ratio at the receiver when operating in a tactical situation. Unwanted jammer signals are nulled out by the adaptive processor which is controlled by the LMS algorithm. The processor operates at RF (microwave) frequencies. The adaption rate and improvement in signal to noise levels are sensitive to the precise design of the array and the processor feedback loop, and the components used therein. A computer simulation of the adaptive system has been made to assist in the processor development and the results of these aspects of the study will be presented. Author

N84-24566*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT AND FLIGHT TEST OF A HELICOPTER COMPACT, PORTABLE, PRECISION LANDING SYSTEM CONCEPT
G. R. CLARY, J. S. BULL, T. J. DAVIS, and J. P. CHISHOLM (Sierra Nevada Corp.) Apr. 1984 11 p refs
(NASA-TM-85951; A-9729; NAS 1.15:85951) Avail: NTIS HC A02/MF A01 CSCL 17G

An airborne, radar-based, precision approach concept is being developed and flight tested as a part of NASA's Rotorcraft All-Weather Operations Research Program. A transponder-based beacon landing system (BLS) applying state-of-the-art X-band radar technology and digital processing techniques, was built and is being flight tested to demonstrate the concept feasibility. The BLS airborne hardware consists of an add-on microprocessor, installed in conjunction with the aircraft weather/mapping radar, which analyzes the radar beacon receiver returns and determines range, localizer deviation, and glide-slope deviation. The ground station is an inexpensive, portable unit which can be quickly deployed at a landing site. Results from the flight test program show that the BLS concept has a significant potential for providing rotorcraft with low-cost, precision instrument approach capability in remote areas. Author

N84-24568# Systems Control Technology, Inc., West Palm Beach, Fla.
CONUS LORAN-C ERROR BUDGET: FLIGHT TEST Final Report
L. D. KING, E. D. MCCONKEY, and K. J. VENEZIA Dec. 1983 127 p
(Contract DTFA01-83-C-20041)
(AD-A139871; FAA-PM-83-32) Avail: NTIS HC A07/MF A01 CSCL 17G

This report contains the description and results of a Loran-C flight test program conducted in the continental United States (CONUS). The data collection period was during July 1983. The purpose of the program was to collect Loran-C signal coverage and accuracy data representative of low altitude, low speed operations typical of helicopters and general aviation aircraft. The test aircraft use a Beechcraft Queen Air, Model 65. The aircraft was configured with a data collection palate and multipin electrical connectors located in the aircraft cabin. A Teledyne TDL-711 navigation receiver was used in the test, utilizing an E-field antenna mounted on the top of the fuselage. A microprocessor controlled data collection system, utilizing a scanning DME and other aircraft navigation instruments, was used to record data and establish aircraft reference position. Route segments, totaling over 9500 nm covering much of CONUS, were flown during the project. Data were recorded on all route segments. Over 12,000 data points were used in the accuracy analysis. Calibration procedures, used at five locations, reduced errors throughout an area within a 75 nm radius of the calibration point. Author (GRA)

N84-25685# Radio Technical Commission for Aeronautics, Washington, D. C.
MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) AIRBORNE EQUIPMENT, VOLUME 1
23 Sep. 1983 366 p 2 Vol.
(RTCA-DO-185-VOL-1; SC-147-VOL-1) Avail: NTIS HC A16/MF A01

Minimum operational performance standards for the Traffic alert and Collision Avoidance System (TCAS) are described. Equipment applications and operational goals, definition of performance under standard and stressed environmental conditions, and an overview of the collision avoidance algorithms are included. Specific bench and performance tests for the electronic equipment are outlined. M.A.C.

N84-25686# Radio Technical Commission for Aeronautics, Washington, D. C.
MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) AIRBORNE EQUIPMENT, VOLUME 2
23 Sep. 1983 372 p 2 Vol.
(RTCA/DO-185-VOL-2; SC-147-VOL-2) Avail: NTIS HC A16/MF A01

The specifications for the collision avoidance algorithms are presented. The data structures, interfaces, and system parameters used by the Collision Avoidance System. The logic for the main loop, which cycles at a nominal rate of once per second and calls the tasks contained in later sections, and the logic performed when a Traffic Alert and Collision Avoidance System (TCAS) related message is received through the Mode S transponder is described. The tracking algorithms for intruder aircraft and own aircraft altitude and sensitivity level are defined. The threat detection algorithms are included. The logic for selection of resolution advisories, for coordination with equipped threats, and cleanup of data structures is examined. The algorithms for generating traffic advisories, and the composite display of resolution and traffic advisories are explained. M.A.C.

N84-25687# Human Engineering Labs., Aberdeen Proving Ground, Md.
EMULATION OF A VOICE INTERACTIVE DOPPLER NAVIGATION SET Final Technical Note
R. G. HACKENBERG and F. J. MALKIN Mar. 1984 27 p
(AD-A140204; HEL-TN-5-84) Avail: NTIS HC A03/MF A01 CSCL 09B

Software emulating the operation of the Doppler Navigation Set entirely by voice commands is described. The software, written in Microsoft BASIC using a vocabulary of 67 words, is implemented on the Interstate Electronics VRT 103 Voice Recognition Terminal. Procedural diagrams illustrating the man-machine interaction occurring during the program's subroutines are included. Author (GRA)

N84-25688# Systems Control Technology, Inc., West Palm Beach, Fla.
CONUS (CONTINENTAL UNITED STATES) OMEGA/VLF DATA COLLECTION: FLIGHT TEST Final Report
L. D. KING and E. D. MCCONKEY Dec. 1983 114 p
(Contract DOT-FA01-80-C-10080)
(AD-A140252; FAA/PM-83/35) Avail: NTIS HC A06/MF A01 CSCL 17G

This report contains the description and results of an Omega/VLF flight program conducted in the continental United States (CONUS). The data collection period was during May 1983. The purpose of the program was to collect Omega and VLF signal coverage and accuracy data representative of low altitude, low speed operations typical of helicopters and general aviation aircraft. The aircraft used was a Beechcraft Queen Air, Model 65. The aircraft was configured with a data collection palate and multipin electrical connectors located in the aircraft cabin. An ARINC 599 type Omega/VLF navigation receiver was used in the project. A flat plate, E-field antenna was mounted in the bottom of the fuselage near the empennage. A microprocessor controlled data collection system, utilizing a scanning DME and other aircraft navigation instruments, was used to record data and establish aircraft reference position. Route segments, totaling over 7000 nm covering much of CONUS, were flown during the project. Data were recorded on all route segments. Over 7000 data points were used in the accuracy analysis. GRA

N84-25691# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ADVANCES IN STRAPDOWN INERTIAL SYSTEMS
Apr. 1984 225 p refs In ENGLISH and FRENCH Lecture held in Athens, 14-15 May 1984, in Rome, 17-18 May 1984, and in Copenhagen, 21-22 May 1984
(AGARD-LS-133; ISBN-92-835-0351) Avail: NTIS HC A10/MF A01

Advances in strapdown inertial system technology during the last five years are addressed. Areas include advances in strapdown instruments, computational algorithms and the application to commercial aircraft, remotely. Piloted vehicles, flight controls, instrumentation, and navigation problems in general.

N84-25692# Draper (Charles Stark) Lab., Inc., Cambridge, Mass. G&N Advanced Programs Div.
ADVANCES IN STRAPDOWN INERTIAL SYSTEMS: INTRODUCTION AND OVERVIEW
G. T. SCHMIDT *In* AGARD Advan. in Strapdown Inertial Systems 4p Apr. 1984 refs
Avail: NTIS HC A10/MF A01

The significant advances in strapdown inertial system technology since the last Lecture Series (No. 95) in 1978 on the subject are presented. Areas that are addressed in the Lecture Series include advances in strapdown instruments and computational algorithms and the applications to commercial aircraft, remotely piloted vehicles, flight controls, instrumentation, and navigation problems in general. Author

N84-25693# Strapdown Associates, Inc., Minnetonka, Minn.
ADVANCES IN STRAPDOWN SENSORS
P. G. SAVAGE *In* AGARD Advan. in Strapdown Inertial Systems 24p Apr. 1984 refs
Avail: NTIS HC A10/MF A01

The advanced that have taken place in strapdown sensor technology since 1978 are reviewed. Principal areas addressed in strapdown gyro technology are the state of the art in mainstream floated rate-integrating and tuned-rotor strapdown gyros, performance advances in laser gyros, specical design considerations associated with mechanically dithered laser gyros, the state of the art in magnetic mirror and multioscillator laser gyros, present and projected application areas for laser gyros related to size, performance and cost, the theory of operation and state of the art in fiber optic rate sensor technology, and the fundamental distinctions between the laser gyro and fiber optic rate sensor. Basic areas addressed in strapdown accelerometer technology are performance advances in pendulous accelerometers, and the theory of operation and state of the art in vibrating beam accelerometer technology. Author

N84-25695# Boeing Commercial Airplane Co., Seattle, Wash. Navigation Sensors/Displays Dept.
REQUIREMENTS, APPLICATIONS, AND RESULTS OF STRAPDOWN INERTIAL TECHNOLOGY TO COMMERCIAL AIRPLANES
P. J. FENNER *In* AGARD Advan. in Strapdown Inertial Systems 47p Apr. 1984 refs
Avail: NTIS HC A10/MF A01

The basis for selection of strapdown inertial system for short to medium range jet transports is discussed. Inertial data requirements and associated performance requirements are shown for commercial airplanes. Good performance at low cost and high reliability are key requirements of inertial technology application to commercial airplanes which do not have a long range navigation need. The Honeywell laser inertial reference system (IRS) selected by Boeing for the 757/767/737 airplanes is described, along with airplane installation and interface details. Test programs instituted to validate the design and reduce program risk are described. Performance and reliability experience data from Boeing flight tests, and over the first year of airline service, are shown to exceed expectations. Author

N84-25696# Societe de Fabrication d'Instruments de Mesure, Massy (France). Strapdown Systems Engineering Group.
STRAPDOWN INERTIAL SYSTEMS FOR TACTICAL MISSILES USING MASS UNBALANCED TWO-AXIS RATE GYROS
J. L. MICHELIN and P. MASSON (Lab. de Recherches Balistiques et Aerodynamiques.) *In* AGARD Advan. in Strapdown Inertial Systems 41p Apr. 1984
Avail: NTIS HC A10/MF A01

In 1979, SFIM began work on strapdown inertial systems using two axis dry tuned gyros (DTG). Since the first feasibility developments SFIM has worked on a large number of applications, the most important being for tactical missiles. All current developments are based on the same concepts - mass unbalanced gyros (M.U.G.) - fully digitized electronics - leading to a systems family - SIL 1 (Systmems Inertiels lies) - in which the cost and volume requirements are the essential points. The basic ideas, some examples of utilization and the test results obtained on some functional models and prototypes by SFIM and essentially by LRBA are presented. Author

N84-25697# Draper (Charles Stark) Lab., Inc., Cambridge, Mass. Inertial Subsystem Div.
MODULAR STRAPDOWN GUIDANCE UNIT WITH EMBEDDED MICROPROCESSORS
J. P. GILMORE *In* AGARD Advan. in Strapdown Inertial Systems 16p Apr. 1984 refs Previously announced as A80-18534
(Contract F08635-76-C-0306)
Avail: NTIS HC A10/MF A01

The Low-Cost Inertial Guidance System (LCIGS) is a modular strapdown implementation of attitude (gyro) and velocity (accelerometer) axes which permits the interchangeable use of different manufacturer's instruments without affecting the system's electronic or mechanical interfaces or processing software. This design flexibility is made possible by the use of microprocessors for processing and control. The microprocessors are embedded in each module and five are used: one per accelerometer triad, one each per gyro module, and one in the service module. The processors effect on-line digital torquing control of the gyros, active instrument error model compensation, including modeling for temperature sensitivity effects, temperature control, self-testing, etc. Adaptation of processing and calibration algorithms to accommodate for instrument changes or sensed environmental variations is achieved through the use of an alterable read-only data base that may be updated by the LCIGS support equipment as required at calibrations or upon an instrument replacement. This data base is accessed by the microprocessors and used to compute coefficient corrections for the processing algorithms. The system architecture is presented and the microprocessor software partitioning and functions are described. (Author) IAA

N84-25698# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
APPLICATION OF MULTIFUNCTION STRAPDOWN INERTIAL SYSTEM
D. L. SEBRING (McDonnell Douglas Corp., St. Louis), J. M. PERDZOCK, and J. T. YOUNG *In* AGARD Advan. in Strapdown Inertial Systems 20p Apr. 1984 refs
Avail: NTIS HC A10/MF A01

Reliability, redundancy, and survivability are key issues as integrated requirements for flight control, fire control, propulsion control and navigation are developed. These integrated systems require dependable sources of inertial measurement data. Current inertial sensors, however, are expensive to acquire and maintain, dedicated to specific systems, and are not designed to meet integrated reliability, redundancy, and survivability requirements. The Multifunction Strapdown Inertial System concept uses a minimum number of inertial sensors in a survivable configuration to provide inertial data for flight control, navigation, weapon delivery, cockpit displays, and sensor stabilization. Because of advantages in survivability, life cycle cost, maintainability and performance, the Multifunction Flight Control Reference System (MFCRS) program was initiated to verify, through flight test, on a McDonnell Douglas F-15 Eagle the key issues of redundancy management and flight control. A redundancy management system based on parity equations was designed. Author

N84-25699# Litton Technische Werke, Freiburg (West Germany). Systems Design Dept.
INITIAL ALIGNMENT AND AUGMENTATION OF THE ARINC 705 STRAPDOWN AHRS LTR-81
W. HASSENPFLUG and M. KLEINSCHMIDT *In* AGARD Advan. in Strapdown Inertial Systems 14p Apr. 1984 refs
Avail: NTIS HC A10/MF A01

After systems hardware description the attitude, heading and vertical loops are discussed. System simulation results are compared with flight test results achieved during A 300 B4 FFC flight certification and BMFT/LITEF sponsored flight tests. Techniques for further system improvements are shortly described. Author

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A84-34451#
DESIGN AND EXPERIMENTAL VERIFICATION OF THE USB FLAP PANEL STRUCTURE FOR NAL-STOL RESEARCH AIRCRAFT
M. SANO (National Aerospace Laboratory, Tokyo, Japan), Y. FUJIMORI (National Space Development Agency, Tokyo, Japan), and S. MAEKAWA (Kawasaki Heavy Industries, Ltd., Gifu, Japan) (International Council of the Aeronautical Sciences, Congress, 13th and AIAA Aircraft Systems and Technology Conference, Seattle, WA, August 22-27, 1982, Proceedings. Volume 1, p. 370-375) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 353, 354; Abridged.

Previously cited in issue 20, p. 3149, Accession no. A82-40917

A84-34452#
APPLICATION OF COMPUTATIONAL AERODYNAMICS TO AIRPLANE DESIGN
L. R. MIRANDA (Lockheed-California Co., Computational Aerodynamics Dept., Burbank, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 355-370. refs

Previously cited in issue 08, p. 1185, Accession no. A82-22028

A84-34907*# Boeing Commercial Airplane Co., Seattle, Wash.
WINGLET EFFECTS ON THE FLUTTER OF TWIN-ENGINE-TRANSPORT TYPE WING
K. G. BHATIA, K. S. NAGARAJA (Boeing Commercial Airplane Co., Seattle, WA), and C. L. RUHLIN (NASA, Langley Research Center, Configuration Aeroelasticity Branch, Hampton, VA) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984. 11 p. refs
(AIAA PAPER 84-0905)

Flutter characteristics of a cantilevered high aspect ratio wing with winglet were investigated. The configuration represented a current technology, twin-engine airplane. A low-speed and a high-speed model were used to evaluate compressibility effects through transonic Mach numbers and a wide range of mass-density ratios. Four flutter mechanisms were obtained in test, as well as analysis from various combinations of configuration parameters. The coupling between wing tip vertical and chordwise motions was shown to have significant effect under some conditions. It is concluded that, for the flutter model configurations studied, the winglet related flutter was amenable to the conventional flutter analysis techniques. Author

A84-34950
AIRCRAFT NOISE CONTROL - PROGRESS AND PROSPECTS
M. J. T. SMITH (Rolls-Royce, Ltd., London, England) Aerospace (UK) (ISSN 0305-0831), vol. 11, May-June 1984, p. 27-37. refs

Attention is given to a range of experimental determinations concerning turbofan-powered airliner noise emission patterns, as well as to the development status of technology aimed at reducing such noise emissions. To date, a reduction of 20 dB has been achieved from the levels of the pure turbojet engines which originally powered the 707-generation airliners. A more recent stagnation in noise reduction gains is due to the lack of commercial interest, during recession years, which would otherwise have warranted the launching of engine design initiatives and regulatory uncertainties associated with the certification process for new engine derivatives. An evaluation is made of the effect on noise of thrust requirement reductions, 'managed' low drag approaches, selective use of noise shielding techniques, and greater climb and descent angles. O.C.

A84-35024
USB APPLIED TO HIGH-SPEED AIRCRAFT
D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 4, May-June 1984, p. 15-18.

NASA's Quiet Short-haul Research Aircraft was originally developed to investigate the low speed aerodynamic effects associated with its Upper Surface Blowing (USB) propulsive lift technique. A novel proposal currently under consideration would extend USB development and testing to an advanced high speed aircraft. NASA is contemplating the use of an existing A-3B airframe, which is stressed for high subsonic speeds and carrier landings. This aircraft is, moreover, of the high-wing, fuselage-mounted landing gear configuration required for the conversion to USB operation. Four turbofan engines will be mounted above slightly swept wings, which will incorporate tip winglets, and a high T-tail empennage will be added to prevent engine exhaust impingement on control surfaces. O.C.

A84-35025
TILT ROTOR CONCEPT EXAMINED
D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 4, May-June 1984, p. 40-44.

The design principles and operational capabilities of tilt-rotor aircraft are discussed, with a view to their bridging of the current performance gap between the helicopter and conventional turboprop aircraft. Attention is given to the recent demonstration of the tilt rotor concept by the XV-15 experimental aircraft, and to the specifications which are being addressed by tilt rotor aircraft designers for the Joint Services Advanced Vertical Lift Aircraft, or JVX, program. These include the ability to hover out of ground effect at 4000 ft, a 250-knot cruise speed, a tactical range of 1400 nautical miles, an endurance of 4 hr at 30,000 ft altitude, and high ballistic survivability and shipboard capability. O.C.

A84-35174#
F/A-18A/F404 PROPULSION SYSTEM INTEGRATION
B. R. WILLIAMS (McDonnell Aircraft Co., St. Louis, MO) and C. J. WENDEL (General Electric Co., Lynn, MA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p.
(AIAA PAPER 84-1330)

The propulsion system integration program instituted for the F-18 fighter and its F404 engines emphasized unrestricted operational capability, optimum naval carrier suitability, and excellent propulsion system reliability and maintainability. Over 5000 aircraft flight hours were flown during the Full Scale Development flight test program. Both subsonic and supersonic inlet/-engine compatibility trials demonstrated surge-free operation. Attention was given to the compatibility of armament firing and release operations with the engine inlet system, especially at flight envelope and maneuvering extremes. O.C.

A84-35215*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN OF LONG-ENDURANCE UNMANNED AIRPLANES INCORPORATING SOLAR AND FUEL CELL PROPULSION
J. W. YOUNGBLOOD, T. A. TALAY, and R. J. PEGG (NASA, Langley Research Center, Hampton, VA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(AIAA PAPER 84-1430)

Attention is given to the design features and operational capabilities of a class of unmanned flight vehicles possessing multiday mission endurance capabilities, based on the use of a mixed-mode electric power system which incorporates solar cells for diurnal energy production and a nonregenerative H2-O2 fuel cell for nocturnal energy supply. Energy is thereby provided for not only propulsion, but also the operation of the payload and the vehicle's avionics. The excess solar energy available during high insolation portions of the diurnal period may be used for climb/maneuvering or payload-related functions. Empirical structure scaling algorithms are combined with low Reynolds number aerodynamics algorithms to estimate requisite size and geometry for the chosen mission. Wing loadings will be of the order of 0.9-1.3 lb/sq ft. O.C.

A84-35687
AIRCRAFT STRUCTURES (2ND EDITION)
J. J. AZAR (Tulsa, University, Tulsa, OK) and D. J. PEERY New York, McGraw-Hill Book Co., 1982, 463 p. refs

An exposition is made of the fundamental concepts in the design and analysis of flight structures, and unified analytical tools are developed for the prediction and assessment of structural behavior irrespective of the field of application. Attention is first given to the definition of a structural system and its constituents, loads, supports, and reactions, as well as to the concepts of statics and the principles of mechanics. There follows a discussion of the basic elasticity relations and of material behavior and selection. The load analysis of flight vehicles and the analysis and design of specific flight vehicle structural components is undertaken using finite difference, stiffness matrix and energy methods for the deflections of structures. O.C.

N84-24569 Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
ESTIMATION OF THE FLIGHT PARAMETERS OF LOW FLYING AIRCRAFT USING THE RADIATED NOISE Thesis - Hochschule der Bundeswehr
J. SCHILLER Sep. 1983 157 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium der Verteidigung
(LFD-211; REPT-4-83) Avail: Issuing Activity

The use of acoustic sensors might make it possible to close the RADAR detection gap for low flying aircraft. Measurements made using one single sensor are presented. Variances in bearing angle are given and compared with computer simulation results. Two methods for estimating the dynamic flight parameters of inertially moving targets on the basis of single sensor measurements are developed and tested with real data. It is shown, that in the case of targets at high speed the retardation effect can be used for parameter estimation. Author

N84-24570# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
SYSTEM MODELING AND IDENTIFICATION OF EQUIVALENT SYSTEMS WITH AND WITHOUT COMPENSATING TIME DELAY FOR CONTROL-AUGMENTED AIRCRAFT
J. SKUDRIDAKIS Nov. 1983 106 p refs In GERMAN; ENGLISH summary Also announced as translation (ESA-TT-852)
(DFVLR-FB-83-36; ESA-TT-852) Avail: NTIS HC A06/MF A01; DFVLR, Cologne DM 34
The identification of the aerodynamic and equivalent derivatives in the longitudinal and lateral motions of modern fighter aircraft is described. The goal of the investigation was, in particular, the determination of handling qualities parameters through reduced evaluation methods in order to fulfill the requirements of the MIL-F-8785 C calculation. To accomplish this goal, the highly complex method of observing aircraft motion was reduced by means of goal-oriented simplifications to a lower order system. The report describes the mathematical modelling for various control inputs with and without compensating time-delay, their influence on the results and their accuracy. Author

N84-24571# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Wolkenphysik.
FIRST STAGE OF EQUIPMENT FOR AIRCRAFT DO 28 OF DFVLR AS A RESEARCH AIRCRAFT FOR ICING AND FIRST RESEARCH RESULTS
H. E. HOFFMAN and J. DEMMEL Nov. 1983 65 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-855)
(DFVLR-FB-83-40) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 22,50
The first stage of equipment of a Do 28 of DFVLR as a research aircraft for icing has been finished. These measurements can be made: Liquid water content (2 types of devices), temperature, rel. humidity, backscatter coefficient, ice accretion (on three different standard cylinders). During first flights in February and March 1983 the measurements resulted among other things in: The thickness of ice accretion on the standard cylinders increased linear with liquid water content between 0,06 and 0,30 g/sq m LWC; the ice accretion was the more intensive the thinner the cylinder was; when the temperature was only some degrees lower, the ice accretion was significant thicker; two different types of devices for measuring LWC resulted in good consistency. Author

N84-24572# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
THE USE OF ARALL IN FUSELAGE SKINS
J. B. DEJONGE 20 Aug. 1982 28 p refs
(Contract NIVR-1950)
(AD-B080831; NLR-TR-82081-U) Avail: NTIS HC A03/MF A01
A general review of the loading of transport aircraft fuselages is given as well as the consequent fuselage skin stresses. Taking the F-28 fuselage as an example, the potential weight savings that can be obtained by using aramide reinforced aluminum laminate as skin material, are assessed. R.J.F.

N84-24573# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THE INFLUENCE OF A MOVING SUSPENSION ON THE BEHAVIOUR OF MODELLED HELICOPTER UNDERSLUNG LOADS B.S. Thesis
J. D. LESSER and G. J. WALKER Jun. 1983 91 p refs
(BU-288) Avail: NTIS HC A05/MF A01
The influence of a moving suspension on the behavior of helicopter underslung loads was investigated both experimentally and analytically. Experimental modelling was achieved using a double pendulum arrangement incorporating three mutually perpendicular translational support stiffnesses. Both experimentally and analytically, the influence of suspension point characteristics on the behavior of the load was shown to be radical. Generic classification of this non-linear system enabled the predominant behavioral features to be isolated. Author

N84-24574# Bristol Univ. (England). Dept. of Aeronautical Engineering.
THE STRUCTURAL AND AERODYNAMIC BEHAVIOUR OF A SEMI-INFLATABLE WING B.S. Thesis
M. J. HOPKINSON and A. S. HANNHEIM Jun. 1983 44 p refs Original contains color illustrations
(BU-297) Avail: NTIS HC A03/MF A01
The viability of a semi-inflatable aerofoil structure to be used as a collapsible wing on a small Remotely Piloted Vehicle (RPV) is investigated. A prototype is tested in an open jet wind tunnel both from an aerodynamic and a structural point of view. As first tested, the form of construction was found to be inadequate. The aerofoil, in its final form, was found to be suitable for the RPV application, although improvement in the basic design could reduce the overall weight of the structure, and the internal pressure required. M.A.C.

N84-24575# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Direction Etudes.
STATISTICAL APPROACH TO DAMAGE TOLERANCE ASSESSMENT
J. M. THOMAS, B. LACHAUD, C. LAURENT, and J. M. LEONARD 23 Feb. 1984 17 p Presented at 12th ICAF Conf., Toulouse, 25-27 May 1983
(SNIAS-832-111-112) Avail: NTIS HC A02/MF A01
Civil transport aircraft fatigue strength is a very arduous problem, considering the complexity of aircraft, the diversity of their missions and airline operation and the present state of science in this field. In order to take the influence of parameters such weight, flight frequency, mission characteristics and the stress level associated with the structural design into account in a global approach, and with a view to customizing fatigue predictions for the type of operation of each commercial airline, an extensive statistical fatigue methodology was developed. This fully computerized methodology associates on one hand a parametric phase enabling an aircraft and its operation to be customized by mean of two data bases: the parametric stress data base and the disturbance statistics data base, and on the other a statistical fatigue analysis based on a representation of the stress spectrum as a stress/frequency diagram. The analysis uses a rain flow type method extended to the statistical aspect and clearly highlights the contribution of the ground-air-ground cycle. R.J.F.

N84-24576# Air Force Flight Test Center, Edwards AFB, Calif.
ELECTRICAL SUBSYSTEMS FLIGHT TEST HANDBOOK *Final* Report, Jun. 1983 - Jan. 1984
K. J. LUSH Jan. 1984 104 p
(AD-A139783; AFFTC-TIH-84-1) Avail: NTIS HC A06/MF A01 CSCL 01C
This Handbook provides engineers with guidelines for the testing of aircraft electrical subsystems. Future technological advances, characteristics of individual aircraft and test programs and cost constraints may necessitate other methods being used in some cases. A background is provided on aircraft electrical subsystems and the requirements to which they are designed. Details are provided of individual tests, test support requirements and evaluation criteria and suggestions made for presentation of results. Author (GRA)

N84-25615# Naval Air Development Center, Warminster, Pa.
CURRENT PROCUREMENT SPECIFICATION DESIGN REQUIREMENTS FOR US NAVY AIRCRAFT
S. J. KETCHAM *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 2 p Mar. 1984
Avail: NTIS HC A05/MF A01
An important step in the acquisition of a new naval aircraft is the review of detailed specifications by materials and process specialists. The specifications are studied for compliance with SD-24, MIL-F-7179 and MIL-S-5002. In addition, reports on Adhesives, Lubricants, Finishes and Corrosion Control Plans are

furnished as a contractural requirement. Some of the most important considerations are the materials to be used, designs incorporating dissimilar metals, and water tightness. Test programs may be necessary to validate a particular choice of material of design. In the final analysis, however, cost and performance are the overriding considerations so some compromises usually have to be made. The challenge is to obtain as corrosion free a vehicle as possible within these constraints. Author

N84-25616# Army Materials and Mechanics Research Center, Watertown, Mass.
CURRENT DESIGN REQUIREMENTS FOR CORROSION CONTROL ON HELICOPTERS
M. LEVY and R. D. FRENCH *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 5 p Apr. 1984
Avail: NTIS HC A05/MF A01

Aeronautical Design Standard ADS-13C embodies the general requirements for the materials and processes utilized in the design and construction of Army aircraft. The materials and processes are utilized in accordance with AMCP706-203, the Engineering Design Handbook Helicopter Engineering, part three, Qualification Assurance. The properties of materials are generally obtained from MIL-HDBK-5, MIL-HDBK-17 and MIL-HDBK-23, for metallic materials, plastics, and structural sandwich composites respectively. All of the system parts are finished to provide protection from corrosion and other forms of material deterioration in accordance with a contractor prepared and Government-approved material deterioration prevention and control (MADPAC) plan which is detailed in the appendix to ADS-13. This appendix describes the managerial and technical responsibilities of Army contractors in the design, validation, development and production phases of Army aviation systems. It provides a mechanism for the implementation of sound materials selection practices and finish treatments during the life cycle of all Army aviation weapon systems and defines the organization and implemenation of a MADPAC finish specification which complies with MIL-F-7179. ADS-13C repesents the most recent revision of the standard which embodies some of the corrosion lessons learned from Army helicopters where weight reduction was the overriding concern in the design and construction of the aircraft. Author

N84-25617# Westland Aircraft Ltd., Yeovil (England).
THE INTERPRETATION OF DESIGN REQUIREMENTS FOR MULTI-MARKET HELICOPTERS
D. R. HAYWARD *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 3 p Mar. 1984
Avail: NTIS HC A05/MF A01

An approach to corrosion control in helicopters is given. All drawing are vetted before issue to ensure that obvious corrosion sites, sharp edges, and water traps are designed out and of course to obtain the most economical means of protecting components. Wherever possible a coat of pain is applied before assembly. Measures are taken to prevent ingress of water to joints and structures by the use of caulking materials; however, great care is taken to ensure structures are adequately drained. Specific treatments of aluminum, steel, and magnesium are detailed. R.J.F.

N84-25618# Saab-Space A.B., Linkoeping (Sweden). Materials Lab.
CURRENT REQUIREMENTS ON SPECIFICATIONS FOR CORROSION PREVENTION
E. HULTGREN *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 13 p Mar. 1984
Avail: NTIS HC A05/MF A01

The of aluminum, low alloy steel, magnesium, titanium, and composite materials in aircraft construction aimed at corrosion prevention and resistance is discussed. Protective coatings, adhesives and sealants are discussed. The importance of design considerations is explained. R.J.F.

N84-25620# Vought Corp., Dallas, Tex. Materials and Processes Dept.
DESIGN AND MANUFACTURING PRACTICES TO MINIMIZE CORROSION IN AIRCRAFT
A. E. HOHMAN *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 5 p Mar. 1984 refs
Avail: NTIS HC A05/MF A01

Military weapon systems face tradeoffs of performance, cost of production and maintenance versus long term durability and reduced reliability resulting from corrosion. There is a broad set of requirements presented to contractors which represent the collective wisdom of what is needed for durability. These requirements are judged to be cost effective and near optimum in this tradeoff of performance/cost with corrosion resistance. A few examples of some specific designs, processes and materials which were found by one manufacturer to have significant advantages in this tradeoff by their excellence of protection with minimum tradeoff penalties are discussed. These details of successful experiences are intended to set the stage for two other theses. The first is that the data incorporated in United States Military documents, such as the requirements in MIL-F-7179, Protection of Aerospace Weapon Systems, Mil-Std-1568, Materials and Processes for Corrosion Control, and the materials portions of SD-24, Design and Construction of Weapon Systems, are indeed an excellent base from which we can begin the design of a weapon system. But it is an almost impossible situation to try to spell out the details required to actually obtain performance excellence in the design tradeoffs; or to define the required intricate details necessary to accomplish optimum protection from the pervasive thermodynamics of materials seeking lower free energy states. R.J.F.

