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Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(177)
August 1984

National Aeronautics and Space Administration

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A Continuing Bibliography with Indexes

Pages 501-569

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

STAR (N-10000 Series)	N84-22527 - N84-24527
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NASA SP-7037(177)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 177)

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 July 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 469 reports, journal articles, and other documents originally announced in July 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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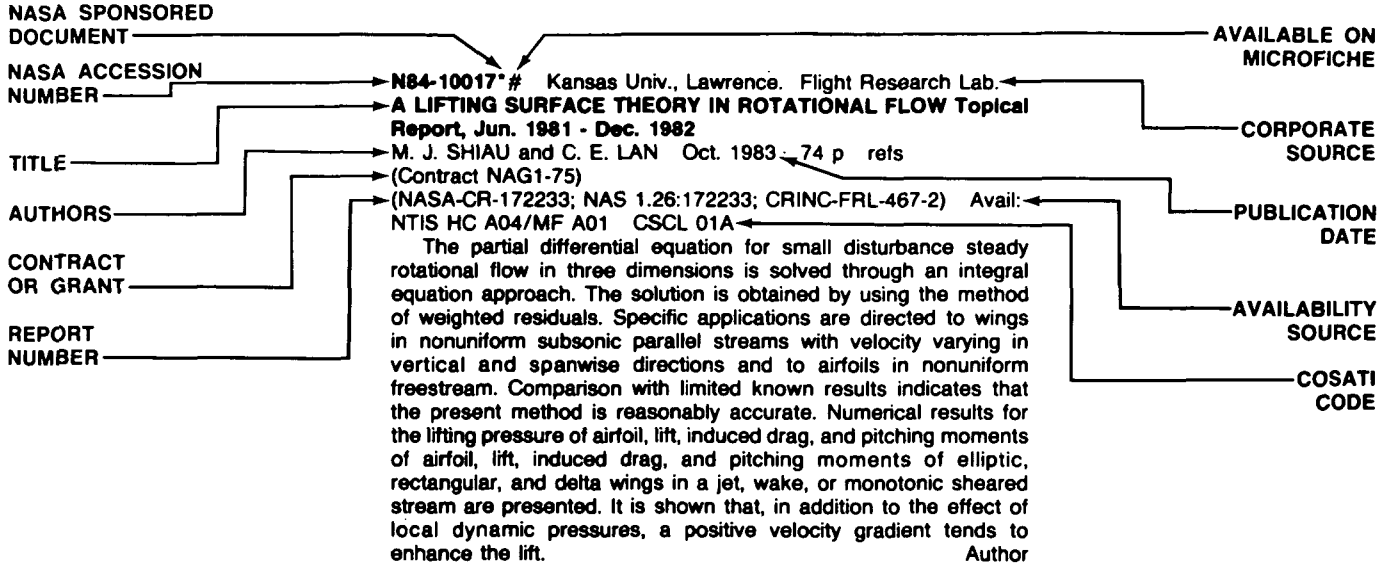

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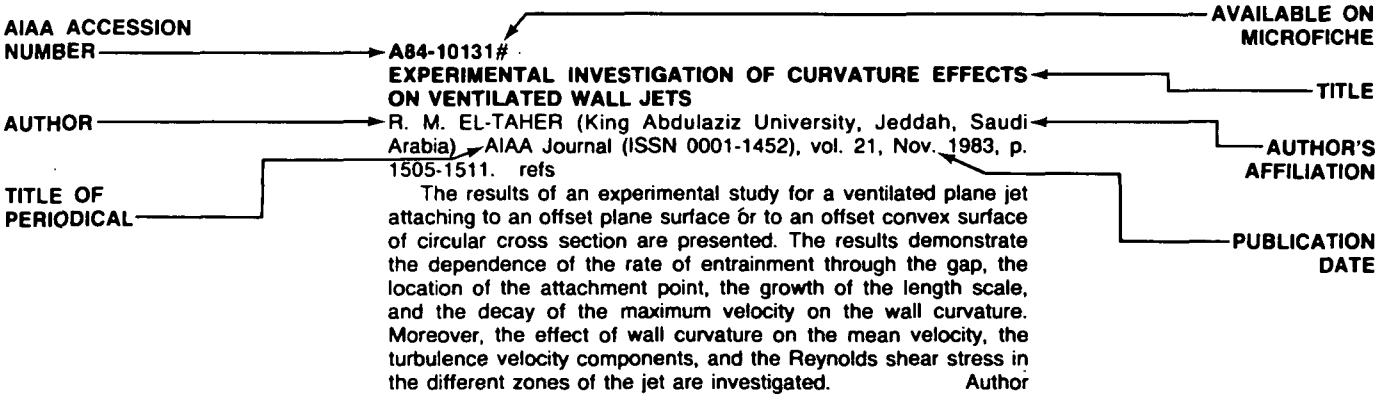

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 177)

AUGUST 1984

01

AERONAUTICS (GENERAL)

A84-30474#
SOVIET DESIGN POLICY AND ITS IMPLICATIONS FOR U.S. COMBAT AIRCRAFT PROCUREMENT
R. V. STRODE (National Institute for Public Policy, Fairfax, VA) Air University Review (ISSN 0002-2594), vol. 35, Jan.-Feb. 1984, p. 46-61. refs

An historical account is given of the tactical aircraft requirement formulation, design, and manufacturing policies of the Soviet Union, with a view to trends in the correlation of technological sophistication with aircraft complexity, versatility and performance capability. The persistence of the policy of design commonality, conservatism and simplicity for the sake of maximum production output is noted to have been weakened more recently, with the emergence of tactical aircraft closely following Western design practices and approximating Western performance capabilities in avionics, radar, combat radius, and mission versatility. O.C.

A84-31627#
INNOVATION IN AIRCRAFT STRUCTURES - FIFTY YEARS AGO AND TODAY
N. J. HOFF (Stanford University, Stanford, CA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1-14. refs
(AIAA PAPER 84-0840)

The development of the metal monocoque is traced from its precursor, the Lockheed Vega, to the Douglas DC-3. The evolution of the composite plane is followed from the German and Japanese glass-fiber gliders of the mid 1950s to the AV 8B Advanced Harrier and the German Championship sailplanes, all built of graphite-epoxy. J.N.

A84-31762
PARACHUTE THEORY ACCOUNTING FOR THE CANOPY FABRIC STRUCTURE [TEORIIA PARASHIUTA S UCHETOM STRUKTURY TKANI KUPOLA]
KH. A. RAKHMATULIN and R. KHUDAIBERDIEV (Tashkentskii Politekhnicheskii Institut, Tashkent, Uzbek SSR) Akademiia Nauk Uzbekskoi SSR, Doklady (ISSN 0134-4307), no. 1, 1984, p. 16-18. In Russian.

A two-dimensional theory of the parachute is based on the ideal fabric hypothesis in which friction is absent between the threads of the warp and the weft. The total pressure of the threads of the weft on the threads of the warp is small due to the character of the interweaving. The structure of the arrangement of the threads of the warp and weft must be such that the sections containing the slings are planar. A system of integral functional equations is obtained and integrated with the appropriate initial conditions, yielding parameters for a given flat canopy radius with given sling length and load mass. J.N.

A84-31765
THEORY OF AN AXISYMMETRIC PARACHUTE ALLOWING FOR FABRIC DEFORMABILITY [TEORIIA OSESIMMETRICHNOGO PARASHIUTA S UCHETOM DEFORMIRUEMOSTI TKANI]
R. KHUDAIBERDIEV (Tashkentskii Politekhnicheskii Institut, Tashkent, Uzbek SSR) Akademiia Nauk Uzbekskoi SSR, Doklady (ISSN 0134-4307), no. 2, 1984, p. 15-18. In Russian.

A method for calculating the stressed state of a parachute canopy which accounts for fabric deformability is developed. The parametric equilibrium equations for a radial section of the canopy derived by Rakhmatulin (1943, 1975) are used to determine the stressed state of the canopy of an axisymmetric parachute with many slings. A numerical analysis for five types of fabric shows that the maximum equatorial tension is reached near the edges and middle of the canopy, while neighboring values differ only slightly from the maximum. J.N.