N84-25627# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
THE INFLUENCE OF V/STOL ON WING DESIGN AND TAILPLANE DESIGN
C. L. BORE *In* AGARD Spec. Course on V/STOL Aerodyn. 6 p Apr. 1984
Avail: NTIS HC A17/MF A01

It is shown that one of the most powerful influences upon the payload/range of V/STOL aircraft is exerted by reducing the weight of the wing. The process of designing a lightweight wing involves meticulous effort to achieve exceptionally high maneuvering lift coefficients, combined with due attention to the geometrical and structural interactions. There are constraints all round, such as the need to avoid undue interference with jet effluxes below the wing roots, and the physical constraint of providing fuel volume and space for low drag store carriage. Any structural complexities which threaten to increase wing weight seriously (such as cut-outs, opening panels for fans or ejectors and so on) are inefficiences which should be entertained only for valuable benefits. B.W.

N84-25628*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL CONCEPTS IN THE UNITED STATES: PAST, PRESENT, AND FUTURE
W. P. NELMS and S. B. ANDERSON *In* AGARD Spec. Course on V/STOL Aerodyn. 44 p Apr. 1984 refs Previously announced as N84-22532
Avail: NTIS HC A17/MF A01 CSCL 01C

Nonhelicopter types of V/STOL aircraft developed in the United States are reviewed, and some lessons learned from a selected number of concepts are highlighted. The AV-8B, which was developed by modifications to the British Harrier is the only current concept examined. Configurations proposed for the future subsonic, multimissing aircraft and the future supersonic fighter/attack aircraft are described. Emphasis is on these supersonic concepts. B.W.

N84-25634# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
GROUND BASED TESTING WITHOUT WIND TUNNELS
C. L. BORE *In* AGARD Spec. Course on V/STOL Aerodyn. 6 p Apr. 1984 refs
Avail: NTIS HC A17/MF A01

Ground based tests of V/STOL aircraft not requiring wind tunnels are described. Harrier aircraft and the Bristol-Siddeley BS 53 (Pegasus) engine are given particular consideration. Tests of aircraft reaction controls, air intakes, anti-lift (suckdown) forces, and hot gas recirculation (HGR) are discussed. Jet thrust was the critical parameter studied in all of the test schemes. Modifications in aircraft design, such as the use of underfuselage strakes, were addressed. R.S.F.

N84-25637# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
NOTES ON SPECIAL FLIGHT ASPECTS, SUCH AS STO, SKI-JUMP AND ODM
C. L. BORE *In* AGARD Spec. Course on V/STOL Aerodyn. 6 p Apr. 1984 refs
Avail: NTIS HC A17/MF A01

The dimensionless parameters which dominate the performance of jet-lift V/STOL aircraft are reviewed. Thrust ratings, forces extant in partially jet-borne flight, short takeoff, takeoff-weight ratio, ski-jump takeoff, and deck launch are considered. Harrier aircraft and the Bristol-Siddeley BS 53 (Pegasus) engine serve as the paradigms for the discussion. R.S.F.

N84-25700# Cranfield Inst. of Tech., Bedfordshire (England). College of Aeronautics.
A TECHNIQUE FOR OPTIMIZING THE AERODYNAMIC DESIGN OF A GENERALIZED COMBAT AIRCRAFT WITH FORWARD SWEPT WINGS FOR THE PURPOSES OF STABILITY AND CONTROL INVESTIGATION
M. V. COOK and S. J. P. ORIORDAN Jan. 1984 87 p refs
(CA-8325) Avail: NTIS HC A05/MF A01

A technique was developed to optimize the airframe for aerodynamic performance of a genaralized combat aircraft with a forward swept wing with close coupled canard. A computer program was written and its output includes geometric and other parameters as a required for stability and control studies. A second computer program was written to estimate the aerodynamic stability and control derivatives of an optimized airframe. Two airframes with a single engine and with two engines were investigated. The flying qualities problems arising from the configurations were studied. An analogue simulation was carried out which highlighted some problems resulting from the longitudinal static instability inherent in both configurations. A trade off between the requirement for minimum weight and the stability characteristics is undertaken. E.A.K.

N84-25701*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
F-14 MODELING STUDY Final Report
W. H. LEVISON and S. BARON May 1984 91 p refs
(Contract NAS1-16738)
(NASA-CR-172336; NAS 1.26:172336) Avail: NTIS HC A05/MF A01 CSCL 01C

Preliminary results in the application of a closed loop pilot/simulator model to the analysis of some simulator fidelity issues are discussed in the context of an air to air target tracking task. The closed loop model is described briefly. Then, problem simplifications that are employed to reduce computational costs are discussed. Finally, model results showing sensitivity of performance to various assumptions concerning the simulator and/or the pilot are presented. M.G.

N84-25702*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STRUCTURAL SIZING OF A SOLAR POWERED AIRCRAFT Final Report
D. W. HALL and S. A. HALL Apr. 1984 105 p refs
(Contract NAS1-16975)
(NASA-CR-172313; NAS 1.26:172313; LMSC-D878711) Avail: NTIS HC A06/MF A01 CSCL 01C

The development of sizing algorithms for very lightweight aircraft structure was studied. Three types of bracing schemes were analyzed and fully cantilevered strut bracing and wire bracing and scaling rules were determined. It is found that wire bracing provides the lightest wing structure for solar high altitude powered platforms. E.A.K.

N84-25703# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Direction Etudes.
RENOVATION OF THE HELICE [LA RENOVATION DE L'HELICE]
D. BERGER and P. JACQUET 23 Feb. 1984 25 p In FRENCH Presented at Salon Intern. Des Tech. et Energies Du Futur (SITEF) 83, Toulouse, 18 - 23 Oct. 1983
(SNIAS-832-111-109; REPT-474.145/83) Avail: NTIS HC A02/MF A01

Technical, economic, and political reasons for renewed interest in propulsion by propeller are examined. Manifestations of this revival are new aircraft programs and studies conducted by the designers of propellers and aircraft engines. Highlights of the American Advanced Turboprop project (propfan technology) are included. The French program for developing propellers for aircraft capable of flight between 0.7 and 0.8 Mach number is emphasized. Transl. by A.R.H.

N84-25704# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Direction Etudes.
CARBON STRUCTURES ON THE WING OF THE REGIONAL TRANSPORT PLANE ATR-42 [LES STRUCTURES DU CARBONE SUR LA VOILURE DE L'AVION DE TRANSPORT REGIONAL ATR-42]
G. HELLARD 23 Feb. 1984 17 p In FRENCH Presented at SAMPE Conf., Bordeaux, 17 - 20 Oct. 1983
(SNIAS-832-111-113) Avail: NTIS HC A02/MF A01

The A.T.R. 42 aircraft, capable of transporting from 42 to 50 passengers a maximum distance of 1760 km, has a number of important structural composites on the wing as well as the fuselage and the empennages. Kevlar and the hybrid Kevlar/carbon are used for the wing unit. Carbon fibers are used for the ailerons and the high lift flaps. Studies conducted to define the best performing material for the ailerons and flaps, at minimal cost, are described. It was found that the monolithic multiribbed box are best for the wing and that carbon/Nida sandwich structures are best for the flaps. These elements were certified by static tests and fatigue/aging test of the entire part. A.R.H.

N84-25705# Societe .Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
SYSTEM CONCEPTS FOR HELICOPTER AIR-TO-AIR COMBAT
BRUNELLO, LETOUZEY, SCARAMUZZINO, and CATANI 1983 4 p Presented at the AAAF 8th European Rotorcraft and Powered Lift Aircraft Forum, Aix-en-Provence, France, 31 Aug - 3 Sep. 1982
(SNIAS-832-210-102) Avail: NTIS HC A02/MF A01

A simulation method for helicopter air to air combat is described. A model is developed and firing data is compared through actual sighting and firing experiments. Examples of firing simulation and subsequent accuracy are examined. M.A.C.

N84-25706# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
THE DEVELOPMENT OF THE NAVY VARIANT OF THE DAUPHIN 2 HELICOPTER
A. CASSIER 1983 12 p Presented at the AAAF 9th European Rotorcraft and Powered Lift Aircraft Forum, Stresa, Italy, 13-15 Sep. 1983
(SNIAS-832-210-106) Avail: NTIS HC A02/MF A01
AEROSPATIALE'S SA 365 DAUPHIN is a new generation 4 tons helicopter. It has been designed to meet civil and military operator's requirements in various configurations. The civil version, SA 365 N, has been in service since 1981; it is particularly well suited for passengers' transport or offshore missions. This multipurpose helicopter is easily adapted to military roles. The naval version, SA 365 F, was developed in 1981 and is being delivered now. SA 365 F is available in several configurations for Search and Rescue (SAR), Anti Surface Vessel Warfare (ASV) and Anti Submarine Warfare (ASW) missions. The purpose of this expose is to review the main characteristics of these various configurations and to discuss the development of this helicopter.
Author

N84-25707# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
AEROSPATIALE'S EXPERIENCE ON HELICOPTER FLIGHT IN ICING CONDITIONS
D. TRIVIER and G. AVEDISSIAN 1983 10 p refs Presented at the AAAF 9th European Rotorcraft and Powered Life Aircraft Forum, Stresa, Italy, 13-15 Sep. 1983
(SNIAS-832-210-107) Avail: NTIS HC A02/MF A01
Helicopter rotor icing protection systems are evaluated through flight tests under actual icing conditions. The development of a practical flight envelope which considers altitude, temperature, and icing severity is discussed. Flights without deicing protection are conducted to determine flight characteristics under total system failure. M.A.C.

N84-25709# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flaechenflugzeuge.
DESIGN AND IMPLEMENTATION OF INPUT SIGNALS FOR IDENTIFICATION OF PILOT/AIRCRAFT MODELS
R. KOEHLER Jan. 1984 45 p refs In GERMAN; ENGLISH summary Translation will also be announced as ESA-TT-880
(DFVLR-FB-84-08; ESA-TT-880) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 17
A flight test method to investigate flying qualities of combat aircraft in ground attack maneuvers is presented. Simulated attacks to dynamically switched ground based targets are carried out to assess flying qualities and to identify pilot/aircraft systems. The method has been successfully applied in pilot rating tests. This report deals with the design of input signals and preparation of flight tests. Author

N84-26437 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich.
THE AIRBUS: THE STATE-OF-THE-ART TODAY, AND FUTURE DEVELOPMENTS [DER AIRBUS: HEUTIGER STAND UND ZUKUENFTIGE ENTWICKLUNGEN]
H. G. KLUG *In its* Tech. and Sci. Publ. 1983 p 109-118 1983 In GERMAN Presented at Haus der Tech., Essen, 16 Nov. 1982
(MBB-UT-22-83-O) Avail: Issuing Activity
The European collaboration on the European Airbus construction is reported. The historical background of the Airbus, and the contributions by the participating countries are enumerated. The structural characteristics, and the urther development and improvements are discussed. Transl. by E.A.K.

N84-26439 Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany). Werkstoff-und Verfahrenstechnik.
SUCCESSFUL UTILIZATION OF ECONOMIC, LIGHT ALUMINUM-CASTED STRUCTURES IN AIRPLANE CONSTRUCTION [ERFOLGREICHE EINFUEHRUNG WIRTSCHAFTLICHER UND LEICHTER ALUMINIUM-GUSSSTRUKTUREN IM FLUGZEUGBAU]
D. MIETRACH *In* MBB Tech. and Sci. Publ. 1983 p 139-157 1983 refs In GERMAN Presented at Lehrgang: Ontwerpen en Gieten van Hoogwaardige Construct., Delft, 19-20 Oct. 1983
(VFW-31/83-O) Avail: Issuing Activity
Aluminum casting techniques in the aircraft industry are examined. The advantages of casting techniques, casting procedures and materials, directions for casters and quality control are described. New casting methods, test methods and possibilities, and reproducible castings are discussed. Transl. by E.A.K.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A84-33830
INDICATION AND ALERTING
T. E. FORD Aircraft Engineering (ISSN 0002-2667), vol. 56, April 1984, p. 6-9.
The Engine Indication and Crew Alerting (EICAS) system incorporated into the flight decks of the 757 and 767 airliners is arranged so that each parameter has a dedicated display location for normal operations, while automatic display changes occur only to indicate engine or system abnormality. Redundant computers and CRT displays ensure EICAS availability in the event of a component failure, and the built-in test equipment has a ground test mode (including a test pattern and a system of self-test indication) on each CRT. The EICAS computers monitor over 400 analog and digital input signals for the generation of alert, status, and maintenance messages. Automatic recording of subsystem parameters occurs whenever an alert message is indicated.
O.C.

A84-35899
REDUNDANT COLOR CODING ON AIRBORNE CRT DISPLAYS
C. B. LUDER (Birkbeck College; London, University, London, England) and P. J. BARBER (Birkbeck College, London, England) Human Factors (ISSN 0018-7208), vol. 26, Feb. 1984, p. 19-32. refs
An experiment is described that compares the use of redundant color coding for search and identification tasks under dual-task conditions; subjects made judgements about the state of components of a systems-management display while performing a compensatory tracking task. The availability of redundant color coding on the secondary task resulted in a global improvement in tracking performance (primary task) that applied at all times, even when subjects were not attending to the systems-management display. With regard to the response-time data for the color-coded display, redundant color coding improved search performance, but there was no benefit for performance on the identification task. The implications of the results for hypotheses relating to the serial or parallel processing of shape and color, and for cockpit applications generally, are discussed. Author

A84-36259#

DIGITAL SCAN CONVERSION

J. C. WALLACE (Philips Electronics and Associated Industries, Ltd., MEL Div., Crawley, Sussex, England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 301-306.

The choice of format for the airborne display of digital scan-converter pictures is discussed, as are problems involved in the processing of raw radar data required for a standard 625 line TV to display the many shapes needed to categorize the varied radar echoes in a busy tactical scene. A constant scanner rotational speed is considered, and both the pulse width and PRF are varied for different tactical requirements. Incoming data are digitized at a high rate and transferred to the mainstore for further processing and TV readout. The data are later parallel processed using pattern recognition and enhancement prior to conversion from R0 to XY coordinates. It is established that the replacement of a 'high definition' direct view display with a comparatively low definition raster scanned TV display results in less operator fatigue, greater accuracy of data, and sharper clarity of display. J.N.

A84-36261

A SMALL INTEGRATED J BAND ALTIMETER

L. D. CLOUGH, D. E. LLOYD, J. C. PARKER, and W. RICHMOND (Royal Signals and Radar Establishment, Malvern, Worcs., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 339-343.

A miniature totally-integrated radar altimeter constructed using thick film microstrip and hybrid techniques is described. The receive and transmit antennas are of the traveling-array type fabricated in thick film microstrip on alumina substrates. The antennas have a gain of 7 dBs with a beamwidth of approximately 35 deg in both E and H planes. The antennas are protected with a radome interface which only slightly modify the polar diagram. The transmitter is a GaAs Read IMPATT diode in a microstrip matching circuit giving 8 watts peak power in a 80 ns pulse. The transmitter modulator is directly integrated to the device in thick film hybrid using VMOS technology. A drop in isolator is used between the transmitter and the antenna. The receiver uses a 90 deg hybrid balanced mixer in thick film microstrip with a conversion loss of 8 dBs. The LO uses a low power Gunn diode microstrip oscillator which is stabilized by a dielectric resonator. The video amplifier and processing electronics are fabricated in thick film hybrid and packaged in three 40 pin packages. The overall unit measures 300 mm x 90 mm x 60 mm. Author

A84-36262#

A 60 GHZ COLLISION WARNING SENSOR FOR HELICOPTERS

B. REMBOLD, H. G. WIPPICH, M. BISCHOFF, and W. F. X. FRANK (Telefunken AG, Ulm, West Germany) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 344-351. refs

Using a frequency near the atmospheric attenuation maximum of 60 GHz a short range collision warning device for helicopters has been developed. The system consists of a pulsed radar sensor using semiconductors exclusively, a fast scanning mechanism and a display. First measurements showed that high voltage transmission lines having diameters of about 20 mm could be detected at a distance of more than 400 m. Author

A84-36287#

NEW RESULTS OF AIRBORNE MEASUREMENTS WITH A SENSITIVE, HIGH RESOLUTION 90 GHZ RADIOMETER - FIRST RESULTS FOR AN EQUIVALENT 140 GHZ SYSTEM

H. SUESS, K. GRUENER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany), and B. VOWINKEL (Koeln, Universitaet, Cologne, West Germany) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 534-540. refs

The principal possibilities of passive airborne imaging in the 90 GHz and 140 GHz region by a sensitive high resolution system are demonstrated. The front-end module of the system consists of an antenna scalar feed horn and a GaAs single-ended Schottky mixer and an integrated first-stage FET IF-amplifiers. The scanning antenna system consists of a high-speed swinging offset parabolic mirror. Results of 90 GHz measurements carried out during fog are presented, and initial data for 140 GHz measurements are compared to equivalent 90 GHz measurements. J.N.

A84-36299

INFRA-RED LASER VELOCIMETRY

J. M. VAUGHAN (Royal Signals and Radar Establishment, Malvern, Worcs., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 625-631.

Optical and signal processing techniques for the remote measurement of velocity employing coherent laser radars at 10 microns are described. Both CW and stabilized pulse lasers may be used; recent investigations have achieved quantum limited efficiencies. A number of applications are outlined including a compact airborne system for measurement of true airspeed and gust and shear warning. Most recent studies with the Laser True Airspeed System (LATAS), currently installed in the HS125 trials aircraft at RAE Bedford, are described. Author

07

AIRCRAFT PROPULSION AND POWER

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

A84-34134

STRENGTH CALCULATION FOR AN AVIATION GTE STATOR IN AXISYMMETRIC DEFORMATION [RASCHET NA PROCHNOST' STATORA AVIATSIONNOGO GTD PRI OSESIMMETRICHNOM DEFORMIROVANII]

V. B. ZHUKOV Problemy Prochnosti (ISSN 0556-171X), no. 4, 1984, p. 93-101. In Russian.

The forces, displacements, and stresses associated with a stator in axisymmetric deformation are determined for an evaluation of the strength and economic operation of gas-turbine engines. The present calculation method models the stator structure as an integral arrangement of circular rings, annular plates, and shells. The rings serve as the principal connecting elements and are used to determine boundary conditions and the junction of plates and shells. The shells are of finite length and zero Gaussian curvature, and are calculated using the theory of restoring moments supplemented by edge effect equations. All elements are considered to operate in the elastic region. Conditions for the simultaneous deformation of stator elements are given for both ascending and descending systems of rings, plates, and shells. The computer solution of 2m linear algebraic equations for m rings in terms of radial displacements and angular rotations also solves for displacements of the center of gravity of the ring sections. J.N.

A84-34455*# Southwest Research Inst., San Antonio, Tex.
SPECIFICATION, DESIGN, AND TEST OF AIRCRAFT ENGINE ISOLATORS FOR REDUCED INTERIOR NOISE
J. F. UNRUH (Southwest Research Institute, San Antonio, TX) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 389-396. refs
(Contract NAS1-14861)
Previously cited in issue 10, p. 1377, Accession no. A83-25932

A84-34457#
THRUST REVERSER EXHAUST PLUME REINGESTION MODEL TESTS
N. F. AMIN and C. J. RICHARDS (Northrop Corp., Advanced Design Propulsion Dept., Hawthorne, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 401-407.
Previously cited in issue 16, p. 2307, Accession no. A83-36293

A84-34723
COMPARISON OF COMBUSTION EFFICIENCIES FOR RAMJET ENGINES [VERGLEICH VON VERBRENNUNGSGUETEGRADEN FUER STAUSTRAHLANTRIEBE]
J. W. BERGMANN (Industrieanlagen - Betriebsgesellschaft mbH, Ottobrunn, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Mar.-Apr. 1984, p. 129-133. In German.
Four different combustion efficiencies commonly used for assessing ramjet engines are compared. The mixture ratios cover a range from stoichiometric to an equivalence ratio of 0.2, and the polyethylene/air propellant system is used. The ratio of effective to ideal temperature rise is taken as reference efficiency. As might be expected, major differences can be observed near stoichiometric and down to equivalence ratios of 0.5. These are quantitatively demonstrated. Author

A84-34905#
DESIGN OF INTEGRALLY DAMPED COMPRESSOR VANES
P. M. NISKODE, R. B. DICKMAN, and M. J. SCHUMACHER (General Electric Co., Cincinnati, OH) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984. 7 p.
(AIAA PAPER 84-0867)
Integrally damped compressor stator vane configurations use viscoelastic material sleeves bonded to both the vane inboard end and the inboard shroud ring to dissipate vibratory energy in shear as well as in extension and compression. The degree and the character of the energy dissipation, which are dependent on the vane's configuration and its vibratory mode characteristics, are presently calculated by means of a finite element program. Both the vane and the viscoelastic materials are modeled in terms of isoparametric, eight-node box elements. Study results indicate vibratory stress levels for integrally damped vanes which are significantly lower than those of their undamped counterparts. This offers designers latitude for the minimization of compressor weight. O.C.

A84-35128#
DESIGN OF ROBUST DIGITAL CONTROLLERS FOR GAS TURBINES WITH EXPLICIT ACTUATOR AND SENSOR DYNAMICS
B. PORTER (Salford, University, Salford, Lancs., England) and T. MANGANAS AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p. refs
(AIAA PAPER 84-1185)
Multi-input multi-output dynamical systems such as gas turbines usually exhibit explicit actuator and sensor dynamics which are often ill-defined. Singular perturbation methods are accordingly used to provide a basis for the design of discrete-time tracking systems incorporating fast-sampling error-actuated digital controllers for multivariable plants with such explicit actuator and sensor dynamics. These general results are illustrated by designing a robust digital controller for the rotational speeds of the low-pressure and high-pressure spools of a typical gas turbine. Author

A84-35133#
AXIAL FLOW COMPRESSOR PERFORMANCE DETERIORATION
C. BALAN and W. TABAKOFF (Cincinnati, University, Cincinnati, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 14 p. refs
(Contract DAAG29-82-K-0029)
(AIAA PAPER 84-1208)
Aircraft engines operating in areas where the atmosphere is polluted with small solid particles are subjected to performance deterioration. Improvement in performance deterioration can prolong the engine life and save operating expenses. Such an improvement is possible only by understanding the basic mechanism of erosion and the associated performance degradation. This paper presents experimental work carried out on two-dimensional compressor cascades along with a theoretical model to predict the performance deterioration of cascades subjected to erosion. In addition, investigations are carried out on a single stage axial flow compressor to study the effect of erosion on performance. Author

A84-35134#
AXISYMMETRIC APPROACH AND LANDING THRUST REVERSER CONCEPTS IN-GROUND EFFECTS WIND TUNNEL TEST RESULTS
M. F. EIGENMANN, D. E. KITZMILLER (McDonnell Aircraft Co., St. Louis, MO), and A. D. HAKIM (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 13 p. refs
(AIAA PAPER 84-1215)
Low speed wind tunnel model tests were conducted to evaluate the operational effects of three axisymmetric nozzle approach and landing thrust reverser (ALTR) concepts on the stability and control characteristics of a typical twin-engine fighter aircraft. Both in-ground and out-of-ground effects testing was accomplished. To broaden the general applicability of the data, single centerline vertical tail and twin vertical tail airframe configurations were evaluated with selected ALTRs. The in-ground effects test results showed that, in general, the ALTRs had a minimal (sometimes favorable) impact on the aircraft longitudinal and directional stability and control characteristics. The changes in longitudinal characteristics from the baseline aircraft were primarily due to the interaction of the lower reverser jets with the ground flowfield. Changes in directional characteristics were due to the reverser jet influence on the vertical tail flowfield. Reverser flowfield visualization obtained during the testing indicated that the potential for inlet hot gas ingestion is a direct function of the reverser flow turning angle, lateral splay angle, and nozzle pressure ratio. Author

A84-35136#
AN EXPLORATORY STUDY OF RETIREMENT-FOR-CAUSE FOR GAS TURBINE ENGINE COMPONENTS
J. N. YANG and S. CHEN (George Washington University, Washington, DC) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 14 p. refs
(Contract F33615-81-C-5015)
(AIAA PAPER 84-1220)
A probabilistic retirement-for-cause (RFC) analysis methodology based on the application of fracture mechanics is developed for gas turbine engine components. The initial fatigue quality is represented by both the statistical distributions of the initial flaw size and the time to crack initiation. Various statistical uncertainties in the entire RFC system, such as nondestructive evaluations, crack growth damage accumulations, etc., have been taken into account. A cost/risk optimization analysis has been been

formulated to determine the optimal inspection interval and the corresponding life-cycle-cost savings. It is shown that the scheduled inspection maintenance can be used to improve the reliability of gas turbine engine components significantly, and that the application retirement-for-cause procedures results in a substantial life-cycle-cost saving. Practical examples are given to demonstrate the application of the proposed methodology. Author

A84-35149*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
HIGHLY INTEGRATED DIGITAL ENGINE CONTROL SYSTEM ON AN F-15 AIRPLANE
F. W. BURCHAM, JR. (NASA, Flight Research Facility, Edwards, CA) and E. A. HAERING, JR. AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(AIAA PAPER 84-1259)

The highly integrated digital electronic control (HIDEC) program will demonstrate and evaluate the improvements in performance and mission effectiveness that result from integrated engine-airframe control systems. This system is being used on the F-15 airplane at the Dryden Flight Research Facility of NASA Ames Research Center. An integrated flightpath management mode and an integrated adaptive engine stall margin mode are being implemented into the system. The adaptive stall margin mode is a highly integrated mode in which the airplane flight conditions, the resulting inlet distortion, and the engine stall margin are continuously computed; the excess stall margin is used to uptrim the engine for more thrust. The integrated flightpath management mode optimizes the flightpath and throttle setting to reach a desired flight condition. The increase in thrust and the improvement in airplane performance is discussed in this paper. Author

A84-35153#
REGENERATIVE INTERCOOLED TURBINE ENGINE (RITE) STUDY
E. A. T. MOCK, R. T. CALDWELL, and K. E. BOYD (Garrett Turbine Engine Co., Phoenix, AZ) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p.
(AIAA PAPER 84-1267)

A study was conducted to determine the suitability of an advanced technology Regenerated Intercooled Turbine Engine (RITE) for aircraft propulsion. A cycle performance analysis was conducted for a 250 shp, 25,000 ft cruise turboprop engine for a pressurized twin engine six-place turboprop aircraft. The RITE engine cycle consists of a two-stage compressor with a rotary intercooler, gas generator turbine driving the compressors, a combustor, rotary regenerator, and power turbine. Cycles were analyzed over a range of design-point pressure ratios and heat exchanger sizes at a turbine inlet temperature of 2500 F. An aircraft and its flight characteristics were defined to evaluate candidate engines on the basis of prescribed mission fuel consumption. After preliminary design selection, a life cycle cost analysis was performed in which the reference engine was compared to a conventional turboprop engine. The selected engine design achieves a cruise specific fuel consumption of 0.252 lb/hp-hr which is about half that of a conventional engine with the same power rating. The predicted life cycle cost of the engine is lower without an intercooler, due to marginal improvement in cycle efficiency contributed by intercooling. Author

A84-35154#
ADVANCED TURBOFAN CONCEPT WITH REGENERATOR AND INTER-COOLED COMPRESSOR
Y. MIURA and C. SAKURAI (Metropolitan College of Technology, Tokyo, Japan) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 10 p. refs
(AIAA PAPER 84-1270)

A performance prediction assessment is made for a high bypass turbofan engine concept which incorporates not only the exhaust waste heat-recirculating regenerator stage of previous investigations, but also an intercooling stage between high and low pressure compressors. The intercooler employs both cool fan exhaust air and cold freestream ram air as heat sinks. Detailed thermodynamic calculations are presented for the various stages of the combined intercooler/regenerator cycle, and performance levels are predicted for both cruising flight and takeoff conditions that are then compared with performance values representative of similarly sized conventional turbofans. Improvements are noted in thrust-specific fuel consumption, with favorable consequences for flight range. O.C.

A84-35155#
ASPECTS OF ADVANCED FIGHTER ENGINE DESIGN ON THE BASIS OF EQUAL TECHNOLOGY
H. TOENSKOETTER (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 12 p.
(AIAA PAPER 84-1271)

The extended high thrust mission phases of future air-defense fighters, together with technologically increased turbine inlet temperature, will consequently lead to a reheatless (dry) engine concept. To illustrate this, a dry-engine and a reheat engine with low bypass-ratios have been projected, utilizing a moderate-advanced technology level available for engines of the early nineties. Due to the different engine characteristics, life potential of the dry-engine hot parts can be much lower compared with the reheat engine. Furthermore, the dry engine will feature a lower overall pressure ratio (lower cooling-air temperature), so that for this engine type a more than 100 K higher turbine inlet temperature can be realized. Nevertheless, the technology levels of both engines are equal. Comparing a dry-engine and a reheat engine, both individually tailored to the air-defense fighter role, the dry-engine leads to a 20 percent reduction in total propulsive weight and to about 10 percent lower aircraft weight. Author

A84-35176*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY FLIGHT TEST RESULTS OF THE F100 EMD ENGINE IN AN F-15 AIRPLANE
L. P. MYERS and F. W. BURCHAM, JR. (NASA, Flight Research Center, Edwards, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 10 p. refs
(AIAA PAPER 84-1332)

An assessment is given of results from a 17-flight evaluation of the F100 Engine Model Derivative (EMD) powerplant in an F-15 fighter. The EMD variant of the F100 engine incorporates a larger fan, a higher temperature turbine, a digital control system, and a 16-segment afterburner. These modifications result in a 15 to 20 percent increase in thrust which is exhibited in the reduction of F-15 acceleration time to Mach 2.0 by 23 percent. The only uncorrected shortcoming of the engine upon completion of the 17-flight test course was the occurrence of compressor stalls at the throttle's idle setting. These stalls had not been predicted by either ground facility tests or compressor stability assessments. O.C.

A84-35177#
LESSONS LEARNED IN THE DEVELOPMENT OF A DIGITAL ELECTRONIC ENGINE CONTROL
R. CORY (Pratt and Whitney Aircraft, West Palm Beach, FL) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p.
(AIAA PAPER 84-1335)

Recent F15 and F16 flight tests have substantiated the predicted benefits of a full authority electronic engine control system. These benefits, which include improved performance, operability and on line failure detection and accommodation, have paved the way for incorporation of the Digital Electronic Engine Control (DEEC) system into derivatives of the F100 engine. The DEEC, which is the primary engine control, ensures safe engine operation while controlling the various engine variables. The basic control concept was conceived and developed over a period of time beginning in 1974. A large analytical effort supported the control mode selection, along with several thousand engine test hours at sea level and altitude conditions. The advent of digital electronic engine controls has brought about 'new lessons learned' as part of the development process. This paper reports on these lessons and the impact they have had and will continue to have on the development of the next generation of full authority electronic engine control systems. Author

A84-35178#
V/STOL ENGINE DEVELOPMENT
W. J. LEWIS (Rolls-Royce, Ltd., Bristol, England) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p.
(AIAA PAPER 84-1337)

The development of the Pegasus vectored thrust V/STOL engine is described with particular emphasis on achieving thrust growth while meeting the requirement imposed by its V/STOL aircraft installation. In addition, problems that occurred with certain components of the engine due to its V/STOL application are outlined. Some of the lessons learned during the development program of both the basic engine and of the powerplant installation are listed and these provide an indication of some procedures that need to be accepted to ease the development of future V/STOL propulsion systems. Author

A84-35199#
DEMONSTRATION OF A NEW BODY-FITTED COORDINATE CODE FOR MODELING GAS-TURBINE COMBUSTOR FLOWS
W. SHYY, S. M. CORREA, and S. S. TONG (General Electric Co., Schenectady, NY) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 8 p. refs
(AIAA PAPER 84-1381)

Since gas-turbine combustors have complex shapes, models for predicting their behavior should be based on curvilinear coordinate systems. Ease of grid generation and the possibility of dynamically adaptive grids are consequent advantages. An assumed shape pdf/fast-chemistry, k-epsilon turbulence model using the Favre-averaged Navier-Stokes equations and based on numerical coordinate transformation is presented. The model is applied to a generic two-dimensional combustor by way of demonstration and to assess the performance of various finite-difference operators (first-order upwind, second-order central, second-order upwind and QUICK) in the transformed equations. Three grids were used: a relatively uniform 31 x 26 grid, a less unform 31 x 26 grid, and a 41 x 41 grid. It is demonstrated that the second-order upwind scheme is the best compromise in terms of accuracy and stability. The code was also used to study grid clustering and showed that the optimal grid is highly flow-dependent. Finally, an internal check on the accuracy and the sufficiency of the grid - based on the continuity of mass flux in the physical domain - shows that the denser grids (40 x 40) are very satisfactory. Author

A84-35204*#
DESIGN OF A HIGH-PERFORMANCE ROTARY STRATIFIED-CHARGE RESEARCH AIRCRAFT ENGINE
C. JONES and R. E. MOUNT (John Deere Technologies International, Inc., Rotary Engine Div., Wood-Ridge, NJ) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(Contract NAS3-23056)
(AIAA PAPER 84-1395)

The power section for an advanced rotary stratified-charge general aviation engine has been designed under contract to NASA. The single-rotor research engine of 40 cubic-inches displacement (RCI-40), now being procured for test initiation this summer, is targeted for 320 T.O. horse-power in a two-rotor production engine. The research engine is designed for operating on jet-fuel, gasoline or diesel fuel and will be used to explore applicable advanced technologies and to optimize high output performance variables. Design of major components of the engine is described in this paper. Author

A84-35207#
UNITED KINGDOM MILITARY ENGINE MONITORING EXPERIENCE
G. L. P. ALDHOUSE AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 7 p.
(AIAA PAPER 84-1409)

Royal Air Force (RAF) policy is to progress as expeditiously as possible towards on condition maintenance for its entire engine inventory. In connection with the need to achieve this goal in a cost-effective manner, the RAF became actively involved in the development of engine usage and monitoring systems. The characteristics of the developed Engine Usage Monitoring System (EUMS) are discussed, taking into account aspects of EUMS application, the Data Acquisition Unit, the Quick Access Recorder, the Ground Data Processing Station, and the minicomputers with the microprocessor. EUMS results are examined, giving attention to low cycle fatigue (LCF), LCF exchange rates calculated from EUMS data, the LCF counter, and EUMS improvements. A description of engine condition monitoring systems is also provided, and future developments are discussed. G.R.

A84-35208#
EVALUATION OF BENEFITS OF THE A-10/TF34 TURBINE ENGINE MONITORING SYSTEM SQUADRON INTEGRATION PROGRAM
S. W. TARQUINIO, J. W. OLSEN (ARINC Research Corp., Annapolis, MD), J. FLORES (USAF, San Antonio Air Logistics Center, Kelly AFB, TX), and R. B. CHRISTOPHEL (ARINC Research Center, San Antonio, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. refs
(AIAA PAPER 84-1414)

The A-10/TF34 Turbine Engine Monitoring System (TEMS) Squadron Integration Program (SIP) was initiated in September 1981 to establish an engine maintenance environment based on continuous in-flight engine monitoring. The primary objective is the integration of engine monitoring and diagnostic capabilities into the maintenance and logistics procedures for the A-10/TF34 engine. That maintenance environment is further supported by the prototype Comprehensive Engine Management System (CEMS) Increment IV, which provides ground-based data processing capability. ARINC Research Corporation evaluated the overall operational effectiveness of the TEMS SIP in the areas of flight operations, maintainability, logistics, and maintenance procedures. Preliminary results indicate that continuous in-flight monitoring enhances base level maintenance and is especially effective in identifying potential engine problems early enough to avoid catastrophic failure. This paper outlines the SIP operations, summarizes our experience with the TEMS detections of engine failures, and reviews the preliminary results of TEMS on the engine maintenance process. Author

A84-35216#
PROPANE POWERED ENGINE FOR LONG DURATION UNMANNED AIRCRAFT
J. E. BORETZ (TRW, Inc., Applied Technology Div., Redondo Beach, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 7 p. refs
(AIAA PAPER 84-1431)

Attention is given to six propulsion system alternatives which have been systematically considered as the basis for unmanned aircraft missions of duration ranging from several days to 4 years at altitudes of from 47,500 ft to 110,000 ft. Each propulsion system studied furnishes an electrical power output to electric motor-driven propellers. The system configurations were (1) a solar cell array with storage batteries; (2) a propane-powered Organic Rankine Cycle Electric Power System (ORCEPS); (3) a solar array/propane-powered ORCEPS combination; (4) a Po-210 isotope ORCEPS; (5) a Pu-238 isotope ORCEPS; and (6) a liquid metal-cooled U-ZrH reactor ORCEPS system. O.C.

A84-35222#
MEASURING TURBINE ENGINE INLET TOTAL TEMPERATURE PROBLEMS AND SOLUTIONS
J. L. EDWARDS, T. J. SCHWARTZ (Rosemount, Inc., Minneapolis, MN), and R. J. HART (Pratt and Whitney Aircraft of Canada, Ltd., Quebec, Canada) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p.
(AIAA PAPER 84-1457)

The use of a platinum resistance thermometer is assumed in the present discussion of the problems encountered in the gathering of accurate total temperature measurements for turbine engine inlets. Such accurate measurements are required in order to both reduce pilot workload and ensure safe and efficient engine operation. Significantly improved prospects for the achievement of high measurement accuracies are noted for the use of microprocessors, since sensors that might previously have been considered too inaccurate can be used as control system inputs to which error source rating margins will be automatically applied. O.C.

A84-35232#
DEVELOPMENT OF THE NAVY JET TRAINER DUTY CYCLE
S. M. COTE (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 5 p. refs
(AIAA PAPER 84-1486)

The U.S. Navy has selected the T-45 aircraft powered by the Adour Mk851 turbofan to serve as its new advanced jet trainer. To avoid significant engine durability problems and associated system support costs, an accelerated simulated mission endurance test (ASMET) was developed. A T-2C and TA-4J aircraft were instrumented for recording actual trainer engine usage data which were the basis for the ASMET. Squadron interviews determined the specific training flight profiles and hot time content. The new trainer duty cycle was developed to simulate 1000 engine operating hours. A production Adour engine was tested to this duty cycle, demonstrating its component durability. Results of the test have shown that the Adour engine has adequate durability to satisfy the new trainer duty cycle requirements. Other aspects regarding usage and durability are discussed. Author

A84-35235#
FUEL EFFECTS ON GAS TURBINE COMBUSTION - LINER TEMPERATURE, PATTERN FACTOR AND POLLUTANT EMISSIONS
A. H. LEFEBVRE (Purdue University, West Lafayette, IN) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 18 p. USAF-supported research. refs
(AIAA PAPER 84-1491)

Data acquired on the effects of fuel properties on the performance and reliability of several gas turbine combustors, including J79-17A, J79-17C, F101, TF41, TF39, J85, TF33, and F100 are studied. Quantitative relationships are derived between liner wall temperature, pattern factor, and exhaust emissions, and the fuel properties, combustor design features, and combustor operating conditions. It is concluded that fuel chemistry, as indicated by hydrogen content and/or aromatics content, has a significant effect on flame radiation and liner wall temperature, but only a slight effect on the emissions of carbon monoxide and oxides of nitrogen. The physical properties that govern atomization quality and evaporation rates affect carbon monoxide emissions, but other important performance parameters, such as nitrogen oxide emissions and liner wall temperature, are sensibly independent of physical properties over the range of fuels studied. Author

A84-35651#
EVALUATION OF SINGLE AND COUNTER ROTATION GEARBOXES FOR PROPULSION SYSTEMS
J. GODSTON and F. J. MIKE (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 13 p. refs
(AIAA PAPER 84-1195)

Attention is given to the conceptual development status of advanced gear-driven propfan propulsion systems that are being investigated under NASA program sponsorship. Both 31-percent lower fuel burn and 14-percent lower operating costs are envisaged for these single- and counter-rotation gear-boxes, by comparison with turbofan engines of comparable sophistication. These performance gains are predicted on a minimization of the number of bearings and gears, the provision of an external blade pitch control system, modular construction principles, and technology that is to be available in 1988. Both tractor and pusher propfan installation configurations are under consideration, and the gearing systems include dual compound idler, offset spur and inline differential planetary, inline split path planetary, and inline interprop planetary types. O.C.

A84-35652#
AXISYMMETRIC APPROACH AND LANDING THRUST REVERSERS FOR SINGLE ENGINE FIGHTERS
W. C. BITTRICK (General Dynamics Corp., Fort Worth, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(AIAA PAPER 84-1214)

The axisymmetric Approach and Landing Thrust Reverser (ALTR) was evaluated to (1) identify and quantify the potential benefits of thrust reversers, and (2) develop the technical data base required to validate feasibility and performance characteristics in order to justify their further development for tactical aircraft. Candidate ALTR concepts were integrated into an Advanced Tactical Combat Aircraft (ATCA) and into the F-16, and the effects on structure, weight, c.g., performance, and stability and control were predicted. On the basis of cost, the ALTR proved a rational selection for achieving balanced field-length capability. Also, the ALTR impacts on the F-16 engine and airframe and the resulting airplane performance characteristics were predicted. The ALTR proved a functionally/mechanically feasible means of achieving balanced fieldlength capability. Author

A84-35655#
AN ENGINE FOR TOMORROW'S SMALL HELICOPTERS
E. E. COHEN and D. R. JACOBY (Hughes Helicopters, Inc., Culver City, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 5 p.
(AIAA PAPER 84-1277)

The present consideration of small helicopter engine development requirements notes that, while current engine design criteria are primarily concerned with the achievement of the lowest possible specific fuel consumption at full rated power (with partial power output being predicated on lowered component efficiencies), future fuel consumption, weight and cost criteria will be strongly driven by life cycle considerations. As a result, maximum efficiency will be achieved at some partial power output value, at an altitude as low as 4000 ft. Power will be added at decreasing efficiency until full rated power values are reached. O.C.

A84-35656#
THE AHIP POWER PLANT
F. E. CONN (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) and F. M. SHALLENE (Bell Helicopter Textron, Fort Worth, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 12 p.
(AIAA PAPER 84-1282)

The U.S. Army's Helicopter Improvement Program (AHIP) has led to the certification of the 250-C30R engine for the OH-58D helicopter. The engine has already accumulated over 3/4-million hours of commercial service, and it has over the 1800 test stand

and 1800 flight test hours of the AHIP program fully demonstrated the capabilities and reliability of a novel digital control system. The 250-C30R's 650 shp rating represents a highly effective output of 518 shp at 4000 ft, under ambient temperature conditions of 95 F. Installation features include an integral vortex tube particle separator, a low loss exhaust system, maintenance-free drive couplings, and a suction fuel supply system. O.C.

A84-35659#
FUTURE COMBAT ENVIRONMENTS - IMPLICATIONS FOR THE ENGINE DEVELOPMENT PROCESS
J. L. BIRKLER (Rand Corp., Santa Monica, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 5 p.
(AIAA PAPER 84-1339)

The demands and unpredictability of future combat environments will require turbofan engine subsystems exhibiting superior reliability, durability and maintainability. Accordingly, maintainability will have to receive development emphasis comparable to that given reliability and durability. Substantial progress has already been demonstrated in this regard with the F404 engine. The reliability and durability requirements have made the demonstration and validation phase of engine development more intensive and protracted, and emphasis in this process is moving away from design point performance toward an approximation of full-scale development engine characteristics that can be tested at a far earlier point in the powerplant acquisition cycle. O.C.

A84-35666#
DEVELOPMENT OF THE ENGINE CONDITION MONITORING SYSTEM FOR THE HH-65A HELICOPTER
K. K. EHLERS (Aerospatiale Helicopter Corp., Grand Prairie, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p.
(AIAA PAPER 84-1411)

The Engine Condition Monitoring System (ECMS) developed for the U.S. Coast Guard's Short Range Recovery Helicopter has as its goals the reduction of operating costs, the reduction of flight crew workload, and the elimination of monitoring system weight increases through the obviation of dedicated hardware. ECMS software is supplied to the Mission Computer Unit, in order to coordinate aircraft sensor data with the Cockpit Control/Display units, Caution Advisory Panel, and Flight Data Storage Unit. The resulting flight data processing is used to accurately calculate and record cycles, trends, and out-of-limit conditions. O.C.

N84-24577* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTOR LINER CONSTRUCTION Patent
H. M. CRAIG (United Technologies Corp., East Hartford, Conn.), W. B. WAGNER (United Technologies Corp., East Hartford, Conn.), and W. J. STROCK, inventors (to NASA) (United Technologies Corp., East Hartford, Conn.) 15 Nov. 1983 6 p Filed 2 Apr. 1980 Sponsored by NASA
(NASA-CASE-LEW-14035-1; US-PATENT-4,414,816; US-PATENT-APPL-SN-136652; US-PATENT-CLASS-60-757)
Avail: US Patent and Trademark Office CSCL 21E

A combustor liner is fabricated from a plurality of individual segments each containing counter/parallel Finwall material and are arranged circumferentially and axially to define the combustion zone. Each segment is supported by a hook and ring construction to an opened lattice frame with sufficient tolerance between the hook and ring to permit thermal expansion with a minimum of induced stresses.
Official Gazette of the U.S. Patent and Trademark Office

N84-24578*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS RESEARCH CENTER SPIN RIG AND ITS USE IN VIBRATION ANALYSIS OF ROTATING SYSTEMS
G. V. BROWN, R. E. KIELB, E. H. MEYN, R. E. MORRIS, and S. J. POSTA May 1984 19 p refs
(NASA-TP-2304; E-1829; NAS 1.60:2304) Avail: NTIS HC A02/MF A01 CSCL 21E

The Lewis Research Center spin rig was constructed to provide experimental evaluation of analysis methods developed under the NASA Engine Structural Dynamics Program. Rotors up to 51 cm (20 in.) in diameter can be spun to 16,000 rpm in vacuum by an air motor. Vibration forcing functions are provided by shakers that apply oscillatory axial forces or transverse moments to the shaft, by a natural whirling of the shaft, and by an air jet. Blade vibration is detected by strain gages and optical blade-tip motion sensors. A variety of analogy and digital processing equipment is used to display and analyze the signals. Results obtained from two rotors are discussed. A 56-blade compressor disk was used to check proper operation of the entire spin rig system. A special two-blade rotor was designed and used to hold flat and twisted plates at various setting and sweep angles. Accurate Southwell coefficients have been obtained for several modes of a flat plate oriented parallel to the plane of rotation. Author

N84-24579*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TANDEM FAN APPLICATIONS IN ADVANCED STOVL FIGHTER CONFIGURATIONS
C. L. ZOLAR, S. B. WILSON, III, and M. A. ESKEY 1984 20 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83689; E-2140; NAS 1.15:83689) Avail: NTIS HC A02/MF A01 CSCL 21E

The series/parallel tandem fan engine is evaluated for application in advanced STOVL supersonic fighter aircraft. Options in engine cycle parameters and design of the front fan flow diverter are examined for their effects on engine weight, dimensions, and other factors in integration of the engine with the aircraft. Operation of the engine in high-bypass flow mode during cruise and loiter flight is considered as a means of minimizizng fuel consumption. Engine thrust augmentation by burning in the front fan exhaust is discussed. Achievement of very sort takeoff with vectored thrust in briefly reviewed for tandem fan engine configurations with vectorable front fan nozzles. Examples are given of two aircraft configuration planforms, a delta-canard, and a forward-swept wing, to illustrate the major features. design considerations, and potential performance of the tandem fan installation in each. Full realization of the advantages of tandem fan propulsion are found to depend on careful selection of the aircraft configuration, since integration requirements can strongly influence the engine performance. Author

N84-24580*# General Electric Co., Lynn, Mass. Aircraft Business Group.
ROTORCRAFT CONTINGENCY POWER STUDY Final Report
R. HIRSCHKRON, J. F. HAYNES, D. N. GOLDSTEIN, and R. H. DAVIS May 1984 157 p refs
(Contract NAS3-23705)
(NASA-CR-174675; NAS 1.26:174675; R84AEB012) Avail: NTIS HC A08/MF A01 CSCL 21E

Twin helicopter engines are often sized by the power requirement of a safe mission completion after the failure of one of the two engines. This study was undertaken for NASA Lewis by General Electric Co. to evaluate the merits of special design features to provide a 2-1/2 Contingency Power rating, permitting an engine size reduction. The merits of water injection, turbine cooling airflow modulation, throttle push, and a propellant auxiliary power plant were evaluated using military Life Cycle Cost (LCC) and commercial helicopter Direct Operating Cost (DOC) merit factors in a rubber engine and a rubber aircraft scenario. Author

N84-24582*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC STOVL AIRCRAFT WITH TURBINE BYPASS/TURBO-COMPRESSOR ENGINES
L. C. FRANCISCUS and R. W. LUIDENS 1984 15 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83686; E-2138; NAS 1.15:83686) Avail: NTIS HC A02/MF A01 CSCL 21E

Three propulsion systems for a Mach 2 STOVL fighter were compared. The three propulsion systems are: (1) turbine bypass engine with a turbocompressor used for STOVL only; (2) turbine bypass engine with a turbocompressor for both STOVL and thrust during forward flight; and (3) mixed flow afterburning turbofan with a remote burner lift system. In the first system, the main engines have afterburners and the turbocompressors use after burning during STOVL. In the second system, the turbine bypass engines are dry and the turbocompressors have afterburners. The mission used in the study is a deck launched intercept mission. It is indicated that large improvements in combat time are possible when the turbocompressors are used for both left and thrust for forward flight. E.A.K.

N84-24583*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN OVERVIEW OF NASA INTERMITTENT COMBUSTION ENGINE RESEARCH
E. A. WILLIS and W. T. WINTUCKY 1984 33 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83668; E-2111; NAS 1.15:83668) Avail: NTIS HC A03/MF A01 CSCL 21E

This paper overviews the current program, whose objective is to establish the generic technology base for advanced aircraft I.C. engines of the early 1990's and beyond. The major emphasis of this paper is on development of the past two years. Past studies and ongoing confirmatory experimental efforts are reviewed, which show unexpectly high potential when modern aerospace technologies are applied to inherently compact and balanced I.C. engine configurations. Currently, the program is focussed on two engine concepts the stratified-charge, multi-fuel rotary, and the lightweight two-stroke diesel. A review is given of contracted and planned high performance one-rotor and one-cylinder test engine work addressing several levels of technology. Also reviewed are basic supporting efforts, e.g., the development and experimental validation of computerized airflow and combustion process models, being performed in-house at Lewis Research Center and by university grants. Author

N84-24584*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTION GAS PROPERTIES OF VARIOUS FUELS OF INTEREST TO GAS TURBINE ENGINEERS
R. E. JONES, A. M. TROUT, and J. D. WEAR 1984 11 p refs Presented at the Joint Power Generation Conf., Toronto, 1-4 Oct. 1984; sponsored by ASME
(NASA-TM-83682; E-2133; NAS 1.15:83682) Avail: NTIS HC A02/MF A01 CSCL 21E

A series of computations were made using the gas property computational schemes of Gordon and McBride to compute the gas properties and species concentration of ASTM-Jet A and dry air. The computed gas thermodynamic properties in a revised graphical format which gives information which is useful to combustion engineers is presented. A series of reports covering the properties of many fuel and air combinations will be published. The graphical presentation displays on one chart of the output of hundreds of computer sheets. The reports will contain microfiche cards, from which complete tables and graphs can be obtained. The extent of the planned effort and is documented samples of the many tables and charts that will be available on the microfiche cards are presented. E.A.K.

N84-24585*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SENSOR FAILURE DETECTION FOR JET ENGINES USING ANALYTICAL REDUNDANCE
W. C. MERRILL 1984 24 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83695; E-2123; NAS 1.15:83695; AIAA-84-1452) Avail: NTIS HC A02/MF A01 CSCL 21E

Analytical redundant sensor failure detection, isolation and accommodation techniques for gas turbine engines are surveyed. Both the theoretical technology base and demonstrated concepts are discussed. Also included is a discussion of current technology needs and ongoing Government sponsored programs to meet those needs. Author

N84-24586*# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.
FLUTTER AND FORCED RESPONSE OF MISTUNED ROTORS USING STANDING WAVE ANALYSIS
D. J. BUNDAS and J. DUNGUNDJI Mar. 1983 155 p refs Previously announced as A83-29823
(Contract NAG3-214)
(NASA-CR-173555; NAS 1.26:173555; GT/PDL-170) Avail: NTIS HC A08/MF A01 CSCL 21E

A standing wave approach is applied to the analysis of the flutter and forced response of tuned and mistuned rotors. The traditional traveling wave cascade airforces are recast into standing wave arbitrary motion form using Pade approximants, and the resulting equations of motion are written in the matrix form. Applications for vibration modes, flutter, and forced response are discussed. It is noted that the standing wave methods may prove to be more versatile for dealing with certain applications, such as coupling flutter with forced response and dynamic shaft problems, transient impulses on the rotor, low-order engine excitation, bearing motion, and mistuning effects in rotors. V.L. (IAA)

N84-24587*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGHLY INTEGRATED DIGITAL ENGINE CONTROL SYSTEM ON AN F-15 AIRPLANE Final Report
F. W. BURCHAM, JR. and E. A. HAERING, JR. Jun. 1984 13 p refs Presented at the 20th AIAA/ASME/SAE Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-86040; H-1240; NAS 1.15:86040) Avail: NTIS HC A02/MF A01 CSCL 21E

The Highly Integrated Digital Electronic Control (HIDEC) program will demonstrate and evaluate the improvements in performance and mission effectiveness that result from integrated engine/airframe control systems. This system is being used on the F-15 airplane. An integrated flightpath management mode and an integrated adaptive engine stall margin mode are implemented into the system. The adaptive stall margin mode is a highly integrated mode in which the airplane flight conditions, the resulting inlet distortion, and the engine stall margin are continuously computed; the excess stall margin is used to uptrim the engine for more thrust. The integrated flightpath management mode optimizes the flightpath and throttle setting to reach a desired flight condition. The increase in thrust and the improvement in airplane performance is discussed. M.A.C.

N84-24588*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY FLIGHT TEST RESULTS OF THE F100 EMD ENGINE IN AN F-15 AIRPLANE Final Report
L. P. MYERS and F. W. BURCHAM, JR. Jun. 1984 12 p refs Presented at the 20th AIAA/ASME/SAE Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-85902; H-1247; NAS 1.15:85902) Avail: NTIS HC A02/MF A01 CSCL 21E

A flight evaluation of the F100 Engine Model Derivative (EMD) is conducted. The F100 EMD is an advanced version of the F100 engine that powers the F15 and F16 airplanes. The F100 EMD features a bigger fan, higher temperature turbine, a Digital Electronic Engine Control system (DEEC), and a newly designed 16 segment afterburner, all of which results in a 15 to 20 percent increase in sea level thrust. The flight evaluations consist of investigation of performance (thrust, fuel flow, and airflow) and operability (transient response and airstart) in the F-15 airplane. The performance of the F100 EMD is excellent. Aircraft acceleration time to Mach 2.0 is reduced by 23 percent with two F100 EMD engines. Several anomalies are discovered in the operability evaluations. A software change to the DEEC improved the throttle, and subsequent Cooper Harper ratings of 3 to 4 are obtained. In the extreme upper left hand corner of the flight enveloped, compressor stalls occurr when the throttle is retarded to idle power. These stalls are not predicted by altitude facility tests or stability for the compressor. M.A.C.

N84-24589*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A HIGH-WORK LOW ASPECT RATION TURBINE TESTED WITH A REALISTIC INLET RADIAL TEMPERATURE PROFILE
R. G. STABE, W. J. WHITNEY, and T. P. MOFFITT 1984 24 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83655; E-2098; NAS 1.15:83655; AIAA-84-1161) Avail: NTIS HC A02/MF A01 CSCL 21E

Experimental results are presented for a 0.767 scale model of the first stage of a two-stage turbine designed for a high by-pass ratio engine. The turbine was tested with both uniform inlet conditions and with an inlet radial temperature profile simulating engine conditions. The inlet temperature profile was essentially mixed-out in the rotor. There was also substantial underturning of the exit flow at the mean diameter. Both of these effects were attributed to strong secondary flows in the rotor blading. There were no significant differences in the stage performance with either inlet condition when differences in tip clearance were considered. Performance was very close to design intent in both cases. Author

N84-24590# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abt. Verdichter.
INVESTIGATION OF THE BEHAVIOR OF AXIAL COMPRESSOR STAGES WITH STEADY STATE INLET DISTORTIONS Ph.D. Thesis - Technische Hochschule, Aachen
M. LECHT 1983 208 p refs In GERMAN; ENGLISH summary
(DFVLR-FB-83-39) Avail: NTIS HC A10/MF A01; DFVLR, Cologne DM 65

The influence of nonuniform inlet flow on the performance of a subsonic and a transonic axial compressor stage are investigated. Both compressor stages are exposed to screen-induced circumferential total pressure distortions, and moreover, the transonic stage is exposed to an inlet swirl distortion delivered by a special inlet guide vane. The influence of these types of distortion on the performance map as well as on the distribution of the main flow quantities within the stage is shown. An analysis of the measurements is directed to the unsteady rotor behavior in correspondence with a single airfoil subjected to instationary flow conditions. The phenomena of hysteresis as well as an unsteady overshoot of loading over the steady state limits are demonstrated. Based hereon and by means of an unsteady transfer behavior, a model of two compressors working in parallel is extended to give a better estimation of the surge line. Author

N84-24592# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Mechanical Engineering.
BEHAVIOR OF CASCADED AIRFOILS UNDER CONDITIONS OF HIGH MEAN LOADING AND FLOW UNSTEADINESS Final Technical Report, 1 Jun. 1982 - 31 May 1983
F. SISTO and R. B. COLE 15 Dec. 1983 48 p
(Contract N00014-82-K-0369)
(AD-A139799; ME-RT-83007) Avail: NTIS HC A03/MF A01 CSCL 21E

The objectives of this research program were to measure the unsteady flow field in the rotor passage of an axial compressor and map this velocity field when operating near rotor blade stall. A laser Doppler velocimeter system was developed for this purpose and used in conjunction with a single stage compressor designed expressly to facilitate these measurements. An extensive data acquisition system utilizing microcomputer components was designed and partially assembled and data processing algorithms were developed to yield the velocity mapping from the data. Various program sub-elements were completed, but a successful on-rotor velocity realization was not achieved at contract termination. Propagating stall was observed on the compressor and modelling studies using simulated inputs to the data processing system indicated a potential for successful unsteady velocity field mapping. Author (GRA)

N84-24738# Pratt and Whitney Aircraft of Canada Ltd., Mississauga (Ontario). Combustion Aerodynamics Dept.
FUEL CHARACTER EFFECTS ON PERFORMANCE OF SMALL GAS TURBINE COMBUSTION SYSTEMS
P. SAMPATH and M. GRATTON *In* AGARD Combust. Probl. in Turbine Eng. 12p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

The effects of potential broadened specification and alternate source jet fuels on the performance of small gas turbine combustors are presented. The review is based primarily on the results of a research program to evaluate the performance of a small 'can' combustor and two reverse flow annular combustors with fifteen fuels. The fuels represented variations in several key characteristics such as hydrogen content, aromatics, viscosity, boiling range, volatility and thermal stability. Alternate source fuels included oil shale and tar sand derived fuels. Results of property changes of performance parameters of the 'can' combustor, such as life, starting and stability characteristics, exhaust emissions and smoking tendencies, are discussed. Author

N84-24755# Rolls-Royce Ltd., Derby (England). Combustion Technology Dept.
THE DESIGN AND DEVELOPMENT OF A LOW EMISSIONS TRANSPLY COMBUSTOR FOR THE CIVIL SPEY ENGINE
J. K. BHANGU, D. M. SNAPE, and B. R. EARDLEY *In* AGARD Combust. Probl. in Turbine Eng. 18p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

This paper describes the design and development of a low emission turbo-annular combustor now entering service in the Spey aero gas turbine engine. The combustors, ten of which form the turbo-annular combustion system, are constructed from an advanced cooling material known as Transply. Use of this pseudo transpiration cooling material enables a significant saving to be made in the utilization of the wall cooling air. This air is used in optimizing the primary zone and intermediate zone stoichiometry which, combined with the use of an aerodynamic curved vane swirler, results in a substantial reduction in the emission levels. A number of significant durability problems have been overcome to meet the rigorous demands of aero-engine operation. The paper outlines the development process, starting with the constraints imposed by an existing engine design and describing the rig and engine test program leading to a full definition of the aero-thermodynamics of the developed combustor. Author

N84-24756# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
ADVANCED COMBUSTOR LINER COOLING CONCEPTS
B. SIMON, D. SCHUBER, and U. BASLER *In* AGARD Combust. Probl. in Turbine Eng. 10p Jan. 1984 refs Sponsored in part by German Ministry of Defence
Avail: NTIS HC A19/MF A01

Small gas turbine liner cooling is especially difficult due to the low combustor air flow and relatively large flame tube areas. Therefore, it is desirable to increase the cooling potential of the cooling air by application of combined convective-film cooling. Its advantage must be balanced carefully against the disadvantage of increased weight and production cost. The large number of variable parameters of a combined cooling configuration requires a computer model which allows the simulation of different cooling approaches. For the verification of this, model tests with various configurations were conducted in a 2D-cooling rig. Good agreement between measured and calculated liner temperatures could be achieved. Thus, the model is suitable to show under which conditions a marked decreased of wall temperature can be reached compared with the case of straight film cooling under the same conditions. Author

N84-24757# Karlsruhe Univ. (West Germany). Lehrstuhl und Inst. fuer Thermische Stroemungsmaschinen.
DEVELOPMENT OF TEMPERATURE-, VELOCITY- AND CONCENTRATION-PROFILES IN A CURVED COMBUSTOR
S. WITTIG, R. KUTZ, B. E. NOLL, and K. H. PLATZER *In* AGARD Combust. Probl. in Turbine Eng. 9p Jan. 1984 refs Sponsored in part by Deutsche Forschungsgemeinschaft
Avail: NTIS HC A19/MF A01

The influence of bends as found in reverse-flow combustors or in various stationary gas turbines on the flow exiting the mixing zone was studied experimentally. In a first approach, a duct with circular cross-section was chosen with a predetermined temperature-, velocity- and concentration-profile exiting the primary zone of an atmospheric burner. The velocity profiles were measured in three planes (0, 45, 90 deg) and downstream of the bend using a five-hole spherical probe. Also, the temperature and pressure distribution as well as the concentration profiles particularly of CO2 were measured in the respective planes. It was found, that energy as well as species-transport arises primarily from secondary flow phenomena combined with strong pressure gradients. In a first attempt to clarify the various phenomena, the development of the static pressure and the temperature is calculated for two-dimensional flow using a finite difference scheme utilizing the well known k-epsilon-turbulence model. It is shown that similar pressure characteristics are obtained. Corresponding temperature profiles, however, result from different sources. M.G.

N84-24764# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. de Mecanique et Energetique des Systemes.
AN AERODYNAMIC STUDY OF COMBUSTION IN THE COMBUSTION CHAMBERS OF TURBOMACHINES: EXPERIMENTAL AND THEORETICAL APPROACHES [ETUDE AERODYNAMIQUE DE LA COMBUSTION DANS LES FOYERS DE TURBOMACHINES: APPROCHES EXPERIMENTALES ET THEORIQUES]
G. FRAGER, P. HEBRARD, G. LAVERGNE, and A. MIR *In* AGARD Combust. Probl. in Turbine Eng. 16p Jan. 1984 refs In FRENCH
Avail: NTIS HC A19/MF A01

Instead of using local resolution methods which are often too costly at the rough-draft stage of combustor design, there is often an advantage in using either a modular or mixed method approach. In the modular approach, numerous hydraulic tunnel tests and divese video imaging techniques supply the basic data used in the schematics of diverse combustors in the form of a combination of elementary reactors. The addition of chemical kinetics, more or less detailed, (aggregate mode, semi-aggregate, with vaporization) allows the prediction of the total performance of these various combustion chambers with good precision. In the more precise mixed method approach, only the recirculation zones are modeled by an collection of elementary reactors. The regions of direct flow (jet, swirler...) are the object of local calculation (Kappa, Epsilon) in which the behavior of the drops (size, trajectory, vaporization) is considered beginning with a collection of geometric measurements carried out at DERMES. Transl. by A.R.H.