A84-31785
REPAIR OF CRACKED OR DEFECTIVE METALLIC AIRCRAFT COMPONENTS WITH ADVANCED FIBRE COMPOSITES - AN OVERVIEW OF AUSTRALIAN WORK
A. A. BAKER (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) Composite Structures (ISSN 0263-8223), vol. 2, no. 2, 1984, p. 153-181. refs

ARL, Australia, has pioneered a new and highly cost-effective scheme for field or in situ repairs of aircraft components suffering from cracking caused by fatigue or stress-corrosion. The scheme is based on the application of adhesively bonded patches of advanced fiber composites (usually boron fiber reinforced plastic - BFRP). The background of this procedure is outlined and a number of practical applications briefly described. Finally, some other possible applications of selective reinforcement to rectify defective metallic components are discussed. Author

A84-32685
AEROSPACE APPLICATIONS OF SPF AND SPF/DB
J. R. WILLIAMSON (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN: Superplastic forming of structural alloys; Proceedings of the Symposium, San Diego, CA, June 21-24, 1982 . Warrendale, PA, Metallurgical Society of AIME, 1982, p. 291-306.

Development and production applications typical of efforts to establish the feasibility of superplastic forming (SPF) and superplastic forming with concurrent diffusion bonding (SPF/DB) of titanium structures are reviewed. The applications of SPF and SPF/DB in demonstration articles for manufacturing methods, design data components, structural validation components, flight test components, and production hardware are investigated. Typical cost savings of 30-50 percent and weight savings of 20-30 percent were realized in SPF/DB titanium structures such as a B-1 nacelle frame, a B-1 auxiliary power unit door, and a F-14A wing glove vane, as well as in a SPF YC-17 wing trailing edge flap skin. In a comparison of the conventional F-15 aft fuselage structure and the redesign of that structure for SPF and SPF/DB, it is shown that in the center-keel alone, 75 parts can be reduced to four parts and 1420 fasteners to 71 fasteners. The keel section itself was 77 percent less expensive. J.N.

A84-32690#
TACTICAL FIGHTER MODERNIZATION
R. D. RUSS (USAF, Washington, DC) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 46, 47, 58.

Until the deployment of the Advanced Tactical Fighter (ATF) in the mid- 1990s, the United States' tactical fighter forces will consist mainly of new models of the F-15 and F-16 aircraft. Multistage improvement in the design of these aircraft is needed in order to maintain their effectiveness. Among the design modifications reviewed here are: a Low Altitude Navigation and Targeting system for Night (LANTIRN) which will permit round-the-clock operation in all types of weather, as well as more precise munitions targeting through the use of a laser target designator, an Advanced Medium Range Air-to-Air Missile (AMRAAM) which employs an active radar seeker that allows the aircraft to launch the missile then maneuver away quickly, and improvements in propulsion systems to increase the reliability and maintainability of fighter aircraft engines. It is pointed out that improvements in engine design will lower the life-cycle cost of individual F-15s and F-16S by as much as 30 percent. I.H.

A84-32693#
TACAIR MODERNIZING WITH MUNITIONS
D. CARLSON (USAF, Washington, DC) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 60-62, 67.

Objectives of the USAF's Munitions Acquisition Plan to modernize tactical force munitions are discussed. Attention is focused on the acquisition of the all-aspect, all-environment Advanced Medium Range Air-to-Air Missile (AMRAAM); parachute-retarded, rocket-assisted devices with directable runway-cratering submunitions like the Tactical Munitions Dispenser (TMD); Glide-Bomb Unit (GBU)-15; and the Joint Tactical Missile System (JTACMS). For effective attacks on hardened targets, a Sensor Fused Weapons (SFW) with TMD and a Skeet submunition is considered, which combine sensors to detect targets and an explosively-forged penetrator (EFP) to destroy them. For defense suppression, the High Speed Anti-Radiation Missile (HARM) will significantly improve the effectiveness of F-4 Wild Weasels and the Pave Tiger minidrone will be used to kill communication jammers. Finally, advanced programs like the Hypervelocity Missile are expected to incorporate the potentially high payoff technologies such as laser acquisition tracking and guidance and the use of kinetic energy as the kill mechanism against vehicular targets. I.H.