N84-25630# Rolls-Royce Ltd., Bristol (England).
V/STOL PROPULSION SYSTEM AERODYNAMICS
W. J. LEWIS *In* AGARD Spec. Course on V/STOL Aerodyn. 24 p Apr. 1984
Avail: NTIS HC A17/MF A01

Different V/STOL propulsion system concepts are briefly described. Highlighted are those features of the systems which present the aerodynamicist with either more severe problems or different problems from those present on conventional takeoff and landing engines. After illustrating some of the demands V/STOL makes on the engine cycle choice and some of the compromises necessary, the individual parts of the propulsion system are considered in turn. Because of the enormous scope of the subject, attention was limited to aspects which are common to a number of the different propulsion systems. Author

N84-25712*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF DYNAMIC SIMULATION OF TF34-GE-100 TURBOFAN ENGINE WITH POST-STALL CAPABILITY
S. M. KROSEL 1984 11 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83660; E-2104; NAS 1.15:83660; AIAA-84-1184)
Avail: NTIS HC A02/MF A01 CSCL 21E

This paper describes the development of a hybrid computer simulation of a TF34-GE-100 turbofan engine with post-stall capability. The simulation operates in real-time and will be used to test and evaluate stall recovery control modes for this engine. The simulation calculations are performed by an analog computer with a peripheral multivariable function generation unit used for computing bivariate functions. Tabular listings of a simulation variables are obtained by interfacing to a digital computer and using a custom software package for data collection and display. Author

N84-25715# European Space Agency, Paris (France).
COMPARISON OF A PROPFAN/TURBOFAN ENGINE BY THERMODYNAMIC CYCLE CALCULATION
P. SCHIMMING Oct. 1983 44 p refs Transl. into ENGLISH of "Vergleichende kreisprozessrechnungen fuer ein propfan-/tubofan-triebwerk" rept. DFVLR-Mitt-82-18 DFVLR, Goettingen, West Germany, Nov. 1982 Original language document announced as N83-30431
(ESA-TT-820; DFVLR-MITT-82-18) Avail: NTIS HC A03/MF A01; original German report available from DFVLR, Cologne DM 16,80

Propfans are expected to replace turbofans in commercial subsonic, air transportation systems for short and medium range. Thermodynamic cycle calculations are performed for a propfan and a turbofan propulsion systems for a 150 seat twin engine medium range transport aircraft, in order to obtain the difference in specific fuel consumption. Common definitions for the efficiencies of propeller and fan and common treatment of the thermodynamic cycles form the basis of the analysis. M.A.C.

N84-25728# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
PERFORMANCE DERIVATION OF TURBOJETS AND TURBOFANS FROM TESTS IN SEA-LEVEL TEST CELLS
D. M. RUDNITSKI *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 22p Mar. 1984 refs
Avail: NTIS HC A09/MF A01

To most users of aircraft jet engines, the definition of engine performance means the thrust level, and the fuel consumption required to generate it. Just as important, however, is mechanical performance, as an engine may meet the thrust requirement, yet lack sufficient mechanical integrity. The operator must therefore have some means of quantifying engine performance before he can pronounce it as healthy. This type of routine testing is generally conducted in an enclosed ground level test bed. During an engine test, data are recorded at several power settings, corrected for cell effects, and compared against manufacturer's supplied curves to determine actual performance. If an engine was tested on an outdoor stand, under zero wind conditions, the measured thrust, corrected for instrument error, would be the true engine thrust. The act of bringing the engine into an enclosed facility has an effect on measured engine performance. The procedure for quantifying this effect, sometimes called establishing a cell factor, is usually done by correlating the customer's facility to the manufacturer's standard test cell using a gold plated engine. This paper describes the types of measurements, performance parameters, and methods of data presentation for a correlation program. Author

N84-26438 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
GROUND AND INFLIGHT OPERATIONAL EFFECTS OF APU'S
J. H. RENKEN *In* MBB Tech. and Sci. Publ. 1983 p 119-137 1983 Presented at AGARD Propulsion and Energetics (PEP) Meeting/Specialists' Meeting on Auxiliary Power Systems, Copenhagen, 30-31 May 1983
(VFW-30/83-O) Avail: Issuing Activity

The Airbus APU has to deliver well defined quantities of bleed air and electrical power under two very different conditions: on ground and inflight. The on ground operation is essentially governed by problems like noise generation and emission, and ingestion of hot gas, constraining the possible range of intake and exhaust position. The inflight operation is dominated by the external fuselage flow conditions intake and exhaust are exposed to and which may effect significantly the installation pressure-ratio and with that the inflight restart envelope and inflight performance. Depending on fuselage surface pressure and boundary layer conditions, intake and exhaust geometries and ducting have to be designed so that a favorable IPR is provided during APU starting as well as APU operation, keeping at the same time negative effects on the aircraft as for instance drag increase at minimum. The effect of these environmental conditions on the APU performance is discussed. E.A.K.

08

AIRCRAFT STABILITY AND CONTROL

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

A84-33847
TIME FLIES - THE 4D FLIGHT MANAGEMENT SYSTEM
B. WEAVER, D. MOOR, and T. PALMIERI (Lockheed-California Co., Burbank, CA) Lockheed Horizons, no. 15, 1984, p. 20-32.

In the L-1011 '4D' Flight Management System (FMS), time becomes a 'fourth dimension' among aircraft control parameters (geographic location, speed and altitude). This offers the capability of automatically interfacing with air traffic control systems, by positioning the aircraft over a predetermined fix into a terminal area established by ground controllers well in advance of the aircraft's arrival. The basic FMS hardware consists of a computer with 64K words of memory and a control and display unit that interfaces the crew with the FMS. Hardware and software schematics are provided, together with sample display states of the control and display unit for cruise, descent, and metering. Attention is given to the results of the 4D FMS's in-service evaluation with a major airline. O.C.

A84-34453#
AN EXPERIMENTAL INVESTIGATION OF VTOL FLYING QUALITIES REQUIREMENTS IN SHIPBOARD LANDINGS
R. C. RADFORD (Calspan Advanced Technology Center, Buffalo, NY) and D. ANDRISANI, II (Purdue University, West Lafayette, IN) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 371-379. refs
(Contract N62269-78-C-0043)

Previously cited in issue 20, p. 3666, Accession no. A80-45913

A84-34458#
THRUST VECTOR CONTROL OF A V/STOL AIRSHIP
B. L. NAGABHUSHAN and G. D. FAISS (Goodyear Aerospace Corp., Defense Systems Div., Akron, OH) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 408-413. refs

Potential concepts for thrust vector control of a modern airship were investigated using a six degree-of-freedom flight dynamics simulation. The specific thrust vectors simulated included those from two ducted fans mounted one on either side of the airship car, each having the capability of tilting in pitch and roll to give vertical and lateral thrust for control. An auxiliary thruster at the bow or stern of the airship, which augments its directional control, was also considered. It has been found that the tiltable ducted fans provide the airship with greater operational flexibility, especially during takeoff and landing. Thrust vectoring to provide roll control was found to be effective while ground handling. The bow/stern thruster was found to give excellent directional control, which significantly improved the airship lateral maneuverability at low speeds. Thrust reversibility, thrust application rate, and tilt rate of thrust vectors were found to be important design parameters having considerable effect on airship flying qualities. Author

N84-24530# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
MULTIVARIABLE CONTROL LAW THEORY
In its Proc. of the Workshop on Multivariate Control Systems p 8-37 Sep. 1983 refs
Avail: NTIS HC A99/MF A01 CSCL 01C

A summary of the techniques used in the design of high performance tracking systems for aircraft control is provided. A discussion of important facets in their application is also included. The theoretical discussions cover the discrete case and the corresponding continuous design equations. This approach is taken because, although the designs are for a digital implementation, the insight and experience with continuous design principles is used effectively. The methods are essentially identical for continuous and discrete designs. It is often more meaningful to consider the s-plane root locations and migrations as opposed to z-plane analysis. For those cases where the continuous methods are employed, sampling effects and discrete time delay must be examined prior to design acceptance. Author

N84-24531# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
MULTIVARIABLE CONTROL LAWS FOR THE AFTI/F-16 M.S. Thesis
A. F. BARFIELD *In its* Proc. of the Workshop on Multivariate Control Systems p 41-256 Sep. 1983 refs Previously announced as N84-18210
(AFIT/GE/EE/83S-4) Avail: NTIS HC A99/MF A01 CSCL 01C

Recently evolved multivariable design techniques are used to develop control laws for the AFTI/F-16. Designs are investigated to provide pilot control of vehicle rotational rates and accelerations. This line of inquiry is in contrast to the angle control concepts required in previous applications of these new techniques. A computer aided design package called "MULTI" is used in refining the control laws to the preliminary design stage. An aircraft model is developed in state space form for the AFTI vehicle from linearized aerodynamic data. This is accomplished at several points in the flight envelope. After validation, these models are used for the design and evaluation of the control laws. Author

N84-24532# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
DESIGN OF A COMPLETE MULTIVARIABLE DIGITAL FLIGHT CONTROL SYSTEM M.S. Thesis
J. M. BAUSCHLICHER *In its* Proc. of the Workshop on Multivariate Control Systems p 259-416 Sep. 1983 refs
(AFIT/GE/EE/82D-18) Avail: NTIS HC A99/MF A01 CSCL 01C

The application of a singular perturbation method in the design of a complete (lateral and longitudinal) multivariable, error actuated, tracking, digital flight controller is examined. The aircraft model used to test the method is a hypothesized design proposed by Lockheed with augmented flight control surfaces including horizontal and vertical canards, and jet flaps. Multivariable tracker control laws can be designed for the aircraft model examined here equipped with augmented control surfaces - ailerons, rudder, maneuver flaps, canards, and jet flaps. The controllers all perform very satisfactorily at the flight condition for which they are designed. In addition a universal controller is found that is capable of producing satisfactory responses for the three flight conditions previously mentioned, eliminating much of the gain scheduling required with present digital flight controllers. Author

N84-24533# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
DIGITAL MULTIVARIABLE TRACKER CONTROL LAWS FOR THE C-141-A STARLIFTER AIRCRAFT M.S. Thesis
M. A. MASI *In its* Proc. of the Workshop on Multivariate Control Systems p 419-515 Sep. 1983 refs
(AFIT/GE/EE/82D-47) Avail: NTIS HC A99/MF A01 CSCL 01C

The design of digital, multivariable tracker control laws for the C-141-A Starlifter aircraft are investigated. Controllers for the aircraft at three diverse flight conditions were developed. Additions and modifications to the computer package MULTI are included. A six degree of freedom aircraft model is developed. The equations of motion assume linearized aircraft models which make only small perturbations about each nominal flight condition. A discussion of robustness of the control laws determined is included. Digital tracker control laws are designed for this aircraft. A more accurate fully coupled aircraft model should be derived in order to further tune the control laws. MULTI, the computer design and simulation program, is available from the Air Force Institute of Technology. Author

N84-24534# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
HIGH-GAIN ERROR ACTUATED FLIGHT CONTROL SYSTEMS FOR CONTINUOUS LINEAR MULTIVARIABLE PLANTS M.S. Thesis
T. LEWIS *In its* Proc. of the Workshop on Multivariate Control Systems p 517-573 Sep. 1983 refs
(AFIT/GAE/EE/82D-1) Avail: NTIS HC A99/MF A01 CSCL 01C

The theory of high gain error actuated feedback control is applied to the design of various lateral directional decoupling flight control systems for an advanced aircraft. The contollers developed utilize output feedback with proportional plus integral control to produce desirable closed loop responses with minimal interactions between outputs. Because of the structure of the system, measurement variables in addition to the outputs are necessary to apply this method. Controller design robustness are examined by varying the flight conditions or maneuver commands from the ones the controller is specifically designed for, and then judges system performance. The controller is robust with respect to varying flight conditions, but is not robust with respect to varying maneuver commands. The effect of first order actuator dynamics in the system model is examined. Actuator dynamics are shown to significantly affect the control system response, indicating that a simplified model, without actuators, is not desirable in one's control design scheme. Author

N84-24535# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
RECONFIGURABLE DIGITAL CONTROL LAWS FOR THE A-7D DIGITAC 2 AIRCRAFT WITH FAILED PRIMARY CONTROL SURFACES M.S. Thesis
D. E. RUSS *In its* Proc. of the Workshop on Multivariate Control Systems p 575-671 Sep. 1983 refs
(AFIT/GE/EE/82D-59) Avail: NTIS HC A99/MF A01 CSCL 01C

A set of high gain, error actuated multivariable digital control laws for the A-7D DIGITAC 2 aircraft was developd at three different flight conditions and for the aircraft with three different control surface failures. Additional modifications to the computer aided design package MULTI are included. The aircraft model is based on a six degree of freedom model which contains separate left and right horizontal stabilizer and left and right aileron control surfaces. These split surfaces provide additional flexibility and permit the aircraft to perform both conventional and CCV maneuvers. The design procedure used to obtain the various tracker control laws is outlined. The presentation includes a discussion of the effects of surface failures on aircraft performance and the robustness of the controllers at other flight conditions. A proposed reconfiguration strategy is also included. Author

N84-24593*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
OPTIMAL COOPERATIVE CONTROL SYNTHESIS APPLIED TO A CONTROL-CONFIGURED AIRCRAFT
D. K. SCHMIDT and M. INNOCENTI Jan. 1984 33 p refs
(Contract NAG4-1)
(NASA-CR-170411; NAS 1.26:170411) Avail: NTIS HC A03/MF A01 CSCL 01C

A multivariable control augmentation synthesis method is presented that is intended to enable the designer to directly optimize pilot opinion rating of the augmented system. The approach involves the simultaneous solution for the augmentation and predicted pilot's compensation via optimal control techniques. The methodology is applied to the control law synthesis for a vehicle similar to the AFTI F16 control-configured aircraft. The resulting dynamics, expressed in terms of eigenstructure and time/frequency responses, are presented with analytical predictions of closed loop tracking performance, pilot compensation, and other predictors of pilot acceptance. M.A.C.

N84-24595# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.
A SIMPLIFIED METHOD OF EVALUATING AIRCRAFT HANDLING QUALITIES USING A PILOT TRANSFER FUNCTION MODEL
P. N. HUANG 4 Jan. 1984 16 p refs
(GU-AERO-8302) Avail: NTIS HC A02/MF A01

Calculations of the performance of a pilot and aircraft closed loop system were made using a simple pilot mathematical model obtained from simulator testing. Results show that correlation exists between the pilot handling rating and the mean square error signal in the pilot-aircraft circuit in response to a selected disturbance input. This approach could provide the basis for the approximate evaluation of aircraft handling qualities. Author

N84-24596# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.
FAST ESTIMATION OF STATE FEEDBACK GAIN FOR THE DESIGN OF AIRCRAFT AUTOPILOTS
S. Y. GUAN 4 Jan. 1984 24 p refs
(GU-AERO-8305) Avail: NTIS HC A02/MF A01

A fast estimation method to design autopilots for aircraft is presented. A two state feedback gains is determined simultaneously during the preliminary design stage according to some specified requirements. It is shown that the method is simple and straightforward and can be of practical use in the design of some widely used autopilots. E.A.K.

N84-24597# Neilsen Engineering and Research, Inc., Mountain View, Calif.
PRELIMINARY METHOD FOR ESTIMATING HINGE MOMENTS OF ALL-MOVABLE CONTROLS Final Report, 1 Mar. - 30 Nov. 1981
J. N. NIELSEN and F. K. GOODWIN Mar. 1982 344 p
(Contract N00014-81-C-0267)
(AD-A139726; AD-E401117; NEAR-TR-268) Avail: NTIS HC A15/MF A01 CSCL 20D

The objective of the first phase of this 2-phase study is to develop a hinge-moment prediction method for all-movable controls for angles of attack up to 20 deg, control deflections to 15 deg, the complete range of roll angles, and Mach numbers from subsonic to hypersonic if possible. Based on a review of the literature, it was decided to modify on existing computer program, MISSILE 2, to improve its accuracy of hinge-moment prediction. A method based on strip theory and shock-expansion theory is used to improve the prediction of fin axial center-of-pressure position. A special method is included to account for canard and body vortices on fin axial center-of-pressure location. Special extrapolation procedures for the underlying data base were added. Comparison between hinge-moment data and prediction show good agreement at zero roll between Mach numbers of 1.3 and 3.7, but not at transonic speeds. When body or canard vortices are close to tail fins on the leeward side of the body, the predictions were usually not good. Canard fin hinge moments were generally well predicted. GRA

N84-24598# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.
A PILOTED SIMULATOR INVESTIGATION OF DECOUPLING HELICOPTERS BY USING A MODEL FOLLOWING CONTROL SYSTEM
G. BOUWER and K. B. HILBERT May 1984 17 p Presented at the 40th Ann. Forum of the American Helicopter Society, Arlington, Va., 16-18 May 1984
(AD-A139976) Avail: NTIS HC A02/MF A01 CSCL 01C

A U.S. and German piloted simulation experiment conducted to evaluate the performance of a model following control system by applying it to hingeless rotor and teetering rotor helicopters is reported. The explicit model was a linear, decoupled model such that the pilot commanded pitch attitude with the longitudinal cyclic, roll attitude with the lateral cyclic, yaw rate with the pedals, and Earth fixed downward velocity with the collective. The results of the simulation indicate that the performance of the model following control system is primarily dependent on the limitations of the actuating system. Satisfactory handling qualities were achieved for both augmented helicopters flying two specified evaluation tasks: dolphin and slalom maneuvers. The significant improvements in task performance and handling qualities achieved for these two radically different helicopters, augmented with the designed model following control system, indicates the flexibility and versatility of this control technique. Author (GRA)

N84-25632*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL MANEUVERABILITY AND CONTROL
J. A. FRANKLIN and S. B. ANDERSON *In* AGARD Spec. Course on V/STOL Aerodyn. 47 p Apr. 1984 refs Prevously announced as N84-22584
Avail: NTIS HC A17/MF A01 CSCL 01C

Maneuverability and control of V/STOL aircraft in powered-life flight is studied with specific considerations of maneuvering in forward flight. A review of maneuverability for representative operational mission tasks is presented and covers takeoff, transition, hover, and landing flight phases. Maneuverability is described in terms of the ability to rotate and translate the aircraft and is specified in terms of angular and translational accelerations imposed on the aircraft. Characteristics of representative configurations are reviewed, including experience from past programs and expectations for future designs. The review of control covers the characteristics inherent in the basic airframe and propulsion system and the behavior associated with control augmentation systems. Demands for augmented stability and control response to meet certain mission operational requirements are discussed. Experience from ground-based simulation and flight experiments that illustrates the impact of augmented stability and control on aircraft design is related by example. Author

N84-25716*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
VTOL SHIPBOARD LETDOWN GUIDANCE SYSTEM ANALYSIS
A. V. PHATAK and M. S. KARMALI May 1983 60 p refs
(Contract NAS2-10288)
(NASA-CR-166519; NAS 1.26:166519; AMA-82-43) Avail: NTIS HC A04/MF A01 CSCL 01C

Alternative letdown guidance strategies are examined for landing of a VTOL aircraft onboard a small aviation ship under adverse environmental conditions. Off line computer simulation of shipboard landing task is utilized for assessing the relative merits of the proposed guidance schemes. The touchdown performance of a nominal constant rate of descent (CROD) letdown strategy serves as a benchmark for ranking the performance of the alternative letdown schemes. Analysis of ship motion time histories indicates the existence of an alternating sequence of quiescent and rough motions called lulls and swells. A real time algorithms lull/swell classification based upon ship motion pattern features is developed. The classification algorithm is used to command a go/no go signal to indicate the initiation and termination of an acceptable landing window. Simulation results show that such a go/no go pattern based letdown guidance strategy improves touchdown performance. M.A.C.

N84-25719# Naval Postgraduate School, Monterey, Calif.
COMPUTER PROGRAM TO SIMULATE DIGITAL COMPUTER BASED LONGITUDINAL FLIGHT CONTROL LAWS IN A HIGH PERFORMANCE AIRCRAFT M.S. Thesis
J. R. CARTER Dec. 1983 73 p
(AD-A140143) Avail: NTIS HC A04/MF A01 CSCL 01D

The IBM Company's Continuous Systems Modeling Program was used to simulate the longitudinal flight control system of the F/A-18 aircraft. The model is intended for use in investigations of aircraft response to flight conditions which approach spin or stall and is restricted to the automatic flaps up (AFU) flight mode. Program outputs include stabilator deflection, leading and trailing edge flap positions, and cross-axis interconnect signals. Various stick forces, motion sensor inputs and air pressure inputs were simulated to produce transient control surface responses. These computer generated responses exhibited characteristics corresponding to predicted aircraft control surface movements. Author (GRA)

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.

N84-25721# Washington Univ., Seattle.
A NUMERICAL STUDY OF THE CONTROLLED FLOW TUNNEL FOR A HIGH LIFT MODEL Ph.D. Thesis
P. C. PARIKH 1984 122 p
Avail: Univ. Microfilms Order No. DA8404937

A controlled flow tunnel employs active control of flow through the walls of the wind tunnel so that the model is in approximately free air conditions during the test. This improves the wind tunnel test environment, enhancing the validity of the experimentally obtained test data. In the present study this concept is applied to a three dimensional jet flapped wing with full span jet flap. It is shown that a special treatment is required for the high energy wake associated with this and other V/STOL models. An iterative numerical scheme is developed to describe working of an actual controlled flow tunnel and comparisons are shown with other available results. It is shown that control need be exerted over only part of the tunnel walls to closely approximate free air flow conditions. It is concluded that such a tunnel is able to produce a nearly interference free test environment even with a high lift model in the tunnel. Dissert. Abstr.

N84-25723# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
OPERATIONAL AND PERFORMANCE MEASUREMENT ON ENGINES IN SEA LEVEL TEST FACILITIES
Loughton, England Mar. 1984 176 p refs Lecture held in Rome, 26-27 Apr. 1984, in Ankara, Turkey, 30 Apr. - 1 May 1984, and in Athens, 3-4 May 1984
(AGARD-LS-132; ISBN-92-835-0350-3) Avail: NTIS HC A09/MF A01

This Lecture Series considers all the basic features of turbojets and turbofan testing. In the introduction, test cell design is set in historical perspective with brief descriptions of the test arrangement and instrumentation used to test the early jet engines. The way in which these have evolved to modern designs is outlined. Three typical uses for sea level test beds, routine proof testing following overhaul, performance evaluation for type certification and general development testing are described and covered in detail by specialist lectures. One lecture is devoted specifically to turboprop testing. Instrumentation and data handling are dealt with in two lectures, one covering measurement techniques and the other covering data acquisitions and handling. One lecture is devoted to the derivation of the performance of the engine from the test bed measurements.

N84-25724# Ashwood (P. F.), Farnham (England).
OPERATION AND PERFORMANCE MEASUREMEN ON ENGINES IN SEA-LEVEL TEST FACILITIES: INTRODUCTION AND GENERAL SURVEY
P. F. ASHWOOD *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 15p Mar. 1984
Avail: NTIS HC A09/MF A01

Several aspects of sea level testing are reviewed to provide an introduction and background to the specialist papers which make up this Lecture Series. The review commences by setting cell design in historical perspective and considering the facilities that were used in the UK to test the early jet engines. A more modern cell, the Glen Test House at Pyestock, is described in detail because its design contains all the basic features required for testing turbojets and turbofans. Attention is drawn to two areas where the original Glen systems have been enhanced to meet modern requirements: the instrumentation and the method of measuring thrust. Three typical uses for sea level test beds, routine proof testing, performance evaluation and general development testing, are each briefly described and their influence on test bed design and instrumentation requirements discussed. Instrumentation is considered only in outline because of its highly specialist nature, but attention is drawn to the need for the data output to be presented in easily assimilated form, particularly when processing is carried out on line. Finally an account is given of an investigation made at Pyestock under the author's direction to examine the aerodynamic factors which influence thrust measurement. As published information on this topic is still extremely limited, and in view of its relevance to the present Lecture Series, the opportunity has been taken to make the results of these tests more widely available. Author

N84-25725# Ecole Royale Militaire, Brussels (Belgium).
AERO/THERMODYNAMIC AND ACOUSTIC CONSIDERATIONS IN THE DESIGN OF TEST-BEDS FOR TURBOJETS AND TURBOFANS
R. JACQUES *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 23p Mar. 1984 refs
Avail: NTIS HC A09/MF A01

The testing of noninstalled engines or trimming of engines installed on aircraft has to be performed in closed test beds on most of the airfields. The lecture starts with a general presentation of the closed test bed and the layout of the buildings. The thermodynamic equations for the calculation of the air and waterflows needed for the cooling of the hot gases ejected by the turbojet are established. These flows are a function of the thermodynamic performance parameters of the engine, and the maximum value of the temperature allowed by the materials used in the exhaust. Correct measurement of the thrust imposes restrictions on the aerodynamics of the flow such as speeds and depression in the test room. The required air flow enables us to determine the cross section of the test room. The choice of a test bed with one or two air intakes depends on the airflows. The aerodynamic equations must be established in order to calculate approximately the airflows through the test bed. The airflows are functions of the cross sectional areas of intake and exhaust stacks, ejector, flow loss coefficients and such engine parameters as thrust, temperatures and airflow. Noise reduction in the surrounding environment is the first aim of the test bed designer. The allowable noise level imposed by the user depends on the location and the orientation of the test cell, and the distances from residential buildings, offices or workshops. B.W.

N84-25727# Pratt and Whitney Aircraft, West Palm Beach, Fla. Dept. of Test Instrumentation.
INSTRUMENTATION TECHNIQUES IN SEA LEVEL TEST FACILITIES
C. E. CRONIN *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 10p Mar. 1984 refs
Avail: NTIS HC A09/MF A01

This paper describes the application of instrumentation used during testing of turbojet and turbofan engines in sea level test facilities. The operating principal of various transducer types are discussed along with errors encountered and techniques used for calibration. A brief description of systems used for data acquisition, monitoring of engine health, and ensuring safety of the engine under test is also presented. It is the intention of this paper to present general information in the application of instrumentation devices and systems for the benefit of individuals with limited experience in the field of instrumentation. It discusses some, but by no means all, of the measurement techniques practiced in the engine development process. A selection of references is provided for those interested in reading further. Author

N84-25729# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
TESTING OF TURBOSHAFT ENGINES
M. D. WUNDER *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 11p Mar. 1984
Avail: NTIS HC A09/MF A01

Safety in flying is of paramount importance. The high standard of the theoretical principles behind research and design and quality measures during production on their own are not sufficient for guaranteeing adequate safety. Therefore testing of components and engines before installation in aircraft is still required. It may prove possible to reduce the extent of testing, based on more sophisticated evaluation methods and testing techniques. Modular designed engines may be tested even less in the future, if the effect of specific replaced modules is well understood. This lecture is concerned with engine development, manufacturing and maintenance. B.W.

N84-25731# Royal Air Force, Barry (England).
UNINSTALLED AERO ENGINE TESTING IN OPERATION IN THE ROYAL AIR FORCE
J. A. ROWLAND, B. SCOFIELD, C. HAYNES, and C. BROAD *In* AGARD Operational and Performance Meas. on Eng. in Sea Level Test Facilities 19p Mar. 1984
Avail: NTIS HC A09/MF A01

The RAF started with Avon and Spey Uninstalled Testing Run Up Stands (UTRUS) with limited scope, but soon established firm requirements for the comprehensive UETF facilities which we now have to support Adour and RB199. These have full thrust measurement and comprehensive instrumentation; various developments are described. Data analysis methods are emphasized including the use of desk top calculators and the advantages gained from ADP and Automated Power Plant Testing (APT). CSDE's work on continuous calibration is described with examples and a brief introduction to their V mask technique. The paper concludes with a description of the RAF Training schemes for UETF Operators. Author

N84-25732# Aeronautical Research Labs., Melbourne (Australia).
DIGITAL CONTROL OF FLIGHT SIMULATOR MOTION BASE ACTUATOR
J. SANDOR Jan. 1984 54 p refs
(ARL-SYS-TM-69; AR-003-006) Avail: NTIS HC A04/MF A01
Digital control strategies for a nonlinear motion base actuator are considered and a compound linear/nonlinear algorithm is derived for velocity tracking under a range of load conditions for representative moton demands. Discrete frequency domain methods are employed to synthesize the linear components of the control law and to establish the stability of the closed loop system via describing function analysis. The nonlinear compensation, providing attenuation of Coulomb friction effects, is realized through a velocity dependent gain term, which does not significantly affect the satisfactory large amplitude system response. Overall closed loop system performance is validated through computer simulation. Author

N84-25735# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE WIND TUNNEL S2MA OF THE AERODYNAMIC TESTING PLANT IN MODENE-AVRIEUX, FRANCE [LA SOUFFLERIE S2MA DU CENTRE D'ESSAIS AERODYNAMIQUES DE MODANE-AVRIEUX]
J. LAVERRE and F. CHARPIN 1983 64 p In FRENCH
Report will be announced as translation ESA-TT-862
(ONERA-NT-1983-5; ESA-TT-862) Avail: NTIS HC A04/MF A01
The continuous pressurized S2MA wind tunnel has a 1.75 x 1.77 sq m transonic section (Mach 0.1 to 1.3) and a 1.75 x 1.935 sq m supersonic section (Mach 1.5 to 3.1). The different supports used are described as well as an overview of the tests conducted which illustrate the possibilities offered by this facility. Instrumentation as well as data acquisition and processing are discussed. Schematics are included. A.R.H.

10

ASTRONAUTICS

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

A84-34915*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THERMOELASTIC LIMIT CYCLING OF ZIPPERED CROSS SECTION SPACECRAFT BOOMS
R. A. LASKIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984. 25 p. NASA-supported research. refs
(AIAA PAPER 84-1065)
The phenomenon of thermal flutter of open cross section storable tubular extendible member (STEM) spacecraft booms was first observed in OGO IV and subsequently on a number of other satellites. Theoretical work ultimately ascribed the anomalous, undamped oscillations to the low torsional rigidity of the open section booms. This was confirmed when 'zippered' cross section booms, with substantially higher torsional rigidity, were later flown without exhibiting thermal flutter. However, zippered STEM booms generally have sizeable torsional backlash zones. It is shown here that small amplitude thermoelastic limit cycling within this backlash zone is theoretically possible and is the likely explanation for undamped oscillations recorded on Voyager 1 and 2 in the early stages of the Voyager mission. Author

A84-35156*# General Research Corp., McLean, Va.
A VIEW OF FUTURE TECHNOLOGY NEEDS FOR SPACE TRANSPORTATION
C. F. GARTRELL (General Research Corp., McLean, VA) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 10 p. refs
(Contract NASW-3592)
(AIAA PAPER 84-1283)
This paper addresses an independent assessment of space transportation requirements within the NASA and Military Space Systems Technology Models. A critical examination is made of the system needs of the various flight elements with the models as compared to independent technology forecasts and possible technology deficiencies are discussed. These deficits impact the requisite developments needed for chemical propulsion, thermal protection systems, fuel cells, guidance, avionics and data processing for both launch vehicles and orbital transfer vehicles. Also addressed are potential alternative propellant technologies and their impact upon transfer vehicle systems. The primary focus of these anticipated technology developments will be to reduce operational costs, expand flexibility, and increase the payload capability of space transportation. Author

N84-24600*# National Academy of Sciences - National Research Council, Washington, D. C.
ACTIVITIES OF THE AERONAUTICS AND SPACE ENGINEERING BOARD COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS Summary Report, 1 Jan. - 31 Mar. 1984
Apr. 1984 7 p
(Contract NASW-3455)
(NASA-CR-173529; NAS 1.26:173529; SR-14) Avail: NTIS HC A02/MF A01 CSCL 13B
The agenda of the Aeronautics and Space Engineering Board meeting is reviewed. Items discussed included; engineering and technical requirements of the space station, NASA's altitude wind tunnel, rocket engine casings, advanced flight vehicle technology, the space shuttle, and on-orbit space maintenance. Board members along with their institutional affiliation are listed. R.S.F.

N84-24698# Naval Postgraduate School, Monterey, Calif.
DESIGN AND ANALYSIS OF COORDINATED BANK-TO-TURN (CBTT) AUTOPILOTS FOR BANK-TO-TURN (BTT) MISSILES M.S. Thesis
I. S. LIOULIS Dec. 1983 311 p
(AD-A140103) Avail: NTIS HC A14/MF A01 CSCL 16B
This work addresses the design and analysis of the Pitch, Yaw and Roll autopilot for application to the Bank-to-Turn (BTT) missiles. At first, the linear uncoupled channels were designed and analyzed according to the desired requirements. Utilizing the uncoupled channels, the linear coupled autopilots were designed, not including the inertial, kinematic and aerodynamic cross-coupling. Then, the nonlinear CBTT autopilots were designed and analyzed, using the linear CBTT (Coordinated Bank-to-Turn) models, which now have coupled with kinematic, inertial and aerodynamic cross-coupling. The minimization of the above kinematic and inertial coupling and their effects were completed using feedbacks of angle-of-attack and rate of angle-of-attack in the Pitch autopilot. Author (GRA)

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CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A84-35724
CRACK RESISTANCE OF PRESSED AND ROLLED SEMIFINISHED PRODUCTS FROM ALUMINUM ALLOYS USED IN LOAD-BEARING UNITS IN AIRCRAFT WINGS [TRESHCHINOSTOIKOST' PRESSOVANNYKH I KATANYKH POLUFABRIKATOV IZ ALIUMINIEVYKH SPLAVOV, PRIMENIAEMYKH V SILOVYKH KONSTRUKTSIIAKH KRYLA SAMOLETOV]
A. G. VOVNIANKO and A. M. DOTSENKO Fiziko-Khimicheskaia Mekhanika Materialov (ISSN 0430-6252), vol. 20, Mar.-Apr. 1984, p. 99-102. In Russian. refs

The growth rate of cracks 30-500 mm long and with large stress intensity factors is analyzed in specimens of the alloys D16chT, V95pchT1, V95pchT2, 1161T, and 1163T which are used in aircraft panels and wind-box skin. The conditional stress intensity factors characterizing the residual strength of thin-walled structures with a crack are determined. The influence of thickness on crack resistance was studied in semifinished products 4, 8, and 12 mm thick that were cut with the grain. The influence on crack growth rate of sigma-max, which ranged from 68.5 to 216 MPa, was also examined. According to cyclic crack resistance and the conditional critical stress intensity factor, pressed panels of D16chT were superior to rolled slabs of the same alloy. The application of a softening aging regime T2 instead of T1 for the V95pch alloy significantly lowered the crack growth rate, especially for high values of K-max. J.N.

A84-35761
DETERMINATION OF THE HEAT OF COMBUSTION OF REACTIVE FUELS BY A CALCULATION METHOD [OPREDELENIE TEPLOTY SGORANIIA REAKTIVNYKH TOPLIV RASCHETNYM METODOM]
A. F. GORENKOV, T. A. LIFANOVA, I. G. KLIUIKO, and A. I. KUPREEV Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 5, 1984, p. 35, 36. In Russian.

An empirical formula for calculation of the heat of combustion accounts for the relationship between carbon and hydrogen in the molecules of reactive fuels as well as for the mass of the molecules and their arrangement. The present equation for the specific lower heat of combustion is expressed in terms of the percent mass content of aromatic hydrocarbons, the mean temperature of boiling evaporation of the fuel, and the fuel density at 20 C. The maximum deviation from experimental data does not exceed 150 kJ/kg. J.N.

A84-35920#
SURVEY LECTURE AND SPECIAL EXPERIENCES IN FRG
K. BRUNSCH (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) International Conference on Carbon Fibre Application, Brazil, Dec. 5-9, 1983, Paper. 40 p. (MBB-UD-410-83-OE)

An overview of experience gained in the development of carbon fiber composite (CFC) structures for aerospace application is presented. Consideration is given to materials, the use of CFC structures in the solar arrays of Intelsat V, thermal expansion molding for transportation aircraft components, military aircraft, and the use of CFC to regulate torsional stiffness in helicopter rotor blades. For cost-effectiveness, small volume production of aerospace CFC structures indicates a well balanced mix of automated and manual processing. Various testing techniques for quality control of composite components are briefly reviewed. J.N.

A84-36175#
STATISTICS OF CRACK GROWTH OF A SUPERALLOY UNDER SUSTAINED LOAD
J. N. YANG (George Washington University, Washington, DC) and R. C. DONATH (USAF, Materials Laboratory, Wright-Patterson AFB, OH) ASME, Transactions, Journal of Engineering Materials and Technology (ISSN 0094-4289), vol. 106, Jan. 1984, p. 79-83. refs

A statistically-formulated fracture mechanics model for crack growth under sustained load is used to analyze crack growth data from 23 compact tension specimens of IN100, a turbojet engine disk material. The procedures characterize crack growth rates assuming that the growth rate is a lognormal random variable. The mean and standard deviation of the growth rate are determined from test data using the method of maximum likelihood. From these estimates, a lognormal creep crack growth rate model is developed from which is derived a statistical distribution of the crack size at any time. The distribution of time to reach some critical crack size is also presented. These distributions allow for the determination of the effect of hold time in the loading cycle on the life prediction of gas turbine engine disks. Author

N84-24715# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF SYMMETRIC REINFORCEMENT OF QUASI-ISOTROPIC GRAPHITE-EPOXY PLATES WITH A CIRCULAR CUTOUT UNDER UNIAXIAL TENSILE LOADING M.S. Thesis
D. H. PICKETT and P. SULLIVAN Dec. 1983 112 p
(AD-A139998) Avail: NTIS HC A06/MF A01 CSCL 11D

An experimental and computational analysis was made of the strain field around a reinforced circular hole in four HMF330/34 graphite/epoxy (G/Ep) panels under uniaxial tensile loading. The basic panel was a 10.0 in. wide, 26.0 in. long, eight ply, quasi-isotropic (0/+45/90)s cloth laminate. Each panel was reinforced during manufacture by concurring two circular plies of the same material to each side of the panel. A circular one inch hole was drilled concentrically through the laminate to provide a stress concentration. The symmetric reinforcement reported here provided an improvement of 29 to 40% in ultimate strength over a similar but unreinforced panel under the same loading conditions. Test results indicated that panel failure would occur when the fibers in the dominating orientation were strained approximately 1%. There appeared to be a significant load transfer within the laminate at high strains from the failed fibers. A finite element analysis was made and found in excellent agreement with experimental results. GRA

N84-24732# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
COMBUSTION PROBLEMS IN TURBINE ENGINES
Loughton, England Jan. 1984 434 p refs In ENGLISH and FRENCH Symp. held in Cesme, Turkey, 3-6 Oct. 1983
(AGARD-CP-353; ISBN-92-835-0346-5) Avail: NTIS HC A19/MF A01

With ever increasing emphasis on improving gas turbine cycle efficiency, reducing engine development time/cost, reducing cost of ownership, minimizing pollutant emissions, and more recently the need to develop fuel tolerant combustion systems, the combustion problems in gas turbine engines require special considerations. Alternative fuels, fuel preparation, kinetics, soot, liner cooling, and combustion modeling are among the topics discussed.

N84-24733# National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
AVIATION FUEL SPECIFICATION REQUIREMENTS: THEIR SIGNIFICANCE AND FUTURE TRENDS
L. GARDNER and R. B. WHYTE *In* AGARD Combust. Probl. in Turbine Eng. 15p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

During at least the next twenty years the only economically available fuels for aviation turbine engines will be hydrocarbons, but the composition will change due to increased demand relative to other petroleum products, changes in available crudes, changes in refinery processing and the introduction of synthetic crudes from heavy oils, tar sands, shale and coal. An attempt is made to predict some of the changes in fuel properties which are likely to occur and the problems these will cause in current turbine engines. Increasing shortages of suitable crude feedstocks and the threat of disruptions in supply due to world economic and potential international conflicts may require a broadening of current jet fuel specifications to improve availability and to allow, at minimum cost and maximum energy efficiency, the use of feedstocks from alternative sources including heavy petroleum crudes, tar sands, oil shale and coal. To prepare for an uncertain future in jet fuel quality and availability, research is needed to more fully understand the effects of varying fuel properties on engine and aircraft fuel system performance, reliability and durability and to build the technology base that would allow greater fuel flexibility in future aircraft. Since current production engines will still be in service at the turn of the century, research and advanced technology to accommodate possible future fuels must include cost effective retrofit options for current production aircraft as well as new engine and aircraft fuel systems. R.J.F.

N84-24734*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESEARCH ON AVIATION FUEL INSTABILITY
C. E. BAKER, D. A. BITTKER, S. M. COHEN, and G. T. SENG *In* AGARD Combust. Probl. in Turbine Eng. 11p Jan. 1984 refs
Avail: NTIS HC A19/MF A01 CSCL 21B

Current aircraft turbine fuels do not present a significant problem with fuel thermal stability. However, turbine fuels with broadened properties or nonpetroleum derived fuels may have reduced thermal stability because of their higher content of olefins, heteroatoms, and trace metals. Moreover, advanced turbine engines will increase the thermal stress on fuels because of their higher pressure ratios and combustion temperature. In recognition of the importance of this problem, NASA Lewis is currently engaged in a broadly based research effort to better understand the underlying causes of fuel thermal degradation. The progress and status of our various activities in this area are discussed. Topics covered include: nature of fuel instability and its temperature dependence, methods of measuring the instability, chemical mechanisms involved in deposit formation, and instrumental methods for characterizing fuel deposits. Finally, some preliminary thoughts on design approaches for minimizing the effects of lowered thermal stability are briefly discussed. R.J.F.

N84-24735# United Technologies Corp., East Hartford, Conn.
ALTERNATIVE FUEL DEPOSIT FORMATION
J. TEVELDE, L. J. SPADACCINI, E. J. SZETELA, and M. R. GLICKSTEIN (Pratt and Whitney Aircraft) *In* AGARD Combust. Probl. in Turbine Eng. 10p Jan. 1984 refs
(Contract M00140-80-C-0097)
Avail: NTIS HC A19/MF A01

A heated tube apparatus was used to evaluate the deposit formation rates of four liquid hydrocarbon fuels and to determine the effect fuel deposits have on the transfer characteristics of aircraft gas turbine fuel systems. The fuels tested were: a low aromatic JP-5, a blend of 80 percent JP-5 and 20 percent hydrocracked gas oil, a blend of 50 percent JP-5 and 50 percent No. 2 heating oil, and a shale derived JP-5. Deposit formation rates ranging from 10 micrograms per square centimeter per hour to 3000 micrograms per square centimeter per hour were obtained at tube wall temperatures ranging from 480 K to 800 K, with peak formation rates occurring at initial surface temperatures of 644 K to 672 K. Results indicate that deposit formation rate correlates very well with initial surface temperature and the thermal stability rankings derived from present experimental results agree very well with rankings based upon independent analysis. The deposit thermal resistance, as calculated from heat transfer measurements, correlates well with measured deposit quantity and thickness. Heat transfer analyses indicate that the deposit thermal conductivity increases with increasing deposit thickness, and ranges from values approximating the thermal conductivity of the fuel to values approaching that of amorphous carbon. R.J.F.

N84-24736# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
COMBUSTOR TECHNOLOGY FOR BROADENED-PROPERTIES FUELS
W. J. DODDS *In* AGARD Combust. Probl. in Turbine Eng. 12p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

In order to increase the availability and reduce the cost of future fuels for aircraft gas turbine engines, it may be necessary to broaden fuel specifications. Anticipated changes in fuel properties, and the effects of these changes on combustion system performance, operating characteristics, durability, and emissions are briefly reviewed, and results to date of a program being conducted to develop and demonstrate combustor technology required to utilize broadened properties fuels in current and next generation engines are described. Combustion system design considerations and tradeoffs for burning broadened properties fuels are discussed, and test experience with several applicable combustor design modifications to the General Electric CF6-80A combustion system is reviewed. Modifications were demonstrated to improve liner cooling and reduce smoke in the conventional annular combustor, thereby reducing effects of variations in fuel hydrogen content. Advanced staged and variable geometry combustor concepts for burning broadened properties fuels were also demonstrated. R.J.F.

N84-24737# Pratt and Whitney Aircraft, West Palm Beach, Fla. Engineering Div.
FUEL EFFECTS ON GAS TURBINE COMBUSTION SYSTEMS
S. A. MOSIER *In* AGARD Combust. Probl. in Turbine Eng. 15p Jan. 1984 refs Sponsored in part by the U.S. Army and U.S. Navy
Avail: NTIS HC A19/MF A01

The effects of variations in properties and characteristics of liquid hydrocarbon base fuels in gas turbine engine combustors was investigated. Baseline fuels consisted of military specification materials processed from petroleum and shale oil. Experimental fuels were comprised of liquid petroleum blends that were prepared specifically to exhibit desired physical and chemical properties. These fuels were assessed for their influence on ignition and performance characteristics in combustors of the F100, TF30, and J57 (TF33) engines at simulated operating conditions. In general, during relatively short duration tests, combustor ignition and performance became increasingly poorer as fuel quality deviated from specification or historical values. Author

N84-24739# Southwest Research Inst., San Antonio, Tex.
U.S. ARMY ALTERNATIVE GAS-TURBINE FUELS RESEARCH: MERADCOM
C. A. MOSES *In* AGARD Combust. Probl. in Turbine Eng. 10p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

A research program on the effects of alternative fuels on gas turbine engine combustion is reviewed. Experimental programs primarily concentrated on two areas of changing fuel properties; one, the effects of volatility on combustor performance characteristics such as ignition and combustion efficiency; and, two, the effects of changing fuel chemistry on soot formation and flame radiation. R.J.F.

N84-24741# Avco Lycoming Div., Stratford, Conn. Advanced Combustor Design Dept.
ALTERNATIVE FUELS USE IN A VEHICULAR GAS TURBINE
N. R. MARCHIONNA *In* AGARD Combust. Probl. in Turbine Eng. 13p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

Practical aspects of combustor design for the use of alternate fuels in the AGT 1500 vehicular gas turbine engine are discussed. Engine performance test results are compared to laboratory data and to combustor component performance over the range of engine operating conditions. Fuel effects on starting and low power efficiency are related to atomizer peformance and to drop size distribution. Smoke emissions are correlated with fuel characteristics, engine operating conditions, and combustor primary zone design parameters. Results are presented for fuels ranging from gasoline to No. 6 oil. E.A.K.

N84-24758# Leeds Univ. (England). Dept. of Mechanical Engineering.
AN INVESTIGATION OF THE INTERACTION BETWEEN MULTIPLE DILUTION JETS AND COMBUSTION PRODUCTS
P. V. CHLEBOUN (Rolls Royce Ltd.), S. H. NASSER, F. B. SEBBOWA, and C. G. W. SHEPPARD *In* AGARD Combust. Probl. in Turbine Eng. 11p Jan. 1984 refs
Avail: NTIS HC A19/MF A01

An investigation was made of the interaction between multiple dilution jets discharging from a common annulus into hot combustion products. Gas concentrations, mean and fluctuating gas temperatures (using compensated fine wire thermocouples) were measured throughout the mixing region for three dilution jet flow rates. A parallel theoretical study of the same flows was conducted using the Rolls-Royce PACE computer code (a finite difference program employing a k-e turbulence sub-model). The output from this program proved useful in visualizing the flow and interpreting the experimental data. Attention is drawn to the care needed when comparing various types of experimental information and apparently similar parameters output from computer codes on a mass flow weighted basis. M.G.

N84-24759# Centre National de la Recherche Scientifique, Poitiers (France). Lab. d'Energetique et de Detonique.
A STUDY OF THE FUNDAMENTAL PROBLEMS OF COMBUSTION IN THE COMBUSTION CHAMBERS OF TURBOJETS USING A TUBULAR REACTOR [ETUDE DE PROBLEMES FONDAMENTAUX DE LA COMBUSTION DANS LES FOYERS DE TURBOREACTEURS AU MOYEN D'UN REACTEUR TUBULAIRE]
J. C. BELLET, P. CAMBRAY, M. CHAMPION, and D. KARMED *In* AGARD Combust. Probl. in Turbine Eng. 13p Jan. 1984 refs In FRENCH
Avail: NTIS HC A19/MF A01

At the entrance of a tubular reactor, cool gases (hydrocarbon-air) and heated gases are rapidly mixed in such a way that combustion is stabilized by recirculating the heated gases. This tubular reactor is used to validate, under representative combustion chamber conditions, the kinetics of hydrocarbon combustion proposed by other authors, as well as to study the interactions between thermal turbulence and the rates of chemical production. Results obtained previously show that the influence of turbulence on the rate of chemical production can be neglected by a first approximation and the flow in the center line can be considered as quasi-one dimensional. The measured profiles of molecular fractions are used to test models proposed for propane combustion. It appears that, if the most recent models correctly predict the first phase of combustion, they overestimate the reaction rates at the end of combustion, especially in the case of a propane-air-heated gas mixture. In addition, it is proven that, as theory predicts, combustion augments the amplitude of temperature fluctuations present in the initial mixture. Transl. by A.R.H.

N84-24822# Air Force Engineering and Services Center, Tyndall AFB, Fla.
DEGRADATION OF JET FUEL HYDROCARBONS BY AQUATIC MICROBIAL COMMUNITIES Interim Report, 23 Oct. 1981 - 30 Sep. 1983
J. C. SPAIN, C. C. SOMERVILLE, L. C. BUTLER, T. J. LEE, and A. W. BOURQUIN Nov. 1983 226 p
(Contract AF PROJ. 1900)
(AD-A139791; AFESC/ESL-TR-83-26) Avail: NTIS HC A11/MF A01 CSCL 21D

A model fuel mixture of fifteen hydrocarbons representative of those in distillate jet fuels was used to determine whether degradation by natural microbial communities could affect the persistence of such fuels released into aquatic environments. The mixture included hexane, cyclohexane, n-heptane, methylcyclohexane, toluene, n-octane, ethylcyclohexane, p-xylene, cumene, 1,3,5-trimethylbenzene, indan, naphthalene, 2-methylnaphthalene, n-tetradecane, and 2,3-dimethylnaphthalene. The water-soluble fraction of the model fuel was incubated in shake flasks with water or water and sediment suspensions collected at estuarine and freshwater sites. Surface films of the model mixture were studied under quiescent incubation. The disappearance of hydrocarbons was measured by capillary gas chromatography. Control flasks were sterilized with HgCl to estimate losses due to abiotic processes. Fate tests were repeated with petroleum-derived JP-4. The soluble components of JP-4 were volatilized too rapidly for biodegradation to occur. Sedimentation dramatically affected the fate of fuel components when mixing of the hydrocarbon and sediment layers was studied. Sediment-associated components were more resistant to volatilization and microbial attack. GRA

N84-24824# Naval Postgraduate School, Monterey, Calif.
ELECTRICAL SPRAY MODIFICATION WITH VARIOUS FUELS IN A T56 COMBUSTOR
A. ZAJDMAN Mar. 1984 74 p
(AD-A139961; NPS67-83-003CR) Avail: NTIS HC A04/MF A01 CSCL 21D

The possibility of electrically altering the droplet size distribution and injection cone angle of gas turbine fuel injectors has been investigated. The work was carried out both in a combustor rig incorporating a T-56 combustor liner/nozzle and in a non-burning spray optical absorption apparatus into each of which a high voltage electrode could be introduced. Several electrode designs were investigated in an effort to minimize flameholding and subsequent electrical shot circuiting. Fuels investigated included JP-4, the design fuel, JET-A, JP-5, and Diesel Fuel Number 2. Results of the optical experiments indicated reductions in the Sauter Mean Diameter of 7.7 percent. Results of the combustion experiments indicated increases in combustor efficiency of up to 3.6 percent for Diesel Fuel Number 2 and increases up to 0.6 percent for JP-4. Author (GRA)

N84-24825# Defence Research Establishment, Ottawa. (Ontario).
COMPARISON OF JFTOT (JET FUEL THERMAL OXIDATION TESTER) AND ABSORBANCE METHODS FOR DETERMINING JET FUEL THERMAL STABILITY
J. R. COLEMAN and L. D. GALLOP Dec. 1983 26 p In ENGLISH and FRENCH
(AD-A138673; DREO-TN-83-34) Avail: NTIS HC A03/MF A01 CSCL 21D

The thermal stability of five aviation turbine fuels was examined employing the jet fuel thermal oxidation tests and an optical absorbance based on the Phillips 5 ml bomb test. No correlation was observed between the fuels by the two methods. Author

N84-25060*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
STATUS OF UNDERSTANDING FOR BEARING MATERIALS
E. N. BAMBERGER *In* NASA Lewis Research Center Tribology in the 80's, vol. 2 p 773-794 Apr. 1984 refs
Avail: NTIS HC A17/MF A01 CSCL 11F

The structural materials and potential failure modes for high technology aircraft gas turbine bearings are reviewed. Among the failure modes discussed for iron-base through-hardened bearing materials are fatigue, surface distress, and corrosion. It is shown that the sub-surface initiated rolling-contact fatigue failure mode is reasonably well understood and in most cases can be controlled by proper material selection and design. Current bearing materials provide long life and high reliability in existing applications. A new generation of materials are being developed which will provide improved fracture toughness, better corrosion resistance, and a further extension of bearing fatigue life. Bearing problems due to surface distress, caused by a variety of surface and near surface anomalies, are less well understood. This area will require the implementation of an interdisciplinary effort to improve the level of understanding of metallic surface-lubricant reactions and interactions. R.S.F.

N84-25614# Royal Aircraft Establishment, Farnborough (England). Materials and Structures Dept.

CORROSION CONTROL REQUIREMENTS FOR UK MILITARY AIRCRAFT

V. C. R. MCLOUGHLIN *In* AGARD Workshop on Requirements for Aircraft Corrosion Control 5 p Mar. 1984

Avail: NTIS HC A05/MF A01

The designer is given advice on the selection of materials based upon their resistance to corrosion, and mandatory requirements for processes and materials to be used in aircraft structures so as to minimize deterioration and corrosion. Details are given of these requirements and the various sequences of operations required for corrosion control purposes. R.J.F.

N84-25772# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Direction Etudes.

COMPOSITE MATERIALS: THE USER AND THE PRODUCER [LES COMPOSITES: UTILISATEUR ET PRODUCTEUR]

R. RADONDY and TREMILLON (ELF Aquitaine, France) 23 Feb. 1984 34 p In FRENCH Presented at Salon Intern. des Tech. et Energies du Futur (SITEF) 83, Toulouse, 18 - 23 Oct. 1983

(SNIAS-832-111-108) Avail: NTIS HC A03/MF A01

International competition requires the aircraft manufacturer to be constantly on the look out for recent construction materials having the best performance, mass, and cost. Carbon-resin composites are a good comprise for aircraft structures. Currently introduced in moveable surface of civil aviation aircraft, the carbon-resin composite should eventually be adopted for large size primary structures. The process of fiber production is being mastered. To meet the expectations of the aeronautics industry, new generations of carbon fibers were developed (T.400, X.550, type 3, etc.). The intrinsic characteristics of these fibers are discussed as well as the comparative performance of layered structures prepared from T.300 and T.400. Composites used on the Caravel, the Concorde, the Airbus, the Mirage 2000, the Falcon 10, and the ATR 42 aircraft are discussed. Improvements required in properties and fabrication processes are identified.

Transl. by A.R.H.

N84-25774# Electrical Research Association, Leatherhead (England).

INVESTIGATION OF THE RF PROPERTIES OF CARBON FIBRE COMPOSITE MATERIALS Final Report

D. A. BULL, G. A. JACKSON, A. MCHALE, and B. W. SMITHERS Jul. 1982 282 p

(AD-A140261; ERA-81-109; DRIC-BR-84464) Avail: NTIS HC A13/MF A01 CSCL 11D

The resistivity of small CFC samples at frequencies up to 300 MHz was measured using Q-meter techniques. Values of 0.00003 to 0.00015 ohm-meter are typical at low frequencies and increase with increasing frequency indicating the presence of skin effect. Samples showed little change in their d.c. resistance as a result of prolonged exposure to various liquids although boiling in tap or sea water produced substantial increases in resistance. Screening effectiveness to magnetic fields in the range 0.15 - 30 MHz and electric fields in the range 30 - 1000 MHz was measured for panels of CFC incorporated as one face of a copper cubic enclosure and as one surface panel of a Wessex helicopter tail cone. Screening effectiveness of a cylinder completely fabricated from CFC was also measured. Results indicate that the screening effectiveness of a CFC or part CFC fuselage, particularly in the hf band, will be critically dependent on the electrical continuity of bonds and joints and may be significantly less than for present day metal airframes. At vhf and uhf the screening effectiveness of part CFC and present day metal airframes are similar. The performances of vhf and uhf aerials when mounted on CFC or metal ground planes were similar and essentially within manufacturers' specifications. GRA

N84-25828# Materials Research Labs., Melbourne (Australia). Organic Chemistry Div.

INTERACTIONS BETWEEN F-111 FUSELAGE FUEL TANK SEALANTS. PART 1: CHARACTERISATION OF POLYESTER SEALANTS AND THEIR HYDROLYTIC DEGRADATION PRODUCTS

P. J. HANHELA and D. B. PAUL Dec. 1983 24 p refs

(MRL-R-657-PT-1; AR-003-298-PT-1) Avail: NTIS HC A02/MF A01

Interactions between polysulfides and the hydrolysis products of polyester sealants EC 5106 and EC 5146 within integral fuselage fuel tanks of F-111 aircraft lead to fuel leaks. To assist in determining the mechanisms involved in this process a study of the physical changes which occur during contact of typical polysulfides with actual and model polyester products is to be undertaken. Prior to this investigation a detailed analysis of the polyester sealants was necessary to assist selection of model degradation products. Exhaustive degradation of the polyester resins using the transesterification reagent of lithium methoxide in methanol provided suitable samples for analysis by gc/ms and other spectroscopic techniques. Major components were shown to be sebacic acid and neopentyl glycol. The most significant difference between the two polyester prepolymers was in the larger proportion of trihydric alcohol in EC 5146 which would result in a greater degree of crosslinking of this sealant compared with EC 5106. B.W.

N84-25833# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Lab. Central.

INFLUENCE OF THE ENVIRONMENT ON THE APPLICATION AND DRYING QUALITY OF ORGANIC PAINTS [INFLUENCE DES CONDITIONS D'AMBIANCE LORS DE L'APPLICATION ET DU SECHAGE SUR LA QUALITE DES PEINTURES ORGANIQUES]

28 Nov. 1983 23 p In FRENCH Presented at SURFAIR 4 Journees d'Etudes Intern. des Traitements de Surface dans l'Ind. Aeron. et Spatiale, Cannes, France, Sep. 1982

(SNIAS-832-551-102; C.44.593) Avail: NTIS HC A02/MF A01

Problems that surface during the painting of aircraft are associated with the chemical nature of the paints used. Aircraft manufacturers are using type 2 polyurethanes with a hydrolyzed polymer and a polyisocyanate. A climate chamber in which the spraying and drying of paints can be accomplished under strictly controlled conditions is described. The conditions for the appearance of microblisters are listed and the probable cause is identified as carbon dioxide in the film. The benefits of airless and pneumatic spray guns are examined. Studies show that paint should dry at ambient temperatures without any special deposition. Time for the second coating should not be any longer than 6 to 8 hours for base paint and only 4 hours for the decorative trim.

Transl. by A.R.H.

N84-25854*# Simmonds Precision Products, Inc., Vergennes, Vermont. Instrument Systems Div.

STUDY OF EFFECTS OF FUEL PROPERTIES IN TURBINE-POWERED BUSINESS AIRCRAFT Final Report

F. D. POWELL, R. J. BIEGEN, P. G. WEITZ, JR., and A. M. DUKE Apr. 1984 89 p refs

(Contract NAS3-22827)

(NASA-CR-174627; E-2470; NAS 1.26:174627) Avail: NTIS HC A05/MF A01 CSCL 21D

Increased interest in research and technology concerning aviation turbine fuels and their properties was prompted by recent changes in the supply and demand situation of these fuels. The most obvious change is the rapid increase in fuel price. For commercial airplanes, fuel costs now approach 50 percent of the direct operating costs. In addition, there were occasional local supply disruptions and gradual shifts in delivered values of certain fuel properties. Dwindling petroleum reserves and the politically sensitive nature of the major world suppliers make the continuation of these trends likely. A summary of the principal findings, and conclusions are presented. Much of the material, especially the tables and graphs, is considered in greater detail later. The economic analysis and examination of operational considerations are described. Because some of the assumptions on which the economic analysis is founded are not easily verified, the sensitivity of the analysis to alternates for these assumptions is examined. The data base on which the analyses are founded is defined in a set of appendices. Author

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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.

A84-33701* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF STRUCTURAL COUPLING ON MISTUNED CASCADE FLUTTER AND RESPONSE
R. E. KIELB and K. R. V. KAZA (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, Jan. 1984, p. 17-24. refs
(ASME PAPER 83-GT-117)

The effects of structural coupling on mistuned cascade flutter and response are analytically investigated using an extended typical section model. This model includes both structural and aerodynamic coupling between the blades. The model assumes that the structurally coupled system natural modes were determined and are represented in the form of N bending and N torsional uncoupled modes for each blade, where N is the number of blades and, hence, is only valid for blade dominated motion. The aerodynamic loads are calculated by using two dimensional unsteady cascade theories in the subsonic and supersonic flow regimes. The results show that the addition of structural coupling can affect both the aeroelastic stability and frequency. The stability is significantly affected only when the system is mistuned. The resonant frequencies can be significantly changed by structural coupling in both tuned and mistuned systems, however, the peak response is significantly affected only in the latter. Previously announced in STAR as N83-15672 S.L.

A84-33702* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENTS OF SELF-EXCITED ROTOR-BLADE VIBRATIONS USING OPTICAL DISPLACEMENTS
A. P. KURKOV (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, Jan. 1984, p. 44-49. refs
(ASME PAPER 83-GT-132)

The characteristics of optical displacement spectra and their role of monitoring rotor blade vibrations are discussed. During the operation of a turbofan engine at part speed, near stall, and elevated inlet pressure and temperature, several vibratory instabilities were excited simultaneously on the first fan rotor. The torsional and bending contributions to the main flutter mode were resolved by using casing-mounted optical displacement sensors. Other instabilities in the blade deflection spectra were identified. Previously announced in STAR as N83-14523 E.A.K.

A84-33706* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LENGTH TO DIAMETER RATIO AND ROW NUMBER EFFECTS IN SHORT PIN FIN HEAT TRANSFER
B. A. BRIGHAM and G. J. VANFOSSEN (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, Jan. 1984, p. 241-245. refs
(ASME PAPER 83-GT-54)

The relative effects of pin length to diameter ratio and of pin row geometry on the heat transfer from pin fins, was determined. Array averaged heat transfer coefficients on pin and endwall surfaces were measured for two configurations of staggered arrays of short pin fins (length to diameter ratio of 4). One configuration contained eight streamwise rows of pins, while the other contained only four rows. Results showed that both the 8-row and the 4-row configurations for an L sub p/D of 4, exhibit higher heat transfer than in similar tests on shorter pin fins (L sub p/D of 1/2 and 2). It was also found that for this L sub p/D ratio, the array averaged heat transfer was slightly higher with eight rows of staggered pins than with only four rows. Previously announced in STAR as N83-14431 J.D.

A84-33707
EFFECTS OF PIN SHAPE AND ARRAY ORIENTATION ON HEAT TRANSFER AND PRESSURE LOSS IN PIN FIN ARRAYS
D. E. METZGER, C. S. FAN, and S. W. HALEY (Arizona State University, Tempe, AZ) (Tokyo International Gas Turbine Congress, Tokyo, Japan, Oct. 24-28, 1983) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, Jan. 1984, p. 252-257. refs

In order to reduce the cooling airflow required by gas turbine blades, two families of pin fin array geometries which may potentially improve such air-cooled turbine blade airfoils' internal cooling performance are experimentally studied. One family uses circular cross section pins with various array orientations relative to the mean flow direction. The other family employs pins with an oblong cross section, again with various orientations. Heat transfer and pressure loss results indicate that the use of circular pins whose array orientation varies between the staggered and the inline can, in some cases, increase heat transfer while decreasing pressure loss. Elongated pins increased heat transfer, but with increased pressure loss. Pin surface heat transfer coefficients are double the endwall values. O.C.