A84-32789
THE PERFORMANCE OF MAN-POWERED AIRCRAFT
G. M. LILLEY (Southampton, University, Southampton, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, March 1984, p. 58-69. refs

An attempt is made to formulate a simplified aerodynamic treatment of man-powered aircraft, comparing the resulting methods with the actual performance of various such aircraft for which both detailed design data and flight measurements are available. Attention is given to the prospective performance of man-powered aircraft incorporating the energy storage systems recently permitted by the rules of the Kremer (1983) World Speed Record Competition for both assisted takeoffs and cruising flight. The method formulated encompasses weight breakdowns, aerodynamic factors in both straight and level flight and banked turns, the pilots leg energy output, and performance requirements for an energy storage system. The importance of the pilot as an athlete is stressed. O.C.

A84-32961#
FATIGUE LIFE OF THE Z-37 AGRICULTURAL AIRCRAFT, WAYS OF GRADUAL RAISING OF IT, OPERATION, AND MAINTENANCE WITHOUT OVERHAUL
V. KAHANEK Zprava VZLU, no. Z-43, 1983, p. 1-36. refs

The structural characteristics and fatigue-test and service performance of the Czech Z-37/Z-237 agricultural light aircraft are reviewed, and programs underway to improve its service life and maintainability are discussed. The fuselage, wing, stabilizer, and landing gear are examined separately. An inspection program and a required stabilizer replacement after 5250 flight hours have permitted the service life of the Czech and GDR fleets to be raised from 5000 to 5600 h, and further improvements are being undertaken; also in progress is a transition from overhaul maintenance to more economical on-condition maintenance, a procedure compatible with improved inspections. Drawings, graphs, and photographs of typical structural faults are provided. T.K.

A84-32983#
CARBON FIBRE FABRIC REPAIRS TO METAL AIRCRAFT STRUCTURES
K. B. ARMSTRONG (British Airways, Hounslow, Middx., England) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 1 . Stevenage, Herts., England, British Aerospace PLC, 1983, p. 8-1 to 8-12. refs

This paper describes repairs to aluminum alloys aircraft structural components using carbon-fiber tape or fabric and high performance, cold-setting epoxy adhesives. Initially, repairs were made to Concorde wing leading edge panels, and later to an aileron and four body fairing panels. Subsequently, some other repairs were made to a Boeing 747 engine cowling and a pylon fairing. All repairs except one, which used a poor surface preparation method, have proved successful. Further consideration has indicated that Concorde may have a more favorable operating temperature range than the Trident to which the unsuccessful repair was fitted. Tables of flight experience obtained are included. Carbon fiber fabric has proved to be an easy material to work with, and it is hoped that further applications for repair work will be found. Author

A84-33160* National Aeronautics and Space Administration, Washington, D. C.
AN UPDATED HISTORY OF NACA/NASA ROTARY-WING AIRCRAFT RESEARCH 1915-1984
J. WARD (NASA, Rotorcraft Office, Washington, DC) Vertiflite (ISSN 0042-4455), vol. 30, May-June 1984, p. 108-117.

Highlights are drawn from 'A History of NACA/NASA Rotating-Wing Aircraft Research, 1915-1970' by F. Gustafson to build an historical base upon which to build an extension from 1970-1984. Fundamental changes in how NASA conducted rotary-wing research in the early 1970s included an increasing level of contract research and closer ties with research conducted by the U.S. Army. The work done at the Army Research Laboratories at Ames, Langley, and Lewis Research Centers during 1970-1976 is briefly reviewed. In 1976 the Ames Research Center was assigned the Lead Center responsibility for helicopter research, though Langley retained research roles in structures, noise, dynamics, and aeroelasticity in support of rotorcraft. By 1984, NASA Rotorcraft Program Funding reached $35 million per year. J.N.