A84-33829
EDM IN THE AIRCRAFT INDUSTRY
M. WHITMORE (Amchem Co., Ltd., Sileby, Leics., England) Aircraft Engineering (ISSN 0002-2667), vol. 56, April 1984, p. 2-4.

Electrical Discharge Machining (EDM) is particularly suitable for complex contours and cavities in hardened and tough materials that are difficult to machine by conventional metal cutting methods. Computerized numerical control of the discharge parameters, and accurate sensing devices which locate the component prior to machining, can fully automate machining cycles. Attention is presently given to the case of high accuracy, noncircular small hole drilling in the aircraft industry by EDM methods. A high power pulse generator allows fast drilling speeds, while the advanced positioning system employed ensures accuracy of hole location without slowing the production rate. Also noted are the operating principles of a 'rotary transfer' EDM system which machines similar engine components, such as aircraft gas turbine honeycomb ring seals. O.C.

A84-33850
FLOW VISUALIZATION AS AN AERODYNAMIC DIAGNOSTIC TOOL
A. S. W. THOMAS and M. C. WHIFFEN (Lockheed-Georgia Co., Marietta, GA) Lockheed Horizons, no. 15, 1984, p. 56-64.

Current aerodynamic flow-visualization techniques are surveyed and illustrated. Techniques examined include (in water-channel experiments) dye injection, smoke injection, hydrogen bubbles, schlieren photography, a smoke-visualization wind-tunnel, and laser-Doppler velocimetry. The value of digital image processing for deriving quantitative data from visual images is indicated. T.K.

A84-34129

METHOD FOR DETERMINING STRESS INTENSITY FACTORS IN BLADES OF GAS TURBINE ENGINES [METODIKA OPREDELENIIA KOEFFITSIENTA INTENSIVNOSTI NAPRIAZHENII V LOPATKAKH GTD]

A. V. PROKOPENKO (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), no. 4, 1984, p. 21-24. In Russian.

An approximate procedure is suggested for calculating stress intensity factors for turbine blades in tension with a crack from either the leading or trailing edges. The essence of this procedure, based on the method of sections, lies in the fact that the force not transmitted through the plane of the crack is compensated by an increase of stresses with an asymptotic distribution at the crack tip. The present method also accounts for the effect of centrifugal forces in life calculations. J.N.

A84-34133

ESTIMATION OF VIBRATIONAL STRESSED STATE FOR GTE BLADES UNDER RANDOM VIBRATIONS [OTSENKA VIBRONAPRIAZHENNOSTI LOPATOK GTD PRI SLUCHAINYKH KOLEBANIIAKH]

I. V. EGOROV and A. I. STEBUNOV (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR) Problemy Prochnosti (ISSN 0556-171X), no. 4, 1984, p. 85-90. In Russian. refs

A method for the nonparametric estimation of equivalent stresses in a turbine blade under random vibrations is based on statistical processing and an analog computer analysis of actual processes. The proposed schematization of the random vibration process is represented by the sum of two harmonic components of widely differing frequencies. The amplitude of each harmonic is equal to the amplitudes of several narrow-band processes characterized by random blade vibrations. The probability density of the amplitude distribution is determined by the histogram method, and the equivalent stresses are calculated from digital processed information about the vibrations according to a model of fatigue fracture based on linear damage accumulation. The present technique yields an acceptable degree of precision even in the absence of sufficiently complete information on the fatigue behavior of the given turbine blades. J.N.

A84-34463#

DIVERGENCE BOUNDARY PREDICTION FROM RANDOM RESPONSES - NAL'S METHOD

Y. MATSUZAKI and Y. ANDO (National Aerospace Laboratory, Tokyo, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 21, June 1984, p. 435, 436. refs

The Japanese National Aerospace Laboratory's method for the prediction of flutter and divergence boundaries from turbulence-excited responses at subcritical speeds is presently applied to the subcritical divergence testing of a cantilever forward swept wing model in a supersonic wind tunnel. The one-mode analysis indicates that the stability parameter G(1) of Jury's (1964) criteria governing static stability is closely related to the squared value of the frequency of the mode which is losing stability. O.C.

A84-34722

AEROELASTIC OPTIMIZATION OF AXISYMMETRIC CIRCULAR CYLINDRICAL SHELLS FOR SUPERSONIC FLOW

L. LIBRESCU and L. BEINER (Tel Aviv University, Tel Aviv, Israel) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Mar.-Apr. 1984, p. 124-129. refs

The paper deals with the weight minimization problem of axisymmetric circular shells of finite length placed in a high supersonic flow field. The structure is subject to uniform axial loading and to a flutter speed constraint. By using optimal control theory, the necessary conditions for a minimum weight cylindrical shell are derived. To these optimality conditions, a supplementary one is appended which ensures that the flutter speed of the minimum weight structure coincides with the prescribed one. Initial rough estimates of the optimal thickness distribution obtained using Galerkin's method are presented and the influence of the in-plane loading is given. Author

A84-34909*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLAP-LAG DAMPING OF AN ELASTIC ROTOR BLADE WITH TORSION AND DYNAMIC INFLOW IN HOVER FROM SYMBOLICALLY GENERATED EQUATIONS

T. S. R. REDDY (NASA, Ames Research Center, Moffett Field, CA) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984. 15 p. refs

(AIAA PAPER 84-0989)

A program written in FORTRAN IV and coded into subroutines for subsequent numerical study is used to derive symbolically the governing equations of motion of the elastic rotor blade and the dynamic inflow equations. By rearranging the coefficients of the equations, the blade and dynamic inflow equations are converted into equations in a multiblade coordinated system. The final multiblade equations can accommodate any number of elastic blade modes. It is noted that with a given data set, the entire process, from the derivation of the equations to the numerical calculations, is computerized and requires only limited user interface. To demonstrate the usefulness of the approach, damping data in hover with and without dynamic inflow effects are presented for various rotor blade models, including flap-lag, flap-lag-torsion, quasi-static torsion, and rigid blade lag-flap. C.R.

A84-35022#

EXPERIMENTAL DETERMINATION OF THE NATURAL MODES OF SWEPT-WING MODELS USING LASER HOLOGRAPHIC INTERFEROMETRY

W. YOU and S. GU Northwestern Polytechnical University, Journal, vol. 2, April 1984, p. 245-256. In Chinese, with abstract in English.

The fundamental principles of laser time-averaged holographic interferometry are briefly reviewed, and method is proposed for determining the modes of tow swept-wing models by using holographic interferometry supplemented by the method of sand contours. Procedures for controlling the density of fringes on the images reconstructed from time-averaged holograms are explained. The measured mode data are orthogonalized using both Gravitz's and McGrew's methods. The experimental results are found to agree well with calculative results from a finite element program. C.D.

A84-35135#

COUNTER-ROTATING INTERSHAFT SEALS FOR ADVANCED ENGINES

W. L. GAMBLE (United Technologies Corp., Pratt and Whitney Group, West Palm Beach, FL) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 6 p.

(AIAA PAPER 84-1216)

Feasibility for application of a counter-rotating intershaft carbon seal to high thrust-to-weight military gas turbine engines was demonstrated through a series of rig tests. The non-contacting high speed (800 ft/sec) seal incorporating hydrodynamic lift geometry with spiral grooves in the seal plates is similar to that designed by NASA-Lewis Research Center (DiRusso, 1983). Seal air leakage and carbon wear rates were determined for each of two configurations in rig screening evaluations of ten hours duration. One seal assembly was subjected to an additional fifty hours of endurance testing. For both configurations, seal air leakage was approximately one-third the leakage that would occur with a conventional labyrinth seal. The wear rate was low for the configuration tested a total of sixty hours. Author

A84-35195#

SIDEWALL BOUNDARY LAYER CORRECTIONS IN SUBSONIC, TWO-DIMENSIONAL AIRFOIL/HYDROFOIL TESTING

A. L. TREASTER, G. B. GURNEY (Pennsylvania State University, State College, PA), and P. P. JACOBS, JR. (USAF, Flight Test Center, Edwards AFB, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. Navy-supported research. refs

(AIAA PAPER 84-1366)

Historically, two-dimensional airfoil or hydrofoil section characteristics have been obtained by measuring individually the lift, drag and pitching moment by the most accurate technique available. The use of force balances to measure the three quantities simultaneously has met with only partial success. Although the lift and pitching moment data have usually been acceptable, the drag data have varied by as much as an order of magnitude from previous reference data. To investigate the parameters which influence two-dimensional force measurements, an experimental program was conducted in the subsonic wind tunnel of the Applied Research Laboratory at The Pennsylvania State University. From the results of this test program, the sidewall boundary layer was identified as the primary factor contributing to the erroneous drag measurements. A correction procedure which is based on the airfoil/hydrofoil geometry, the flow environment and the measured data was developed. Corrected data from the subject test program and from similar programs in other experimental facilities for both symmetrical and cambered sections are in good agreement with the reference data in all cases. Author

A84-35223*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MEASUREMENT OF FLUID PROPERTIES USING RAPID-DOUBLE-EXPOSURE AND TIME-AVERAGE HOLOGRAPHIC INTERFEROMETRY

A. J. DECKER (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 9 p. refs

(AIAA PAPER 84-1461)

The holographic recording of the time history of a flow feature in three dimensions is discussed. The use of diffuse illumination holographic interferometry or the three-dimensional visualization of flow features such as shock waves and turbulent eddies is described. The double-exposure and time-average methods are compared using the characteristic function and the results from a flow simulator. A time history requires a large hologram recording rate. Results of holographic cinematography of the shock waves in a flutter cascade are presented as an example. Future directions of this effort, including the availability and development of suitable lasers, are discussed. Previously announced in STAR as N84-21849 Author

A84-35237#

PREDICTION OF TURBULENT FLOWS IN COMBUSTOR BY USING REYNOLDS-STRESS CLOSURE

R. S. AMANO and V. S. KODALI (Wisconsin, University, Milwaukee, WI) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 6 p. refs

(AIAA PAPER 84-1494)

A numerical study is reported on the flow in combustion chambers of gas turbine engines in which there is a region of reverse currents created by means of swirlers or bluff bodies. The computations are made by using a Reynolds-stress turbulence closure model. The computed results are compared with experimental data in literature. It was shown that the computed velocity profiles with the present model agree with experiment better than an analytical solution does. The creation and decay of the Reynolds-stresses are further discussed in the flow passage. Author

A84-35301

INTERNATIONAL CONFERENCE ON NUMERICAL METHODS IN FLUID DYNAMICS, 8TH, RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN, AACHEN, WEST GERMANY, JUNE 28-JULY 2, 1982, PROCEEDINGS

E. KRAUSE, ED. (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) Conference supported by the Deutsche Forschungsgemeinschaft, Dornier GmbH, Messerschmitt-Boelkow-Blohm GmbH, U.S. Navy, and U.S. Army. Berlin, Springer-Verlag (Lecture Notes in Physics. Volume 170), 1982, 580 p.

Various aspects of the use of numerical methods to study fluid dynamics are discussed. The topics considered include: computational aerodynamics and change; numerical computations of gas explosions; two-dimensional separated flows; numerical simulation of wall-bounded turbulent shear flows; shock capturing, fitting, and recovery; and flow simulation by discrete vortex method. Numerous other subjects in the area are examined. C.D.

A84-35327

ON THE USE OF SEVERAL COMPACT METHODS FOR THE STUDY OF UNSTEADY INCOMPRESSIBLE VISCOUS FLOW FOR OUTER PROBLEMS. II

Y. LECOINTE and J. PIQUET (Ecole Nationale Superieure de Mecanique, Nantes, France) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 323-328. Sponsorship: Direction des Recherches, Etudes et Techniques. refs

(Contract DRET-81-075)

The present work is concerned with the Navier-Stokes equations in their vorticity stream function formulation discretized spatially by compact algorithms. Four different space discretizations for the vorticity are compared for the case of an impulsively started circular cylinder. The four schemes include a standard upwind scheme with second order corrections implemented in connection with an A.D.I. method in time, either in conservative form or convective form, and two formally fourth-order accurate schemes of the 'mehrstellen' type. It was found that wiggles determine the quality of the mesh resolution, and that upwinding must be switched off at the rear stagnation point in order to protect the symmetry of the flow. J.N.

A84-35341

A COMPOSITE VELOCITY PROCEDURE FOR THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS

S. G. RUBIN and P. K. KHOSLA (Cincinnati, University, Cincinnati, OH) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 448-454. refs

(Contract AF-AFOSR-80-0047)

A boundary layer relaxation procedure for the calculation of large Reynolds number problems with a dominant flow direction is based on a composite velocity formulation for an incompressible Navier-Stokes system. The gradients are considered to be largest in the surface normal direction and the flow outside the thin viscous region is essentially inviscid and is represented by a potential function. The composite representation of the velocity field reflects the matched asymptotic boundary layer-inviscid behavior. The present Navier-Stokes procedure does not significantly differ from its incompressible flow counterpart, and a direct extension to transonic flows in indicated. The equations are written in a body-fitted orthogonal coordinate system and application to internal and external flows is discussed. Laminar flow solutions for Reynolds numbers in the range 1000-100,000 were obtained for a boattail simulator, a Joukowski airfoil, a finite plate and channel geometries. J.N.

A84-35352* Scientific Research Associates, Inc., Glastonbury, Conn.

SOLUTION OF THREE-DIMENSIONAL TIME-DEPENDENT VISCOUS FLOWS

B. C. WEINBERG and H. MCDONALD (Scientific Research Associates, Inc., Glastonbury, CT) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 519-525. refs
(Contract NAS2-10016)

A procedure for solving three-dimensional, time-dependent turbulent flows is presented. The consistently split Linearized Block Implicit (LBI) scheme is used in conjunction with the QR Operator scheme to solve an approximate form of the Navier-Stokes equations in generalized nonorthogonal coordinates employing physical velocity components. Results of computations for both second order finite differences and the fourth order generalized Operator Compact Implicit (OCI) schemes are presented. Author

A84-35353* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A MINIMAL RESIDUAL METHOD FOR TRANSONIC POTENTIAL FLOWS

Y. S. WONG (NASA, Langley Research Center, Institute for Computer Applications in Science and Engineering, Hampton, VA) and M. M. HAFEZ (George Washington University, Washington, DC) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 526-532. refs
(Contract NAS1-15810; NAS1-16394)

For transonic flow calculations, a combination of the successive line over-relaxation (SLOR) and the preconditioned conjugate gradient (CG) method has been suggested by Wong and Hafez (1981). This paper studies the method of minimal residual (MR) which avoids a combined iteration. This method is closely related to the CG method, may be regarded as a first-order gradient method, and is applicable to symmetric and nonsymmetric matrices. The problem is formulated as a nonlinear mixed elliptic-hyperbolic partial differential equation which includes an artificial viscosity and a switching function which is zero in subsonic regions and nonzero in supersonic regions. Alternatives to the SLOR method which provide faster convergence rates are introduced. The preconditioned MR algorithm is developed, and transonic potential flows around NACA 0012 airfoil are calculated for different Mach numbers and angles of attack. Preliminary results are presented, demonstrating that the MR algorithm requires no parameter estimation and rapidly converges for subsonic flows. J.N.

A84-35356

SOME NEW DEVELOPMENTS OF THE SINGULARITY-SEPARATING DIFFERENCE METHOD

Y.-L. ZHU, B.-M. CHEN, X.-H. WU, and Q.-S. XU (Chinese Academy of Sciences, Computing Centre, Beijing, People's Republic of China) IN: International Conference on Numerical Methods in Fluid Dynamics, 8th, Aachen, West Germany, June 28-July 2, 1982, Proceedings . Berlin, Springer-Verlag, 1982, p. 553-559. refs

The singularity-separating difference method is applied to the problem of calculating the problem of interaction between three-dimensional discontinuities in unsteady supersonic multimaterial flow. At the beginning of the flow, there are a shock and a contact discontinuity with different materials on its two sides. The shock then intersects the contact discontinuity, and a shock (or centered wave) is reflected. There are finally two shocks, or a shock and a centered wave, and a contact discontinuity in the flow field. Shocks, contact discontinuities, and boundaries of centered waves are taken as internal boundaries, and the problem is solved usign a second-order mixed scheme for initial-boundary-value problems. For comparison with other methods, calculations were carried out using the L-W scheme for an unsteady flow with a shock, a contact discontinuity, and a centered wave. J.N.

A84-35535

OPTIMIZATION OF LARGE COMPOSITE STRUCTURES WITH STRENGTH AND LOCAL STABILITY RESTRICTIONS [OPTIMIZATSIIA BOL'SHIKH KOMPOZITNYKH KONSTRUKTSII S OGRANICHENIIAMI PO PROCHNOSTI I LOKAL'NOI USTOICHIVOSTI]

R. I. NEPERSHIN, I. B. GINKO, and V. G. PILOSIAN (Akademiia Nauk SSSR, Institut Mashinovedeniia, Moscow, USSR) (Vsesoiuznaia Konferentsiia po Mekhanike Polimernykh i Kompozitnykh Materialov, 5th, Riga, Latvian SSR, Oct. 1983) Mekhanika Kompozitnykh Materialov (ISSN 0203-1272), Mar.-Apr. 1984, p. 313-319. In Russian. refs

A computer program is developed for the optimization of large three-dimensional composite structures using the energy criterion of optimality with restrictions on thickness, strength, and local stability of the elements of the finite-element model of the structure. This technique involves various strength criteria and the local stability of both continuous and three-layer membrane elements with a honeycomb filler and composite carrying layers. Optimization examples are given for a composite cellular cantilever beam and for a carbon-plastic aerodynamic fin structure. The respective finite-element models contained 108 and 580 independent design variables. The spars and ribs of the fin are modeled as shear and rod elements, and the web material is considered to be uniform and orthotropic. J.N.

A84-35537

USE OF COMPOSITE MATERIALS FOR FABRICATING THE ANISOTROPIC STRUCTURE OF A SWEPT-FORWARD WING REQUIRED BY AEROELASTICITY AND STRENGTH CONSIDERATIONS [ISPOL'ZOVANIE KOMPOZITNYKH MATERIALOV DLIA SOZDANIIA TREBUEMOI PO USLOVIIU AEROUPRUGOSTI I PROCHNOSTI ANIZOTROPNOI KONSTRUKTSII KRYLA OBRATNOI STRELOVIDNOSTI]

V. M. FROLOV and A. N. SHANYGIN (Vsesoiuznaia Konferentsiia po Mekhanike Polimernykh i Kompozitnykh Materialov, 5th, Riga, Latvian SSR, Oct. 1983) Mekhanika Kompozitnykh Materialov (ISSN 0203-1272), Mar.-Apr. 1984, p. 353-357. In Russian.

The optimal parameters of the primary structure of a swept-forward wing having structural anisotropy are calculated and selected in terms of stiffness and mass characteristics. The skin is modeled as an isotropic plate, and the longitudinal wing skeleton is modeled by rods oriented at a certain angle to the structural axis of the wing. The optimum orientation angles are determined. The skeleton is considered to be fabricated from a unidirectional composite with a high modulus of elasticity. It is shown that the stress-strained state of the plate structure may be calculated knowing only the vertical deflections at each point of the midplane. The efficiency of using the present scheme with a large degree of anisotropy for decreasing the critical divergence rate is demonstrated. Increasing the modulus of elasticity and thickness of the unidirectional layer significantly improved stiffness characteristics. J.N.

A84-35592

SHEAR STRESS DISTRIBUTION AND SHEAR STIFFNESS IN TRANSVERSELY LOADED, INHOMOGENEOUS CROSS-SECTIONS OF ARBITRARY FORM MADE OF ORTHOTROPIC MATERIALS [ZUR SCHUBSPANNUNGSVERTEILUNG UND SCHUBSTEIFIGKEIT BEI QUERKRAFTBEANSPRUCHTEN, INHOMOGENEN QUERSCHNITTEN BELIEBIGER FORM AUS ORTHOTROPEN WERKSTOFFEN]

R. WOERNDLE (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) and H. MANG (Wien, Technische Universitaet, Vienna, Austria) Ingenieur-Archiv (ISSN 0020-1154), vol. 54, no. 1, 1984, p. 25-42. In German. refs

A new semianalytical method for solving the shear flexure problem of inhomogeneous, orthotropic cantilever beams loaded at their free ends is proposed. The shape of the beam cross-section is arbitrary but constant along the beam axis. The method combines two-dimensional finite element analysis of cross-sectional warping with analysis based on the theory of elasticity. The method is applied to a homogeneous, isotropic beam with a rectangular cross-section for which an analytical solution is available, an inhomogeneous, isotropic beam with a rectangular cross section for which a three-dimensional finite element analysis is performed, and a rotor blade of a helicopter, for which numerical results are compared with experimental ones. The agreement in all three cases is excellent. C.D.

A84-35654#
ORTHOGONAL GRID GENERATION
D. C. IVES and W. D. SIDDONS, JR. (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) AIAA, SAE, and ASME, Joint Propulsion Conference, 20th, Cincinnati, OH, June 11-13, 1984. 11 p. refs
(AIAA PAPER 84-1248)

A technique is presented for the generation of two-dimensional orthogonal grids which is accurate, rapid, conceptually simple, relatively robust, and general enough to be applicable to a wide range of applications when coupled with modern flow solvers. A novel application of the hinge point transformation is used to map a contour onto a half plane, which is thereby transformed into an open rectangle, where the points added to close the rectangle and grid boundary point locations are specified according to preselected stretchings. Exponential spline interpolation determines the physical plane locations corresponding to the grid boundary point locations on three sides of the rectangle, and physical locations corresponding to the fourth side are obtained by inverting the transformations. A fast Poisson solver is then used to determine the physical location of the interior grid nodes. A method for building complex multiple region grids through the matching of simpler grids at common boundaries is illustrated. Suitable grids can be produced for a wide range of nonperiodic geometries. O.C.

A84-35921#
AUTOCLAVE - CURING OF EXTREMELY THIN HM CFC-SKINS
K. BRUNSCH (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) International Conference on Carbon Fibre Application, Brazil, Dec. 5-9, 1983, Paper. 17 p.
(MBB-UD-409-83-OE)

An overview of autoclave and compression molding in aerospace industry presents information on autoclave curing of extremely thin high-modulus carbon fiber composite skin of the Intelsat IV solar array structure and on autoclave curing of a thickness-tapered high-tensile (HT) carbon-fiber-composite (CFC) skin of a taileron. Data obtained during the fabrication of thick HT CFC rotor hub components by press curing are given. An advanced production line for vacuum-oven curing of composite structures, including glass and aramide phenolic prepregs as well as carbon fiber components, is described. J.N.

A84-36151#
TURBULENT HEAT TRANSPORT IN CIRCULAR DUCTS WITH CIRCUMFERENTIALLY VARYING HEAT FLUX
J. W. BAUGHN, M. A. HOFFMAN, R. K. TAKAHASHI (California, University, Davis, CA), and B. E. LAUNDER (University of Manchester Institute of Science and Technology, Manchester, England) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol. 106, Feb. 1984, p. 64-70. refs
(Contract NSF CME-77-27613)

Experiments have been performed with turbulent air flow in a tube with uniform and with top-half heating; the flow was hydrodynamically fully developed at the start of the heated section, and there were negligible buoyancy effects. Numerical solutions of the mean momentum and energy equations which use the suggestion that the ratio of radial-to-circumferential turbulent diffusivities is equal to the corresponding ratio of mean square velocity fluctuations in these directions agree well with the experimental results. Author

A84-36160#
NONLINEAR BENDING AND COLLAPSE OF LONG, THIN, OPEN SECTION BEAMS AND CORRUGATED PANELS
R. C. BENSON (Rochester, University, Rochester, NY) ASME, Transactions, Journal of Applied Mechanics (ISSN 0021-8936), vol. 51, March 1984, p. 141-145. Research supported by the Xerox Corp. refs
(ASME PAPER 84-APM-4)

Long, thin, open section beams and corrugated panels undergo a cross section flattening when bent longitudinally. This leads to a 'soft' nonlinear moment-curvature response and geometrical instability. The problem is analyzed by means of a closed, convergent sequence of algebraic and integral equations which are tractable on modern microcomputers. The shape of the cross section is unrestricted, save that it be thin, symmetrical, and not self-penetrating. Results for circular section and angle section beams are obtained and compared with the existing literature. Example results for a wide, corrugated panel are also obtained. Bifurcations in the deformed cross section are found to occur. Author

A84-36298#
INFRA-RED SURVEILLANCE TECHNIQUES FOR GUIDED WEAPON SYSTEMS
A. T. BAILEY and G. J. ALLOCK (British Aerospace, PLC, Dynamics Group, Stevenage Herts., England) IN: Military microwaves '82; Proceedings of the Conference, London, England, October 20-22, 1982 . Tunbridge Wells, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1983, p. 619-623. Research supported by the Ministry of Defence (Procurement Executive).

A method of giving passive infrared surveillance systems a ranging capability by means of an integrated pulsed CO_2 laser is presented. The problem of providing the required speed of deflection was solved by utilizing the acoustooptical interaction within a crystal to diffract or steer the laser beam. The target detection system includes a multielement cadmium mercury telluride array cooled to 77 K and subtending several degrees in the vertical plane. A helical scan of the scene is provided, giving a coverage pattern of 360 deg in azimuth. In field trial tests, 96 percent of all aircraft which came within the engagement envelope were detected. J.N.

N84-24744# Cranfield Inst. of Tech., Bedfordshire (England). School of Mechanical Engineering.
EFFECTS OF AIRBLAST ATOMIZER DESIGN UPON SPRAY QUALITY
A. K. JASUJA *In* AGARD Combust. Probl. in Turbine Eng. 14p Jan. 1984 refs Sponsored in part by U.K. Ministry of Defence
Avail: NTIS HC A19/MF A01

The application of airblast atomization to gas turbine engines was investigated. The need to identify the effect of various design features on the spray quality to design atomizers of optimum performance with a minimum of cost and complexity is designed. The atomizer scale, configuration, the nature of fuel preparation before exposure to air, for the most commonly used prefilming and plain airblast atomizers are emphasized. The experimental mean drop size data was obtained through the use of laser light scattering techniques over a wide range of conditions. It is concluded that the plain jet airblast atomizer which features multiple, transversely injected liquid jets into a swirling airstream yield spray quality comparable to that achieved by their prefilming counterparts especially under high air pressure conditions. E.A.K.

N84-24747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETAILED FUEL SPRAY ANALYSIS TECHNIQUES
E. J. MULARZ (AVRADCOM), M. A. BOSQUE, and F. M. HUMENIK *In* AGARD Combust. Probl. in Turbine Eng. 10p Jan. 1984 refs Previously announced as N83-34943
Avail: NTIS HC A19/MF A01 CSCL 20D

Fuel spray analyses which are a necessary input to the analytical modeling of the complex mixing and combustion processes which occur in advanced combustor systems are discussed. It is anticipated that by controlling fuel air reaction conditions, combustor temperatures can be better controlled, leading to improved combustion system durability. The capability to measure liquid droplet size, velocity, and number density throughout a fuel spray and to utilize this measurement technique in laboratory benchmark experiments was demonstrated. The experiment to characterize fuel sprays is described. The experiments and data are useful for application to and validation of turbulent flow modeling to improve the design systems of future advanced technology engines. E.A.K.

N84-24929# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
ELECTROMAGNETIC COMPATIBILITY IN AEROSPACE VEHICLES
O. B. M. PIETERSEN 1 Nov. 1983 10 p refs Presented at NERG Symp. of Electromagnetic Compatibility, Delft, 4 Nov. 1982
(NLR-MP-83002-U) Avail: NTIS HC A02/MF A01

Electromagnetic compatibility in aerospace vehicles which requires careful consideration because of the generally high packing density of electronic equipment aboard aircraft or spacecraft, the complex cable hardness and the required reliability margins. The practical and computer aided methods which are in use to arrive at an undisturbed living together of electronic systems board these vehicles are reviewed. E.A.K.

N84-24999*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF INTERNAL COMBUSTION ENGINE COMBUSTION CHAMBER PROCESS STUDIES AT NASA LEWIS RESEARCH CENTER
H. J. SCHOCK 1984 12 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83666; E-2085; NAS 1.15:83666) Avail: NTIS HC A02/MF A01 CSCL 20D

The performance of internal combustion stratified-charge engines is highly dependent on the in-cylinder fuel-air mixing processes occurring in these engines. Current research concerning the in-cylinder airflow characteristics of rotary and piston engines is presented. Results showing the output of multidimensional models, laser velocimetry measurements and the application of a holographic optical element are described. Models which simulate the four-stroke cycle and seal dynamics of rotary engines are also discussed. R.S.F.

N84-25001*# Pennsylvania State Univ., State College. Applied Research Lab.
THE BOUNDARY LAYER ON COMPRESSOR CASCADE BLADES Semiannual Progress Report, 1 Dec. 1983 - 1 Jun. 1984
S. DEUTSCH and W. C. ZIERKE 1984 76 p refs
(Contract NSG-3264)
(NASA-CR-173514; NAS 1.26:173514) Avail: NTIS HC A05/MF A01 CSCL 20D

The characteristics of the flow field about highly loaded turbocompressor blades in a cascade wind tunnel were investigated. Experimental tests were conducted at chord Reynolds number (R sub c) near 500,000. A laser Doppler anemometer was employed in flow velocity measurement. Suction surface mean velocity and turbulence intensity profiles at a single incidence angle are presented. These data contribute to further understanding of two-dimensional boundary layer profiles, points of separation, and transition zones for turbomachine blades, and concomitantly, to compressor cascade predictive models. R.S.F.

N84-25012# Argonne National Lab., Ill.
FLUID FORCES ON A RIGID CYLINDER IN TURBULENT CROSSFLOW
T. M. MULCAHY 1984 14 p refs Presented at the ASME Winter Ann. Meeting, New Orleans, 9 Dec. 1984
(Contract W-31-109-ENG-38)
(DE84-006364; CONF-841201-5) Avail: NTIS HC A02/MF A01

Fluctuating lift and drag, and steady drag force coefficients are presented which were obtained in water flows with Reynolds numbers in the range 3 x 10(4) to 2 x 10(5). Turbulence intensities were varied from 1.5 to 15% while integral scale lengths ranged from 0.5 to 2 tube diameters. The turbulence generated is described and the method of force measurement is outlined. Empirical bounds on the force spectra are given, and available information on spanwise correlation lengths are identified so that the data can be used to make RMS vibration response predictions where fluid structure interaction does not occur. DOE

N84-25013# Massachusetts Inst. of Tech., Cambridge.
CONICAL FLOWS WITH LEADING EDGE VORTICES
E. S. PEREZ and K. G. POWELL 1984 31 p
Avail: NTIS HC A03/MF A01

View graphs show possible leading edge vortex flow patterns. An approach is presented for solving the problem which includes finite volume approximation, smoothing, shock fitting, and the body boundary conditions. The axisymmetric case and small and larger angles of attack are considered. A.R.H.

N84-25019*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMIZATION OF FRINGE-TYPE LASER ANEMOMETERS FOR TURBINE ENGINE COMPONENT TESTING
R. G. SEASHOLTZ, L. G. OBERLE, and D. H. WEIKLE 1984 16 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83658; E-2099; NAS 1.15:83658; AIAA-84-1459)
Avail: NTIS HC A02/MF A01 CSCL 14B

The fringe type laser anemometer is analyzed using the Cramer-Rao bound for the variance of the estimate of the Doppler frequency as a figure of merit. Mie scattering theory is used to calculate the Doppler signal wherein both the amplitude and phase of the scattered light are taken into account. The noise from wall scatter is calculated using the wall bidirectional reflectivity and the irradiance of the incident beams. A procedure is described to determine the optimum aperture mask for the probe volume located a given distance from a wall. The expected performance of counter type processors is also discussed in relation to the Cramer-Rao bound. Numerical examples are presented for a coaxial backscatter anemometer. Author

N84-25061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF UNDERSTANDING FOR GEAR MATERIALS
D. P. TOWNSEND *In its* Tribology in the 80's, vol. 2 p 795-809 Apr. 1984 refs
Avail: NTIS HC A17/MF A01 CSCL 13I

A wide variety of gear materials is available today for the gear designer. The choice of which material to use should be based on the requirements of the application and will include the operating conditions of load, speed, and temperature in addition to reliability, weight, noise limitation, accuracy, and cost. In aircraft applications such as helicopters, V/STOL aircraft, and turboprops, the dominant factors to be considered are reliability and weight. The following gear materials are reviewed herein with an emphasis upon mechanical properties, cost, and durability: plastics, nonferrous metals, copper alloys, iron alloys, metal powders, and steels. R.S.F.

N84-25062*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
STATUS OF UNDERSTANDING FOR SEAL MATERIALS
P. F. BROWN *In* NASA Lewis Research Center Tribology in the 80's, vol. 2 p 811-829 Apr. 1984 refs
Avail: NTIS HC A17/MF A01 CSCL 13I

Material selection for mainshaft face and ring seals, labyrinth seals, accessory gearbox face seals, and lip seals are discussed in light of tribology requirements and a given seal application. Carbon graphite has been found to be one of the best sealing materials and it is widely used in current gas turbine mainshaft and accessory gearbox seals. Its popularity is due to its unique combination of properties which consists of dimensional stability, corrosion resistance, low friction, good self lubricating characteristics, high thermal conductivity and low thermal expansion, the latter two properties combining to provide good thermal shock resistance. A brief description of the seals and the requirements they must meet are discussed to provide insight into the limitations and advantages of the seals in containing the lubricant. A forecast is made of the operational requirements of main shaft and gearbox seals for advanced engines and candidate materials and coatings that may satisfy these advanced engine requirements. Author

N84-25088*# General Dynamics Corp., San Diego, Calif.
INHERENT PROBLEMS IN DESIGNING TWO-FAILURE TOLERANT ELECTROMECHANICAL ACTUATORS
S. HORNYAK *In* NASA. Goddard Space Flight Center The 18th Aerospace Mech. Symp. p 155-170 May 1984
Avail: NTIS HC A14/MF A01 CSCL 13I

An electromechanical ac-powered rotary actuated four-bar linkage system for rotating the Shuttle/Centaur deployment adapter is described. The essential features of the deployment adapter rotation system (DARS) are increased reliability for mission success and maximum practical hazard control for safety. The requirements, concept development, hardware configuration, quality assurance provisions, and techniques used to meet two-fault tolerance requirements are highlighted. The rationale used to achieve a degree of safety equivalent of that of two-failure tolerance is presented. Conditions that make this approach acceptable, including single failure point components with regard to redundancy versus credibility of failure modes, are also discussed. Author

N84-25092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACELAB 4: PRIMATE EXPERIMENT SUPPORT HARDWARE
P. R. FUSCO and R. J. PEYRAN *In its* The 18th Aerospace Mech. Symp. p 215-241 May 1984
Avail: NTIS HC A14/MF A01 CSCL 14B

A squirrel monkey feeder and automatic urine collection system were designed to fly on the Spacelab 4 Shuttle Mission presently scheduled for January 1986. Prototypes of the feeder and urine collection systems were fabricated and extensively tested on squirrel monkeys at the National Aeronautics and Space Administration's (NASA) Ames Research Center (ARC). The feeder design minimizes impact on the monkey's limited space in the cage and features improved reliability and biocompatibility over previous systems. The urine collection system is the first flight qualified, automatic urine collection device for squirrel monkeys. Flight systems are currently being fabricated. Author

N84-25107# Old Dominion Univ., Norfolk, Va.
LARGE DEFLECTION MULTIMODE RESPONSE OF CLAMPED RECTANGULAR PANELS TO ACOUSTIC EXCITATION, VOLUME 1 Final Report, 1 Oct. 1980 - 31 May 1983
C. MEI Wright-Pattersn AFB, Ohio AFWAL Dec. 1983 67 p
(Contract AF-AFOSR-0107-80; AF PROJ. 2307)
(AD-A139622; AFWAL-TR-83-3121-VOL-1) Avail: NTIS HC A04/MF A01 CSCL 20K

An analytical method is developed for the determination of large deflection multimodal random response of clamped rectangular plates subjected to normal incidence acoustic impingements. The Karman-Herrmann large deflection plate equations are solved by a technique which reduced the fourth order nonlinear partial differential equations to a set of second order nonlinear differential equations with time as the independent variable. The differential equation solution utilizes a Fourier-type series representation of the areas function and out-of-plane reflection. The compatibility equation is solved by direct substitution, and the equilibrium equation is solved through the use of Bubnov-Galerkin method. The acoustic excitation is assumed to be Gaussian. The Krylov-Bogoliuboc-Caughey equivalent linearization method is then employed so that the derived set of second order nonlinear differential equations is linearized to an equivalent set of second order linear differential equations. Transformations of coordinates from the generalized displacements to the normal-mode coordinates and an iterative scheme are employed to obtain root-mean-square (RMS) maximum panel deflection, RMS maximum strain and equivalent linear (or nonlinear) frequencies of vibration for clamped rectangular panels at various excitation pressure spectral density (PSD). Convergence of the results is demonstrated by using 4, 6, 10 and 15 terms in the transverse deflection function. Effects of panel length-to-width ratio and damping ratio on panel response are also studied. There are two volumes reporting this research effort; this volume, Volume 1, contains the mathematical formulations and numerical results, Volume 2 gives the computer program codes. Author (GRA)

N84-25864# Cranfield Inst. of Tech., Bedfordshire (England).
EVOLUTION OF A HEAVE CONTROL SYSTEM FOR AN AMPHIBIOUS HOVERCRAFT
P. A. T. CHRISTOPHER, K. F. MAN, Y. N. CHENG, and E. W. OSBOURN Jan. 1984 234 p refs
(CAR-8401; ISBN-0902937-97-9) Avail: NTIS HC A11/MF A01

A heave control system for amphibious hovercraft was designed and tested. The central element in the system being an axial flow, lift fan whose blade angles are continuously varied by means of feedback signals from a pressure transducer located in the front end of the hovercraft cushion and from an accelerometer measuring the heave acceleration are discussed. Results from experiments, conducted on the Cranfield Whirling-Arm facility, have shown that the system provides a rapid and effective means of controlling the heave acceleration, and, in addition, produces a valuable reduction in craft drag whilst traversing waves. An extensive parameter identification program, using a nonlinear optimization algorithm, was constructed and applied to the control subsystem, such that a full mathematical model of the controlled craft was obtained. This was then used to design an optimum control with particular reference to passenger ride comfort. Author

N84-25865# Societe Nationale Industrielle Aerospatiale, Paris (France). Direction Technique.
THE INDUSTRY'S MATERIALS: SNIAS AND GENERAL CONDITIONS OF ITS ENVIRONMENT [LES MATERIAUX DE L'INDUSTRIE: AEROSPATIALE ET LES CONDITIONS GENERALES DE LEURS ENVIRONMENTS]
20 Jun. 1983 11 p In FRENCH
(SNIAS-832-502-101) Avail: NTIS HC A02/MF A01

An overview of the physical characteristics, service life, and prevalent environmental conditions of aircraft and spacecraft construction materials is presented. Emphasis is placed on light weight, high strength metal alloys, and various fiber reinforced composite materials. The role these materials play in the construction of supersonic and subsonic transport aircraft, satellites, civil aircraft, helicopters, and missile engines is charted. Trans. by M.A.C.

N84-25870# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NO. 1983-6, 217/NOVEMBER-DECEMBER
C. SEVESTRE, ed. Apr. 1984 61 p refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimensuel, No. 1983-6, 217/Nov.-Dec. (Paris), 1983
(ESA-TT-841) Avail: NTIS HC A04/MF A01; HC available at ONERA, Paris FF 55; original report in FRENCH available at ONERA, Paris FF 60
Various topics of concern to aerospace engineering are addressed. Nonlinear sampled-data control systems, noise fields generated by launch vehicles, pressure transducers for cryogenic wind tunnels, structural vibration testing, and the structural analysis of laminated plates are discussed.

N84-25920# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADOMES FOR FLIGHT VEHICLES
B. A. PRIGODA and V. S. KOKUNKO 26 Mar. 1984 6 p Transl. into ENGLISH from mono. "Obtekateli Antenn Letatelnykh Appartov" Moscow, Mashinostroyeniye, 1970 p 70-73
(AD-A140174; FTD-ID(RS)T-0398-84) Avail: NTIS HC A02/MF A01 CSCL 09E
The dielectric properties, structural stability, and structural design of a thin walled aircraft radome supported by a metal frame are considered. Radio transmittance and structural weight are emphasized. The theory of long lines facilitates finding a path for lowering the weight of the walls while preserving their radio-engineering characteristics. R.S.F.

N84-25930# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
DERATING REQUIREMENTS AND APPLICATION RULES FOR ELECTRONIC COMPONENTS
Dec. 1982 29 p
(ESA-PSS-01-301-ISSUE-1; ISSN-0379-4059) Avail: NTIS HC A03/MF A01
The minimum derating requirements and application rules for electronic, electrical, and electromechanical components used in flight standard equipment are defined. Parameter degradations to be considered in performing worst case analyses are given. E.A.K.

N84-25960# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
UNSTEADY FLOW IN TURBOMACHINES, VOLUME 1
1984 323 p refs Lecture Ser. held at Rhode-Saint-Genese, Belgium, 20 - 24 Feb. 1984 2 Vol.
(VKI-LS-1984-02-VOL-1) Avail: NTIS HC A14/MF A01
Unsteady flow is an essential aspect of the energy exchange between the fluid and blade rows in a turbomachine. This lecture series concentrated mainly on the rotating stall by discussing the prediction methods for single and multistage compressors, analyzing new experimental evidence on cell patterns and cell structure and proposing methods for the determination of the stall line in industrial and aeromachine compressors. A review of numerical methods for the handling of unsteady flows and the experience of manufacturers and research organizations with engine stall completed the lecture series.

N84-25961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UNSTEADY FLOW IN TURBOMACHINERY: AN OVERVIEW
In Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 1 p 1-20 1984 refs
Avail: NTIS HC A14/MF A01
The importance of understanding and modeling the unsteady flow phenomena in turbomachinery is discussed. Historical events in the application and development of gas turbines for aircraft propulsion are traced. Technology advancements over the years are highlighted with focus on the compression system components. Trends in compressor research within the National Advisory Committee for Aeronautics (NACA)/National Aeronautics and Space Administration (NASA) are noted. The impact of technology advancements on the increased occurrences of unsteady flow related problems in advanced engine development programs is discussed. The impact of the new and more demanding requirements being imposed on the propulsion system to meet advanced aircraft mission needs are also noted. Brief discussions on the present day understanding and modeling capability of the unsteady flow phenomena are presented to include discussions on rotating stall, surge, flutter, forced response and noise generation. Author

N84-25962# Massachusetts Inst. of Tech., Cambridge.
INTRODUCTION TO UNSTEADY FLOW IN TURBOMACHINES
E. M. GREITZER *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 1 62 p 1984 refs
Avail: NTIS HC A14/MF A01
In this lecture some of the fluid dynamic phenomena that are associated with unsteady flow in turbomachines will be examined. It will be seen that there are several different sources of this unsteadiness, and that which of these is most important will depend on which aspect of the overall performance of the turbomachine is being examined. This discussion is intended to be an introduction to the subject and to provide an appreciation for the basic fluid mechanic concepts, rather than to be an exhaustive review. The topics to be covered are: (1) the Inherent Unsteadiness of Turbomachinery Flows; (2) Sources of Flow Unsteadiness in Turbomachines; and (3) Introductory Discussion of Unsteady Viscous Flows. B.W.

N84-25963# Massachusetts Inst. of Tech., Cambridge.
STABILITY OF PUMPS AND COMPRESSORS
E. M. GREITZER *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 1 78 p 1984 refs
Avail: NTIS HC A14/MF A01
This lecture describes the types of flow instabilities that are encountered in dynamic compression and pumping systems. A detailed review is presented in which the different fluid mechanic phenomena associated with these instabilities, as well as the techniques that have been developed for predicting the onset of instability, are surveyed. This paper also contains elementary analyses that shows the phenomena associated with the instabilities, in several different systems of current engineering interest. The second part covers four topics. The first of these is an elementary analysis of rotating stall inception in axial compressors. The second is a description of a procedure for predicting the stalling pressure rise capability of axial flow compressor stages. The third is some additional material on the use of compressor casing and/or hub treatment (i.e. grooves) for stability enhancement. The final topic consists of a brief summary of a recent non-linear analysis of rotating stall in multistage compressors. B.W.

N84-25964# Cornell Univ., Ithaca, N.Y.
THEORY OF ROTATING STALL OF MULTISTAGE AXIAL COMPRESSORS
F. K. MOORE *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 1 112 p 1984 refs
Avail: NTIS HC A14/MF A01
An analysis is made of rotating stall in compressors of many stages, finding conditions under which a flow distortion can occur which is steady in a traveling reference frame, even though upstream total and downstream static pressure are constant. In the compressor, a pressure-rise hysteresis is assumed. Flow in entrance and exit ducts yield additional lags. These lags balance to give a formula for stall propagation speed. For small disturbances, it is required that the compressor characteristic be flat in the neighborhood of average flow coefficient. Results are compared with the experiments of Day and Cumpaty. If a compressor lag of about twice that due only to fluid inertia is used predicted propagation speeds agree almost exactly with experimental values, taking into account changes of number of stages, stagger angle, row spacing, and number of stall zones.

The agreement obtained gives encouragement for the extension of the theory to account for large amplitudes. Author

N84-25965# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
UNSTEADY FLOW IN TURBOMACHINES, VOLUME 2
1984 353 p refs Lecture Ser. held at Rhode-Saint-Genese, Belgium, 20-24 Feb. 1984
(VKI-LS-1984-02-VOL-2; D/1984/0238/294-VOL-2) Avail: NTIS HC A16/MF A01

Various topics concerned with unsteady flow phenomena in turbomachinery are addressed. Particular attention is given to rotating stall, surges, and blade flutter in axial flow compressors.

N84-25966# Rolls-Royce Ltd., Derby (England).
ENCOUNTERS WITH SURGE
A. B. MCKENZIE *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachinery, Vol. 2 30 p 1984
Avail: NTIS HC A16/MF A01

A review of the development of axial compressors for gas turbine engines is presented and the surge characteristics for each particular design are discussed. The Avon, Avon RA14, Conway, Tyne, Spey and RB 211 are addressed. Rotating stall, inlet maldistribution, and design parameters effecting surge occurrences are examined. M.G.

N84-25967# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
STRUCTURE OF ROTATING STALL CELLS. PART 1: ABSOLUTE MOTION
K. MATHIOUDAKIS and F. A. E. BREUGELMANS *In its* Unsteady Flow in Turbomachines, Vol. 2 49 p 1984 refs
Avail: NTIS HC A16/MF A01

Measurement and data processing techniques developed in order to define rotating stall characteristics are presented. Application of these techniques to experiments on an axial flow compressor yielded several conclusions on the structure of the stalled flow field as it is seen from the stationary frame of reference. Two qualitatively different types of rotating stall have been identified: small stall and big stall. Small stall results in a gradual drop in the performance of the compressor. It is characterized by many cells of small amplitude fluctuations of velocity and angle. It is linked to separation on the blades, but the flow continues to move through the rotor without significant reorganization. Big stall causes an abrupt drop in the performance. The velocity and angle variations are very big and the flow field inside the cells is reorganized in a three dimensional manner with the appearance of reverse flow in front of the rotor. Comparison with results of other investigations showed the similarity of the flow field inside the big cells in all cases. M.G.

N84-25968*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL ASPECTS OF UNSTEADY FLOW CALCULATIONS
J. J. ADAMCZYK *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 2 75 p 1984 refs
Avail: NTIS HC A16/MF A01 CSCL 20D

The numerical aspects of simulation unsteady flows which arise in turbomachinery are addressed. In particular the simulation of rotating stall and surge is discussed. Author

N84-25969# Gremli Systemdynamik A.G., Abtwil (Switzerland).
SURGE PREDICTION IN INDUSTRIAL COMPRESSORS
C. GREMLI *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 2 36 p 1984 refs
Avail: NTIS HC A16/MF A01

The stability limit of industrial compressors is strongly influenced by the dynamics of the surrounding process and the individual slopes of the stage characteristics. Most common stall criterions which are also used as surge criterions do not take this into account. In order to include the system dynamics and the individual slopes of the stage characteristics into the surge line prediction, the TOLDYM-method was developed. TOLDYM stands for Two Variable, One Dimensional, Linearized Dynamic Model. The real system is represented by a mathematical model. If the model is stable the real system is assumed to be stable too. Three simplifications (1-dimensional, linearized, constant temperature) are made in order to reduce model complexity. A set of model element types is available for the assembling of a model. The mathematical representation of the model elements and of the entire model are transfer matrices. The test of stability is performed by checking the real part of the eigenvalues of the transfer function. Three examples show that the results of this method are in agreement with measurements. M.G.

N84-25970# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
STRUCTURE OF ROTATING STALL CELLS. PART 2: RELATIVE MOTION
F. A. E. BREUGELMANS and K. MATHIOUDAKIS *In its* Unsteady Flow in Turbomachines, Vol. 2 81 p 1984 refs
Avail: NTIS HC A16/MF A01

The velocity was measured near the blade surface at three different chordwise and two radial positions for all operating conditions of a low speed axial flow compressor. The local flow angle increases in the streamwise direction for a given operating condition on the negative slope part of the characteristic. This flow angle varies in the unstalled region from -7 deg, 18 deg to 60 deg. Important radial flow angles are observed during one and two cell rotating stall patterns. The 25% chord location experience a radially inward flow during rotating stall, while the 50% and 75% locations show radially outward flow. This radial motion decreases near the tip and mixes with the clearance flow. M.G.

N84-25971# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
DETERMINATION OF THE STABLE OPERATING CONDITIONS OF AN AXIAL FLOW COMPRESSOR
B. DELAHAYE *In* Von Karman Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 2 48 p 1984 refs
Avail: NTIS HC A16/MF A01

Unsteady flow phenomena in axial flow compressors are classified and some basic principles of measurement for each unsteady behavior are reviewed. Rotating stall, surge, blade flutter, stall margin, and distorted inlet flow are discussed. The prediction of stable operating conditions is also addressed with emphasis given to stall boundary prediction. Finally, methods for improving engine stability are reviewed. M.G.

N84-25972# Technische Hochschule, Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
UNSTEADY INTERACTIONS IN SUPERSONIC COMPRESSOR STAGES
K. D. BROICHHAUSEN and H. E. GALLUS *In* Von Karmen Inst. for Fluid Dynamics Unsteady Flow in Turbomachines, Vol. 2 32 p 1984 refs
Avail: NTIS HC A16/MF A01

The unsteady phenomena in the case of supersonic compressor flow are discussed on the basis of characteristic experimental results. The following conclusions can be drawn: the unsteady upstream disturbances caused by a supersonic rotor decrease hyperbolically and can be predicted by theoretic approaches for the relative flow; speeds generating slight supersonic relative inlet flow are critical for upstream interference; the downstream interference is caused by wakes and shockwaves; the unsteady pulsations in the stator increase with higher speeds; at high speeds the change of the flow angle is responsible for the unsteady effects; at lower speeds the influence of the velocity decay becomes more and more important; the unsteady fluctuations do not decrease continuously, but are intensified whenever shock oscillations are caused; and, finally, unsteady pulsations are able to influence the stage-performance particularly near the blockage-line. M.G.

N84-25986# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
COMPUTATIONAL FLUID DYNAMICS, VOLUME 2
1984 395 p refs Lecture Ser. held at Rhode-Saint-Genese, Belgium, 12 - 16 Mar. 1984 2 Vol.
(VKI-LS-1984-04-VOL-2) Avail: NTIS HC A17/MF A01

Various examples for Euler and Navier-Stokes equations in the solution of computational fluid dynamic flow problems are described. Topics include vortical flow around several wing configurations, implicit time dependent solutions for transonic flows, multigrid techniques for Euler equation solutions, and turbulent flow applications of the Navier-Stokes equations.

N84-25990# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IMPLICIT TIME DEPENDENT METHODS FOR THE SOLUTION OF THE EULER EQUATIONS. PART 2: APPLICATION TO TRANSONIC FLOWS
J. SIDES *In* Von Karman Inst. for Fluid Dynamics Computational Fluid Dyn., Vol. 2 29 p 1984 refs
Avail: NTIS HC A17/MF A01

Numerical implicit methods are examined for an efficient solution of the unsteady compressible Euler equations. The interest of implicit methods lies in the fact that they can theoretically benefit from the absence of any limitation on the choice of the time step. Basic implicit schemes are applied to the solution of realistic flow problems governed by the Euler equations. The implicit finite volume method is also considered. M.A.C.

N84-25997# Boeing Military Airplane Development, Seattle, Wash.
MULTI-LENGTH SCALE TURBULENCE MODELS Final Report, 15 Apr. 1982 - 18 Jul. 1983
S. F. BIRCH Aug. 1983 50 p
(Contract F49620-82-C-0032; AF PROJ. 2307)
(AD-A140527; AFOSR-84-0249TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Development of a new two-length scale turbulence model is described. This work was undertaken because the performance of current models for certain flows appears to be limited by an inadequate treatment of the turbulence length scale. One flow for which current turbulence models are not adequate is the initial developing region of a plane mixing layer. Available mixing layer data is briefly reviewed. An improved ability to analyze this flow is required for improved prediction of the near field of a jet for a wide range of applications including those for STOL aircraft applications. The work was performed in the context of developing an improved turbulence model for general application to complex three-dimensional jets. The new model is based on the physical observation that the turbulence shear stress and the turbulence energy production are associated primarily with the large scale eddies, while most of the turbulence energy is dissipated by small scale eddies near the high frequency end of the turbulence energy spectrum. Therefore, except for flows close to equilibrium, separate turbulence length scales are required to characterize the large and small scale motions. GRA

N84-26032# Air Products and Chemicals, Inc., Allentown, Pa.
SOLID STATE COMPRESSOR Status Report, 1 Oct. - 31 Dec. 1983
W. A. STEYERT 20 Jan. 1984 20 p
(Contract N00014-83-C-0394; DARPA ORDER 4746)
(AD-A140498; SR-2) Avail: NTIS HC A02/MF A01 CSCL 13G

The overall goal of this program is to develop a gas compressor which uses modern piezoelectric or electrostrictive materials in place of a magnetic type motor. These materials can exert very large forces, but have only a limited travel. The key to the successful implementation of this compressor concept is a motion amplifier which will be studied at APCI in a one cell simulator. Prior to building the simulator which will be used primarily to study material properties, we have analyzed the elastomer requirements. The motion amplifier is an elastomer which is squeezed between two plates. The elastomer is basically incompressible; therefore, as the plates move together the elastomer will extrude from around the edges. It is necessary to understand the mechanics of the elastomer motion in order to design the motion amplifier and, thus, the compressor. GRA

N84-26044# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
A THERMAL CYCLING TEST FOR THE SCREENING OF SPACE MATERIALS AND PROCESSES
Aug. 1982 24 p
(ESA-PSS-01-704-ISSUE-1; ISSN-0379-4059) Avail: NTIS HC A02/MF A01

A thermal cycling test under vacuum for the screening of materials and processes intended for use in the fabrication of ESA spacecraft and associated equipment is outlined. The test determines the ability of these articles to withstand extreme changes of ambient temperature under vacuum. E.A.K.

N84-26045# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Quality Control Dept.
NONDESTRUCTIVE TESTING OF COMPOSITE STRUCTURES
M. CHIQUILLO, B. GAGNAGE, and M. TORRES 1983 11 p Presented at the AAAF 8th European Rotorcraft and Powered Life Aircraft Forum, Aix-en-Provence, France, 31 Aug. - 3 Sep. 1982
(SNIAS-832-210-108) Avail: NTIS HC A02/MF A01

The use of composite materials in helicopter construction is growing rapidly. With composite parts, the composite material and the final aircraft are obtained simultaneously during the curing process. Manufacturing defects may appear not only at the junction areas but also at the core of the composites. The purpose of non-destructive tests is to detect such defects and thus determine the conformity of the parts. Nondestructive tests appropriate for the examination of composite parts are reviewed, and the general principle of each method along with some examples of application are given. Among the tests reviewed are: sonic inspection, ultrasonic flow detection, X-ray inspection, holographic interferometry, stiffness measurement, acoustic emission, and stroboscopic inspection. R.S.F.

N84-26048# Aeronautical Research Labs., Melbourne (Australia).
NERF: A COMPUTER PROGRAM FOR THE NUMERICAL EVALUATION OF RELIABILITY FUNCTIONS-RELIABILITY MODELING, NUMERICAL METHODS AND PROGRAM DOCUMENTATION
G. D. MALLINSON and A. D. GRAHAM 1983 622 p refs
(AR-00-984; ARL-STRUC-397) Avail: NTIS HC A99/MF A01

A computer program is described which was designed to evaluate reliability functions derived by Payne and others that result from the application of reliability analysis to the fatigue of aircraft structures. The development of the reliability functions evaluated by the NERF program is elaborated. A.R.H.

N84-26057# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN THE NETHERLANDS DURING THE PERIOD MARCH 1981 - FEBRUARY 1983
J. B. DEJONGE, ed. Mar. 1983 45 p refs Presented at 18th ICAF Conf., Toulouse, 30-31 May 1983
(AD-B082166; NLR-MP-83016-U) Avail: NTIS HC A03/MF A01

A brief review is given of work performed in the Netherlands in the field of aeronautical fatigue. Where possible, applicable references are presented. Flight simulation testing procedures, crack propagation studies, fatigue of joints, fatigue of composite materials, and nondestructive inspection and repair procedures are discussed. R.J.F.

N84-26058# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
THE SARIB VIBRATION ABSORBER
P. HEGE and G. GENOUX 1983 13 p Presented at the AAAF 9th European Rotorcraft and Powered Lift Aircraft Forum, Stresa, Italy, 13-15 Sep. 1983
(SNIAS-832-210-104) Avail: NTIS HC A02/MF A01

The SARIB I and II vibration absorbing systems were tested. The major vibration absorber systems under study or installed on Aerospatiale's and other various world manufacturers' aircraft are reviewed and the results of the flight tests performed on the SARIB I and II vibration absorbers as mounted on the AS 350 Ecureuil are presented. It is shown that the reduction in vibration level is quite significant and also weight saving. E.A.K.

N84-26059# Ballistic Research Labs., Aberdeen Proving Ground, Md.
***REVISIONS TO THE PETROS 4 SHELL RESPONSE CODE* Final Report**
N. J. HUFFINGTON, JR. and H. L. WISNIEWSKI Feb. 1984 93 p
(Contract DA PROJ. 1L1-61102-AH-43)
(AD-A140268; AD-F300408; ARBRL-TR-02550-REV) Avail: NTIS HC A05/MF A01 CSCL 01B

The existing PETROS 4 finite deflection elastoplastic structural shell response code was modified to permit analysis of the response of structural panels to nearby high explosive detonations. A modified constitutive formulation involving prescribed through-thickness stresses was introduced. Previously omitted surface traction terms were added to the equations of motion. A recycling option based on a strain equivalence criterion was introduced to inhibit the unrestricted growth of a breathing mode. Additional printer and plotter output features were incorporated into the program. GRA

N84-26431 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
ON IMPROVING THE FATIGUE PERFORMANCE OF A DOUBLE-SHEAR LAP JOINT
L. SCHWARMANN *In* MBB Tech. and Sci. Publ. 1983 p 9-17 1983 refs
(VFW-29/83-O) Avail: Issuing Activity

Different methods for improving the fatigue performance of a double-shear lap joint which is representative of airframe structures are discussed. Considering all aspects concerning fatigue performance, fabrication problems and costs, one method is recommended for practical application in aviation. This method involves the installation of cylindrical fasteners with a low degree of interference-fit into cold-worked holes. Author

N84-26440 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Drehfluegler und Verkehr.
A PRINCIPAL ROTOR WITHOUT JOINTS AND PILLOWS, MADE OF FIBER MATERIALS, FOR DYNAMIC SYSTEMS OF FUTURE HELICOPTERS [GELENK- UND LAGERLOSER HAUPTROTROR IN FASERVERBUNDBAUWEISE FUER DYNAMISCHE SYSTEME ZUKUENFTIGER HUBSCHRAUBER]
M. HUBER *In its* Tech. and Sci. Publ. 1983 p 159-187 1983 refs In GERMAN Presented at 3rd Bundesmin. fuer Forsch. u. Technol. (BMFT)-Statusseminar: Luftfahrtforsch. u. Luftfahrttechnol., Hamburg, 2-4 May 1983
(MBB-UD-384-83-O) Avail: Issuing Activity

The development of joint and bearingless main rotors for dynamic systems for helicopters is discussed. The performance, acceleration, durability and safety, and simultaneous reduction of production cost is outlined. Transl. by E.A.K.

N84-26441 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
A REAR ENGINE WITHOUT JOINTS AND PILLOWS [GELENK- UND LAGERLOSES HECKROTORSYSTEM IN FASERVERBUNDBAUWEISE]
H. FROMMLET *In its* Tech. and Sci. Publ. 1983 p 189-219 1983 refs In GERMAN Presented at 3rd Bundesmin. fuer Fosch. u. Technol. (BMFT)-Statusseminar: Luftfahrtforsch. u. Luftfahrttechnol., Hamburg, 2-4 May 1983 Sponsored by Bundesministerium fuer Forschung und Technologie
(MBB-UD-383-83-O) Avail: Issuing Activity

A new joint and bearingless tail rotor was developed. The bearings and joints, which cause the three blade movements, are replaced by a flexible bending/tension element made out of fiber composite materials. The moving rotor performance system was measured. It is found that the swing defector of the tail rotor can be improved. Transl. by E.A.K.

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A84-34508#
AIR-ICE DRAG COEFFICIENTS FOR FIRST-YEAR SEA ICE DERIVED FROM AIRCRAFT MEASUREMENTS
B. A. WALTER, J. E. OVERLAND (NOAA, Pacific Marine Environmental Laboratory, Seattle, WA), and R. O. GILMER (NOAA, Environmental Research Laboratories, Boulder, CO) Journal of Geophysical Research (ISSN 0148-0227), vol. 89, May 20, 1984, p. 3550-3560. Navy-supported research. refs

The air-ice drag coefficient (CD) over l-m-thick first-year sea ice is calculated on the basis of turbulent-flux measurements obtained with the gust probe on the NOAA p-3 aircraft at altitudes 42, 90, 195, and 340 m over the Bering Sea during February, 1982. The data are presented in graphs and tables, and maps and an NOAA-6 IR image are provided. CD referred to 10 m anemometer height is found to be 0.003 + or 0.0006, and the bulk heat-transfer coefficient from turbulent heat flux measurements is 0.00073 + or - 0.00016. Other parameters estimated include Bowen ratio greater than 2.8, geostrophic drag coefficient 0.047, surface-wind turning angle 32 deg, and surface-wind/geostrophic-wind speed ratio 0.76. T.K.

A84-35250
THE DETERMINATION OF VISIBILITY CONDITIONS AT THE FINAL PORTION OF A DESCENT GLIDE [OPREDELENIE USLOVII VIDIMOSTI NA KONECHNOM UCHASTKE GLISSADY SNIZHENIIA]
V. A. KOVALEV (Glavnaia Geofizicheskaiia Observatoriia, Leningrad, USSR) Meteorologiia i Gidrologiia (ISSN 0130-2906), May 1984, p. 40-47. In Russian. refs

The information content of measurements of slant visibility conditions for aircraft landing is discussed. Attention is focused on the possibility of extrapolating data from ground-based instruments which measure horizontal visibility range at runways. The measurements take into account such factors as cloud-layer thickness, background haze, background luminosity, and altitude. It is found that a reasonable agreement exists between measurements of slant and horizontal visibility range. I.H.