N84-22527*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF INVISCID AND VISCOUS FLOWS IN CASCADES WITH AN EXPLICIT MULTIPLE-GRID ALGORITHM
R. V. CHIMA 1984 14 p refs Proposed for presentation at the 17th Fluid Dyn., Plasma Dyn., and Lasers Conf., Snowmass, Colo., 25-27 Jun. 1984; sponsored by AIAA
(NASA-TM-83636; E-2078; NAS 1.15:83636) Avail: NTIS HC A02/MF A01 CSCL 20D

A rapid technique is used for calculating inviscid and viscous flows in turbomachinery cascades. The Euler and thin-layer Navier-Stokes equations are solved using the original explicit MacCormack algorithm. The Baldwin-Lomax eddy viscosity model is used for turbulent flows. Convergence to a steady state is accelerated by use of a variable time-step and a multiple-grid scheme. Computer time is reduced through vectorization. Details of the numerical method are presented along with computed results for two low-speed wind tunnel turning vanes, a space shuttle fuel pump turbine rotor, and a supersonic inflow compressor rotor. The method can predict subtle viscous flow phenomena in

cascades and is fast enough to be used as a design tool.
M.A.C.

N84-22528# Boeing Aerospace Co., Seattle, Wash.
INTEGRATED TESTING AND MAINTENANCE TECHNOLOGIES Final Technical Report, 25 Sep. 1981 - 15 Sep. 1983
R. O. DENNEY, M. J. PARTRIDGE, and R. B. WILLIAMS Wright-Patterson AFB, Ohio AFWAL Dec. 1983 323 p
(Contract F33615-81-C-1517; AF PROJ. 2003)
(AD-A138587; AFWAL-TR-83-1183) Avail: NTIS HC A14/MF A01 CSCL 05A

Maintenance of weapon systems is becoming an increasingly important consideration in weapon system development, because the cost of maintenance is a significant portion of the life cycle cost of the system. The objective of the Integrated Testing and Maintenance Technologies effort is to define requirements for an onboard test system for the avionic suite planned for tactical fighters in the 1990's. Problems with current onboard test systems were analyzed to determine where improvements could be made. In addition, the anticipated avionic architecture and mission of the 1990's were evaluated to determine the impact on maintenance capability. Requirements for the Integrated Testing and Maintenance System were developed and documented in a system specification. Identified improvements over current systems include better filtering of intermittent failure reports, better isolation of intermittent failures through the use of recorded data, more extensive use of system-level tests of mission operational data and a man-machine interface providing more information to the maintenance technician. In addition, artificial intelligence applications were evaluated to determine where they might be effectively applied to ITM. A design concept for a fault classification expert system was developed. Author (GRA)

N84-23551# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
24 Feb. 1984 64 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-84-004) Avail: NTIS HC A04/MF A01

Articles addressing various topics in civil aviation, motor vehicles and highways, maritime and river fleets, and ports and transshipment centers are presented. Several technical briefs are also included for each of the study areas.

N84-23554# Joint Publications Research Service, Arlington, Va.
ILYUSHIN DESIGN BUREAU ACHIEVEMENTS PROFILED
G. V. NOVOZHILOV *In its* USSR Rept.: Transportation (JPRS-UTR-84-004) p 12-17 24 Feb. 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 10, Oct. 1983 p 5-7
Avail: NTIS HC A04/MF A01

A historical review of the achievements of a Soviet design collective is presented. Development of the DB-3, Il-2, the Il-18 turboprop, the reverse thrust Il-62, the Il-76T transport, and others is addressed. M.G.