N84-25154# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Photogrammetry.
MULTI-MODELS TO INCREASE ACCURACY
K. TORLEGAARD *In its* Photogrammetric Res. 109 p 1983 refs
Avail: NTIS HC A10/MF A01

Classical theory of error for photogrammetry divides errors in three groups: blunders, systematic errors and random errors. Systematic errors are caused by the lacking fidelity of the functional part of the mathematical model to the real geometric relations. Block adjustment with additional parameters, multiple photographic coverage and snooping after blunders provide results with high reliability, fidelity and precision. Results based on multi-models formed by averaging two or more single stereo-models are presented. The comprising single models are calculated without correction to lens distortion, atmospheric refraction and earth curvature. The improvement of accuracy by forming multi-models is studied. The precision of photogrammetric stereo-models is decomposed into components related to ground coordinates, image coordinates and image motion due to aircraft speed. The multi-model method provides an increase of the accuracy which is similar to the additional parameters in photogrammetric block adjustment, because both methods are based on multiple photographic coverage. Author

N84-25182# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
OCEAN ENERGY SYSTEMS Quarterly Report, Jan. - Mar. 1983
1983 24 p refs
(Contract DE-AI01-77ET-20342)
(DE84-005200; JHU/APL-OQR-83-1) Avail: NTIS HC A02/MF A01

Progress is reported on the development of Ocean Thermal Energy Conversion (OTEC) systems that will provide synthetic fuels (e.g., methanol), energy-intensive products such as ammonia (for fertilizers and chemicals), and aluminum. The work also includes assessment and design concepts for hybrid plants, such as geothermal-OTEC (GEOTEC) plants. Another effort that began in the spring of 1982 is a technical advisory role to DOE with respect to their management of the conceptual and preliminary design activity of industry teams that are designing a shelf-mounted offshore OTEC pilot plant that could deliver power to Oahu, Hawaii. In addition, a program is underway to evaluate and test the Pneumatic Wave-Energy Conversion System (PWECS), an ocean-energy device consisting of a turbine that is air-driven as a result of wave action in a chamber. The work on the various tasks as of 31 March 1983 is reported. DOE

N84-25223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FACILITIES FOR METEOROLOGICAL RESEARCH AT NASA GODDARD/WALLOPS FLIGHT FACILITY Final Report
J. C. GERLACH and R. E. CARR Jun. 1984 6 p refs
(NASA-TM-84422; NAS 1.15:84422) Avail: NTIS HC A02/MF A01 CSCL 04B

The technical characteristics of the Atmospheric Sciences Research Facility, the improvements being made to the instrumentation there which will enhance its usefulness in atmospheric research, and several of the on-going research programs are described. Among the area of atmospheric research discussed are clouds and precipitation, lightning, ozone, wind, and storms. Meteorological instruments including Doppler radar, spectrophotometers, and ozone sensors are mentioned. Atmospheric research relevant to aircraft design and COMSTAR communication satellites is briefly discussed. R.S.F.

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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.

A84-34773
OPTIMAL CONTROL OF MULTIMODE PLANTS [OPTIMAL'NOE UPRAVLENIE MNOGOREZHIMNYMI OB'EKTAMI]
K. G. FAVORSKII (Moskovskii Aviatsionnyi Institut, Moscow, USSR) *Priborostroenie* (ISSN 0021-3454), vol. 27, March 1984, p. 34-38. In Russian. refs

An analysis is made of a multimode plant with piecewise-stationary parameters. In the case of control in various sections, the control-law parameters satisfying the chosen quality criterion must take into account variations of the plant parameters. A proper choice of state variables makes it possible to achieve stationarity of the control processes. As an example, consideration is given to the synthesis of a system for the time-optimal control of the roll of a flight vehicle for different flight speeds. B.J.

A84-36131*# Cincinnati Univ., Ohio.
PERTURBATION ANALYSIS OF OPTIMAL INTEGRAL CONTROLS
G. L. SLATER (Cincinnati, University, Cincinnati, OH) ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control (ISSN 0022-0434), vol. 106, March 1984, p. 114-116.
(Contract NCA2-OR-130-801)

The application of linear optimal control to the design of systems with integral control action on specified outputs is considered. Using integral terms in a quadratic performance index, an asymptotic analysis is used to determine the effect of variable quadratic weights on the eigenvalues and eigenvectors of the closed loop system. It is shown that for small integral terms the placement of integrator poles and gain calculation can be effectively decoupled from placement of the primary system eigenvalues. This technique is applied to the design of integral controls for a STOL aircraft outer loop guidance system. Author

N84-25307*# SRI International Corp., Menlo Park, Calif.
INVESTIGATION, DEVELOPMENT, AND EVALUATION OF PERFORMANCE PROVING FOR FAULT-TOLERANT COMPUTERS Final Interim Report
K. N. LEVITT, R. SCHWARTZ, D. HARE, J. S. MOORE, P. M. MELLIAR-SMITH, R. E. SHOSTAK, R. S. BOYER, M. W. GREEN, and W. D. ELLIOTT Aug. 1983 531 p refs
(Contract NAS1-15528; SRI PROJ. 7821)
(NASA-CR-166008; NAS 1.26:166008) Avail: NTIS HC A23/MF A01 CSCL 09B

A number of methodologies for verifying systems and computer based tools that assist users in verifying their systems were developed. These tools were applied to verify in part the SIFT ultrareliable aircraft computer. Topics covered included: STP theorem prover; design verification of SIFT; high level language code verification; assembly language level verification; numerical algorithm verification; verification of flight control programs; and verification of hardware logic.

N84-25308*# SRI International Corp., Menlo Park, Calif.
STP: A MECHANIZED LOGIC FOR SPECIFICATION AND VERIFICATION Final Report
R. E. SHOSTAK, R. SCHWARTZ, and P. M. MELLIAR-SMITH *In its* Invest., Develop., and Evaluation of Performance Proving for Fault-Tolerant Computers p 11-28 Aug. 1983 refs
(Contract NAS1-15528; F49620-79-C-0099; NSF MCS-79-04081)
Avail: NTIS HC A23/MF A01 CSCL 09B

A logic and proof theory that was mechanized and successfully applied to prove nontrivial properties of a fully distributed fault tolerant system is described. The system is close to achieving the critical balance in man machine interaction necesary for successful application by users other than the system developers. Motivation for the form of man machine interaction embodied by STP is discussed. A formal description of the logic and the proof theory is contained, and the description illustrated with an example. The use of STP in a large scale effort to prove nontrivial properties on SIFT, a distributed Software Implemented Fault Tolerant operating system for aircraft flight control is discussed. Finally, directions for further work are described. Author

N84-25309*# SRI International Corp., Menlo Park, Calif.
SPECIFYING AND VERIFYING ULTRA-RELIABILITY AND FAULT-TOLERANCE PROPERTIES Final Report
R. L. SCHWARTZ and P. M. MELLIAR-SMITH *In its* Invest., Develop., and Evaluation of Performance Proving for Fault-Tolerant Computers p 37-47 Aug. 1983 refs
(Contract NAS1-15528)
Avail: NTIS HC A23/MF A01 CSCL 09B

A methodology to rigorously verify ultrareliability and fault tolerance system properties is described. The methodology utilizes a hierarchy of formal mathematical specifications of system design and incremental design proof to prove the system has the desired properties. A small example of the approach is given, and the application of the methodology to the large scale proof of SIFT, a fault tolerant flight control operating system, is discussed. Author

N84-25322*# SRI International Corp., Menlo Park, Calif.
THE USE OF A FORMAL SIMULATOR TO VERIFY A SIMPLE REAL TIME CONTROL PROGRAM Final Report
R. S. BOYER, M. W. GREEN, and J. S. MOORE *In its* Invest., Develop. and Evaluation of Performance Proving for Fault-Tolerant Computers p 521-531 Aug. 1983 refs Previously announced as N84-12745
Avail: NTIS HC A23/MF A01 CSCL 09B

The authors present an initial and elementary investigation of the formal specification and mechanical verification of programs that interact with environments. They describe a mechanical proof that a simple, real time control program keeps a vehicle on a straightline course in a variable crosswind. To formalize the specification they define a mathematical function which models the interaction of the program and its environment. They then state and proved two theorems about this function: the simulated vehicle never gets farther than three units away from the intended course, and it comes to the course if the wind ever remains steady for at least four sampling units. GRA (IAA)

N84-25871# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ROBUSTNESS QUANTIFICATION FOR NONLINEAR SAMPLED-DATA SYSTEMS WITH DYNAMIC MULTIPLICATIVE PERTURBATIONS
Y. JOANNIC and O. MERCIER *In its* La Rech. Aerospatiale, Bimonthly Bull., No. 1983-6, 217/Nov.-Dec. p 1-16 Apr. 1984 refs
Avail: NTIS HC A04/MF A01; HC available at ONERA, Paris FF 55; original report in FRENCH available at ONERA, Paris FF 60

Feedback control gains are always computed on the basis of a nominal or average condition for the controlled system. Yet this system is subjected to model variations or mismatches which, combining with attenuation and phase shifts caused by actuators and measuring units, may destabilize the overall regulation. For a given regulator, quantification of admissible perturbations or verifications of a residual stability margin, while accounting for dynamic multiplicative perturbations in the feedback loops, are of extreme importance for the design of multivariable flight controllers of advanced aircraft, whose dynamics are both strongly nonlinear and variable from one point to another of the flight domain. A discrete-time nonlinear system is considered which is subjected to dynamic additive and multiplicative disturbances, the latter kind being modelled by convolution operators (described by transfer matrices in z). Starting with a stability theorem, extending Lyapunov's theory to recurrent systems with convolution operators, structural robustness theorems are established, allowing quantitative measurement of stability margins. More specific results are given with respect to linear-quadratic regulators: they permit evaluation of the multivariable gain and phase margins, in the discrete frequency domain. Altogether, they complement other recently obtained results, dealing with continuous-time feedback control systems. M.G.

N84-26374# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
SINGLE-PILOT IFR FLIGHTS AND OPERATIONS
P. LORANCHET 1983 6 p Presented at the AAAF 9th European Rotorcraft and Powered Lift Aircraft Forum, Stresa, Italy, 13-15 Sep. 1983
(SNIAS-832-210-103) Avail: NTIS HC A02/MF A01

The operational, technical, and human features specific to the single pilot Instrument Flight Rules (IFR) are investigated. Problem solving methods are examined. The results of a pilot questionnaire on single pilot IFR are presented. M.A.C.

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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.

A84-34173
TOWARDS A BETTER UNDERSTANDING OF HELICOPTER EXTERNAL NOISE [VERS UNE MEILLEURE COMPREHENSION DU BRUIT EXTERNE DE L'HELICOPTERE]
A. DAMONGEOT, F. DAMBRA, and B. MASURE (SocieteNationale Industrielle Aerospatiale, Division Helicopteres, Marignane, Bouches-du-Rhone, France) L'Aeronautique et l'Astronautique (ISSN 0001-9275), no. 104, 1984, p. 29-44. In French. refs

The problem of total helicopter noise generation is examined in the context of regulations determined by the ICAO. Flyover, takeoff, and approach are considered, as well as the following noise sources: rotor rotational noise (thickness noise, airload noise, quadrupolar noise), engine noise, and broadband noise. Assessment methods include narrow band analysis of ground microphone recordings, and ground measurements of engine noise. During flyover, the rotor rotational noise of the AS 332 Super-Puma is found to be insignificant compared to engine noise, and consequently, another source of broadband type is required to explain total helicopter noise. The sensitivity of radiated noise level to design parameters is covered, and recommendations for reducing overall noise in flyover and approach are presented (e.g., thickness-tapered, chord-tapered, swept-back blade tips). C.M.

A84-34718
ON THE PROPAGATION OF SOUND IN NOZZLES OF VARIABLE CROSS-SECTION CONTAINING LOW MACH NUMBER MEAN FLOW
L. M. B. C. CAMPOS Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Mar.-Apr. 1984, p. 97-109. refs

Acoustic propagation in nozzles is investigated analytically, taking amplitude, phase, and filtering effects of nonuniform cross section and associated acceleration and deceleration of the mean flow into account. The case of the ID longitudinal accoustic mode an low-Mach-number flow is considered, and a nozzle wave operator and associated differential wave invariant are developed to generalize both horn and convected wave operators. An approximate solution in the WKB limit for a nozzle of slowly varying cross section and an exact solution for an exponential nozzle are obtained, and the modified WKB and exact solutions are compared in graphs and tables. It is shown that the WKB calculation is adequate for determining sound level, acoustic velocity, and pressure amplitude but not for evaluating phase and interference effects. T.K.

A84-34746* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PROPAGATION AND RADIATION OF SOUND FROM FLANGED CIRCULAR DUCTS WITH CIRCUMFERENTIALLY VARYING WALL ADMITTANCES. I SEMI-INFINITE DUCTS. II - FINITE DUCTS WITH SOURCES

C. R. FULLER (NASA, Langley Research Center, Hampton, VA) Journal of Sound and Vibration (ISSN 0022-460X), vol. 93, April 8, 1984, p. 321-351. Research supported by the National Research Council. refs

Sound propagation in infinite, semiinfinite, and finite circular ducts with circumferentially varying wall admittances is investigated analytically. The infinite case is considered, and an example demonstrates the effects of wall-admittance distribution on dispersion characteristics and mode shapes. An exact solution is obtained for the semiinfinite case, a circular duct with a flanged opening: sidelobe suppression and circumferential-mode energy scattering leading to radiated-field asymmetry are found. A finite duct system with specified hard-walled pressure sources is examined in detail, evaluating reflection coefficients, transmission losses, and radiated-field directivity. Graphs and diagrams are provided, and the implications of the results obtained for the design of aircraft-turbofan inlet liners are discussed. T.K.

N84-25422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECTS OF SIMULATED FLIGHT ON THE STRUCTURE AND NOISE OF UNDEREXPANDED JETS

T. D. NORUM and J. G. SHEARIN May 1984 32 p refs
(NASA-TP-2308; L-15760; NAS 1.60:2308) Avail: NTIS HC A03/MF A01 CSCL 20A

Mean plume static and pitot pressures and far-field acoustic pressure were measured for an underexpanded convergent nozzle in simulated flight. Results show that supersonic jet mixing noise behaves in flight in the same way that subsonic jet mixing noise does. Regarding shock-associated noise, the frequencies of both screech and peak broadband shock noise were found to decrease with flight speed. The external flow determines the dominant screech mode over a wide range of nozzle pressure rations. Change in the screech mode strongly affects both the development of the downstream shock structure and the characteristic frequency of the broadband shock-associated noise. When no mode change occurs, the main effect of the external flow is to stretch the axial development of the shock cells. Author

N84-25425*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INSTALLATION NOISE MEASUREMENTS OF MODEL SR AND CR PROPELLERS

P. J. W. BLOCK May 1984 103 p refs
(NASA-TM-85790; NAS 1.15:85790) Avail: NTIS HC A06/MF A01 CSCL 20A

Noise measurements on a 0.1 scale SR-2 propeller in a single and counter rotation mode, in a pusher and tractor configuration, and operating at non-zero angles of attack are summarized. A measurement scheme which permitted 143 measurements of each of these configurations in the Langley 4- by 7-meter low speed tunnel is also described. A.R.H.

N84-25426*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ACOUSTIC MEASUREMENTS OF A FULL-SCALE ROTOR WITH FOUR TIP SHAPES. VOLUME 2: APPENDICES C, D, E AND F

M. MOSHER Apr. 1984 347 p refs
(NASA-TM-85878-VOL-2; A-9602-VOL-2; NAS 1.15:85878-VOL-2) Avail: NTIS HC A15/MF A01 CSCL 20A

A full scale helicopter with four different blade tip geometries is tested in a 40- by 80-foot wind tunnel. Performance, loads, and noise are measured. The four tip shapes tested were rectangular, tapered, swept, and swept/tapered. The noise data include measurements of the sound pressure levels in decibels dB, decibels adjusted dBA, and tone-corrected PNdB, for all of the conditions tested. Also included are the detailed measurements, 1/3 octave spectra and time histories for some selected data, and plots of dBA as function of test condition. Some performance measurements are included to aid interpretation of the noise data. M.A.C.

N84-25429# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

A COMPARISON OF MEASURED TAKE-OFF AND FLYOVER SOUND LEVELS FOR SEVERAL GENERAL AVIATION PROPELLER-DRIVEN AIRCRAFT Final Report

J. F. WILBY and E. G. WILBY Feb. 1984 137 p
(Contract DTFA01-83-P-81230)
(AD-A139901; BBN-5450; FAA-EE-84-9) Avail: NTIS HC A07/MF A01 CSCL 20A

The Federal Aviation Administration is currently reviewing noise certification procedures for general aviation propeller-driven aircraft. As part of this review noise measurements were made for take-offs and flyovers of several propeller-driven aircraft at Dulles International Airport. The data from the tests were analyzed by FAA in terms of the A-weighted sound level. This analysis indicated that there were general differences between take-off and flyover sound levels. The intent of this report is to present a review of the data without going into detailed analyses. Possible reasons for differences between take-off and flyover sound levels are explored and certain conclusions drawn. Recommendations are then made for future work in order to provide a more-detailed understanding of the physical phenomena involved. GRA

N84-25430# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.

NOISE MEASUREMENT FLIGHT TEST: DATA/ANALYSES BELL 222 TWIN JET HELICOPTER

J. S. NEWMAN, E. J. RICKLEY, T. L. BLAND, and S. A. DABOIN Feb. 1984 215 p
(AD-A139906; FAA-EE-84-1) Avail: NTIS HC A10/MF A01 CSCL 20A

This report contains documentary sections describing the acoustical characteristics of the subject helicopter and provides analyses and discussions addressing topics ranging from acoustical propagation to environmental impact of helicopter noise. The report is the first in a series of seven documenting the FAA helicopter noise measurement program conducted at Dulles International Airport during the summer of 1983. The Bell 222 test program involved the acquisition of detailed acoustical, position and meteorological data. This test program was designed to address a series of objectives including: (1) evaluation of 'Fly Neighborly' (minimum noise) operating procedures for helicopters, (2) acquisition of acoustical data for use in heliport environmental impact, (3) documentation of directivity characteristics for static operation of helicopters, (4) establishment of ground-to-ground and air-to-ground acoustical propagation relationships for helicopters, (5) determination of noise event duration influences on energy dose acoustical metrics, (6) examination of the differences between noise measured by surface mounted microphone and a microphone mounted at a height of four feet (1.2 meters), and (7) documentation of noise levels acquired using international helicopter noise certification test procedures. GRA

N84-26382*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NOISE GENERATED BY A PROPELLER IN A WAKE

P. J. W. BLOCK May 1984 65 p refs
(NASA-TM-85794; NAS 1.15:85794) Avail: NTIS HC A04/MF A01 CSCL 20A

Propeller performance and noise were measured on two model scale propellers operating in an anechoic flow environment with and without a wake. Wake thickness of one and three propeller chords were generated by an airfoil which spanned the full diameter of the propeller. Noise measurements were made in the relative near field of the propeller at three streamwise and three azimuthal positions. The data show that as much as 10 dB increase in the OASPL results when a wake is introduced into an operating propeller. Performance data are also presented for completeness. Author

N84-26385# European Space Agency, Paris (France).
PROPELLER NOISE AT SUBSONIC BLADE TIP SPEEDS, TORQUE AND THRUST FORCE
R. STUFF Nov. 1983 84 p refs Transl. into ENGLISH of "Propellerlaerm bei unterschallblattspitzenmachzahlen umfangskraft und axialkraft" rept. DFVLR-Mitt-82-17 DFVLR, Goettingen, West Germany, Oct. 1982 Original language document announced as N83-31425
(ESA-TT-821; DFVLR-MITT-82-17) Avail: NTIS HC A05/MF A01; original German report available from DFVLR, Cologne DM 27,90

A detaild investigation of the generation of sound and noise arising from propeller blade forces was made. Use is made of an acceleration potential in the mathematical treatment. Analytical solutions are obtaind for the sound field of a propeller in yaw with asymmetric disk loading. Author

N84-26386# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF LIGHT AIRCRAFT PROPELLER NOISE Ph.D. Thesis - Univ. de Technologie de Compeigne
H. GOUNET 1982 122 p refs In FRENCH; ENGLISH summary Report will also be announced as ESA-TT-865
(AD-B073101; ONERA-NT-1982-8; ISSN-0078-3781; ESA-TT-865) Avail: NTIS HC A06/MF A01 CSCL 20A

A propeller noise prediction program was developed; a numerical application was made in order to determine the parameters acting on the tone acoustic level. The emitted noise is essentially caused by the mean load on the blades and the tip rotation Mach number is the major parameter of the acoustic emission. These results were confirmed by flight measurements. An assessment method for the acoustic field emitted by a propeller derived from charts was reviewed in order to determine its ability for the prediction study of light aircraft propeller noise. With a view to predicting the perceived acoustic levels under acoustic certification conditions for light aircraft, ground reflection phenomena of sound waves were studied and incorporated in the computation model. Author

N84-26387# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
COMPUTATION OF NOISE RADIATING FROM A FREE JET PERPENDICULAR TO ITS AXIS VIA LASER ANENOMETRY MEASUREMENTS
J. MAULARD and G. ELAIS 1983 53 p refs In FRENCH; ENGLISH summary Report will also be announced as ESA-TT-870
(ONERA-NT-1983-6; ISSN-0078-3781; ESA-TT-870) Avail: NTIS HC A04/MF A01

A model for the acoustic radiation of a cylindrical free jet in a direction perpendicula to its axis of symmetry is presented. This model is based on Lighthill's equation but with a simplified source term. A number of aerodynamic parameters derived from experience are included. They relate in particular to the power spectral densities associated with (a) the fluctuations of the velocity component which is perpendicular to the jet axis and (b) the fluctuations of the squared value of this velocity component. These velocity spectra have been measured by means of laser anemometry and are expressed by an empirical formula which covers all the various results obtained in the effective acoustic field of the jet. The theoretical expression of the radiated acoustic field as derived from the model and including the measured aerodynamic parameters has been computed. This expression does not rely on any empirical coefficient to match the calculated values and the acoustic measurements. For cold as well as hot jets, both sub and supersonic (if the mixing noise only is considered), a good agreement is achieved between theory and experiment not only for the overall acoustic field but also for its power spectra density. Author

N84-26388# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Helicopter Div.
TOWARDS A BETTER UNDERSTANDING OF HELICOPTER EXTERNAL NOISE
A. DAMONGEOT, F. DAMBRA, and B. MASURE 1983 15 p refs Presented at the 39th Ann. Am. Helicopter Soc. Forum, St. Louis, 9-11 May 1983
(SNIAS-832-210-113) Avail: NTIS HC A02/MF A01

A survey of all noise sources which contribute to total external noise of an helicopter is first attempted. This survey is carried out in the frame of the flight configurations (flyover, take off, approach) settled by ICAO for noise regulation. Noise sources considered are: rotor rotational noise (thickness noise, airload noise, quadrupolar noise), engine noise, rotor broadband noise. Noise source levels are assessed through (1) narrow band analysis of ground microphone recordings (2) ground measurements of engine noise (3) theoretical means. The rather quiet AS 332 Super-Puma is taken as an exmple and ICAO annoyance noise unit (PNLdB) is used. Sensitivity of radiated noise level to design parameters is dealt with and some recommendations are suggested in order to reduce the overall noise level in flyover and approach. In particular, thickness-tapered, chord-tapered, swept-back blade tips appear as a good means to reduce the noise in these two flight configurations as it derives from flight measurements carried out on four Aerospatiale helicopters. Author

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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.

N84-25525# International Trade Administration, Washington, D.C. Industry Analysis Div.
COMPETITIVE ASSESSMENT OF THE U.S. CIVIL AIRCRAFT INDUSTRY Final Report
Mar. 1984 192 p refs
(PB84-154913) Avail: NTIS HC A09/MF A01 CSCL 05C

The future international competitiveness of the U.S. civil aircraft industry is examined in terms of its principal businesses: large transport, commuter, business and helicopter aircraft. There is no single view of how the U.S. large transport aircraft business may fare in the 1990s in competition with the European Airbus and a potential, independent entry from Japan. U.S. international competitiveness depends on the performance of an interaction among an array of economic, market and technological variables. The United States does not have an independent entry in the larger commuter aircraft market, a market whose size continues to grow. Future U.S. international competitiveness in this business is expected to remain weak. U.S. business aircraft and helicopter businesses are challenged by strong foreign competition, and imports now account for a significant share of the U.S. market. GRA

N84-25526# Committee on Science and Technology (U. S. House).
THE 1985 NASA AUTHORIZATION
Washington GPO 1984 82 p Hearing before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 98th Congr., 2d Sess., no. 69, 9 Feb. 1984
(GPO-31-453) Avail: Subcommittee on Transportation, Aviation and Materials

Budget requirements and appropriations for NASA research programs are examined. Current structures, aerodynamics, propulsion systems, flight controls, rotorcraft, and high performane aircrft research projects are discussed with particular emphasis on cost effectiveness and technological advancement. M.A.C.

N84-25529# Committee on Science and Technology (U. S. House).
FUTURE OF AERONAUTICS
Washington GPO 1984 144 p Hearings before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 98th Congr., 1st Sess., no. 52, 5 Dec. 1983
(GPO-29-744) Avail: Subcommittee on Transportation, Aviation and Materials

Topics relevant to the long term research and development goals for aeronautics are discussed. Subjects include general information on certain NASA and DOD projects, civil aviation, vertical takeoff aircraft, aircraft control systems, aircraft construction materials, and aerodynamic configurations through computer aided design. Current developments in civil aviation as well as future research plans are outlined by representatives of the aviation industry. M.A.C.

N84-25531# Committee on Appropriations (U. S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Dept. of Housing and Urban Develop.-Independent Agencies Appropriation Bill, 1985 p 33-38 Washington GPO 1984
Avail: US Capitol, House Document Room

The appropriations for the National Aeronautics and Space Administration are described. The research and development account includes funding for the space station and various programs involving the application of space capabilities in remote sensing of land resources, ocean and atmospheric conditions; materials processing; and communications. In the area of space science it includes projects designed to explore the solar system and expand man's knowledge of the universe. Also included under this heading are development programs involving aeronautics technology which support the civilian and military capability of the United States in the area of airframe and engine manufacturing. M.G.

N84-26430 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Abt. Wissenschaftliche-Technishe Information.
TECHNICAL AND SCIENTIFIC PUBLICATION 1983: RESEARCH AND DEVELOPMENT [TECHNISCHE WISSENSCHAFTLICHE VEROEFFENTLICHEN 1983: FORSCHUNG UND ENTWICKLUNG]
1983 360 p refs In ENGLISH and GERMAN
Avail: Issuing Activity

Research and development in science and technology are reported. Topics discussed include: materials science and materials handling in aerospace engineering; transport aircrafts; rotary wings; space transportation, and computer techniques; defense technology; and civil engineering.

N84-26455# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE ONERA AERONAUTICS RESEARCH ESTABLISHMENT IN CANNES (FRANCE) [L'ESTABLISSEMENT ONERA DE CANNES AU SERVICE DE LA RESEARCH AERONAUTIQUE]
A. BEVERT 1983 116 p refs In FRENCH Report will also be announced as ESA-TT-875
(ONERA-P-1983-2; ISSN-0078-379X) Avail: NTIS HC A06/MF A01

The origins, characteristics, equipment, and first tests conducted at the wind tunnel in Cannes are reviewed as well as historical reasons for its location in that city. Further evolution of equipment and the types of tests conducted are described. Reasearch themes include: wing bending; high lift by internal and external blowing; ground effect; vertical takeoff and landing aircraft; ground effect vehicles; supersonic transport aircraft; aircraft with variable bending; the European Airbus; and aerodynamics and active control. Transl. by A.R.H.

N84-26484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REAL-TIME SIMULATION OF AN AUTOMOTIVE GAS TURBINE USING THE HYBRID COMPUTER Final Report
W. COSTAKIS and W. C. MERRILL May 1984 26 p
(Contract DE-AI01-77CS-51040)
(NASA-TM-83593; E-1994; DOE/NASA/51040-52; NAS 1.15:83593) Avail: NTIS HC A03/MF A01 CSCL 13F

A hybrid computer simulation of an Advanced Automotive Gas Turbine Powertrain System is reported. The system consists of a gas turbine engine, an automotive drivetrain with four speed automatic transmission, and a control system. Generally, dynamic performance is simulated on the analog portion of the hybrid computer while most of the steady state performance characteristics are calculated to run faster than real time and makes this simulation a useful tool for a variety of analytical studies. Author

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GENERAL

N84-25602*# National Aeronautics and Space Administration, Washington, D. C.
ASTRONAUTICS AND AERONAUTICS, 1976. A CHRONOLOGY
E. H. RITCHIE 1984 392 p
(NASA-SP-4021; NAS 1.21:4021) Avail: NTIS HC A17/MF A01 CSCL 05D

A chronology of events concerning astronautics and aeronautics for the year 1976 is presented. Some of the many and varied topics include the aerospace industry, planetary exploration, space transportation system, defense department programs, politics, and aerospace medicine. The entries are organized by the month and presented in a news release format. M.A.C.

N84-26564*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LANGLEY AERONAUTICS AND SPACE TEST HIGHLIGHTS, 1983
Jun. 1984 80 p
(NASA-TM-85806; NAS 1.15:85806) Avail: NTIS HC A05/MF A01 CSCL 05B

The role of the Langley Research Center is to perform basic and applied research necessary for the advancement of aeronautics and space flight, to generate new and advanced concepts for the accomplishment of related national goals, and to provide research advice, technological support, and assistance to other NASA installations, other government agencies, and industry. Some of the significant tests which were performed during calendar year 1983 in Langley test facilities, a number of which are unique in the world are highlighted. Both the broad range of the research and technology activities at the Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research are illustrated. R.J.F.

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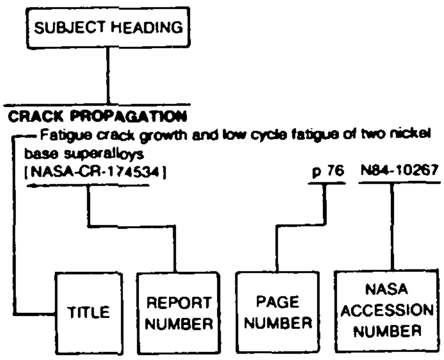

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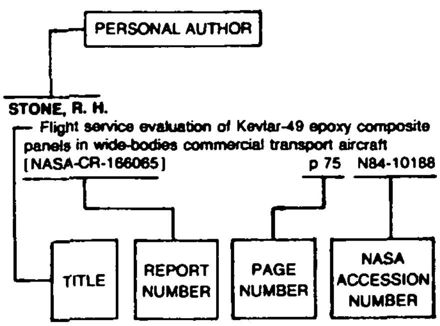

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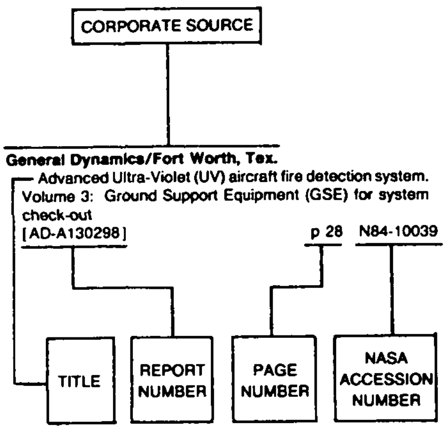

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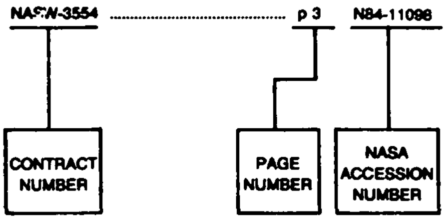

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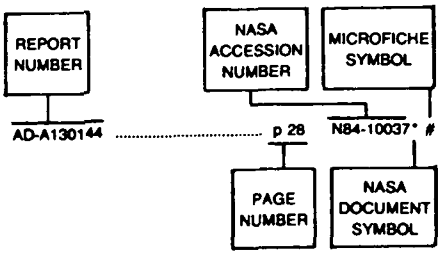

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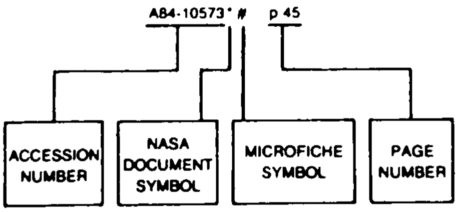

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