N84-23555# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
DEVELOPMENT AND DEMONSTRATION OF ECONOMIC PRODUCTION SYSTEMS IN AIRFRAME CONSTRUCTION. PART 2: TECHNOLOGICAL PHASE. PART 6: REVIEW Final Report, 1 Dec. 1980 - 30 Jun. 1983 [ENTWICKLUNG UND NACHWEIS WIRTSCHAFLICHER FERTIGUNGSVERFAHREN IM FLUGZEUGZELLENBAU. 2: TECHNOLOGIEPHASE. 6: REVIEW]
Nov. 1983 152 p In GERMAN
(Contract RUE-T/R-421/A-0032/A-4468)
Avail: NTIS HC A08/MF A01

The alpha jet pylon; the MRCA aircraft test facilities; statistical and vibratory fatigue limit characteristics of aluminum cast alloys; and compressed titanium fine cast components are treated. Riveting; welding of aluminum cast alloy A357 components; superplastic transformation and diffusion welding of titanium alloys, and aluminum precision forging components are discussed.

N84-23556# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
ALPHA JET PYLON [ALPHA-JET PYLON]
K. F. SAHM *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 9-43 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

The Alpha Jet pylon was investigated in order to check the possibilities of cast components of design and manufacture in airframe construction. Sample tests, evaluation, vibratory fatigue limit, finishing, and statistical component tests were performed. Sample tests of cast components in Precial-casting show that the high fatigue limit and dimensional accuracy requirements are also obtained for large and complex components. A weight reduction of 33% compared to the conventional methods, and a tensile strength of 350 N/sqmm are achieved. The results of testing of sand-cast components show that dimensional stability and tensile strength pose no problems. A weight reduction of 18% and a tensile strength of 360 N/sqmm are obtained. Both cast versions allow a clearly better economic production. Author (ESA)

N84-23557# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
MRCA RUN-IN FLOORS [MRCA-EINLAUFBODEN]
H. FROMEYER *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 44-59 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

Precial cast and low pressure sand-cast run-in floors made of the aluminum cast alloy A357 T6 were manufactured for the MRCA aircraft. A cost reduction of 45% for Precial-cast and 60% for low pressure sand-cast is obtained as compared to the conventional method. Optimization of dimensional and strength characteristics show positive results. Author (ESA)

N84-23564# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
WIND TUNNELS AND TESTING TECHNIQUES
Loughton, England Feb. 1984 514 p refs In ENGLISH and FRENCH Symp. held at Cesme, Turkey, 26-29 Sep. 1983
(AGARD-CP-348; ISBN-92-835-0348-1) Avail: NTIS HC A22/MF A01

The design and operation of cryogenic wind tunnels and transonic facilities are discussed as well as associated fluid motion problems. Testing techniques are considered with emphasis on support interference, inlet/engine/ afterbodies, store separation, half models, aeroacoustic measurements, and wind tunnel-flight data comparisons.

N84-23602# Verve Research Corp., Rockville, Md.
GENERAL AVIATION PILOT AND AIRCRAFT ACTIVITY SURVEY Final Report
J. HAIRSTON, M. R. WRIGHT, A. NARVA, and J. SCHWENK Dec. 1983 79 p refs
(Contract DTRS-57-82-C-00039)
(PB84-154301; DOT-TSC-FAA-83-2; FAA-MS-83-1) Avail: NTIS HC A05/MF A01 CSCL 01C

This report provides a summary and analysis of the data collected in the 1981 General Aviation Pilot and Aircraft Activity Survey. The survey was conducted at a random sample of airports across the nation throughout the months of July, August, and September, 1981 by the Federal Aviation Administration with the assistance of the Civil Air Patrol. The survey data provide information regarding the magnitude and characteristics of general aviation including: type and source of information services, trip length in time and distance, pilot age and certification. Estimates are made of total 1981 general aviation operations, fuel consumption and aircraft miles flown. GRA

02

AERODYNAMICS

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

A84-30629#
VELOCITY CHARACTERISTICS OF THE FLOW AROUND DISKS AND CONES
D. F. G. DURAO and F. C. FIRMINO (Lisboa, Universidade Tecnica, Lisbon, Portugal) American Society of Mechanical Engineers, Winter Annual Meeting, Boston, MA, Nov. 13-18, 1983. 6 p. Research supported by the Stiftung Volkswagnwerk. refs
(ASME PAPER 83-WA/FE-15)

A direction-sensitive laser-Doppler anemometer was used to measure the aerodynamic characteristics in and around the wake of disks and cones located in the centre line of a jet exiting from a tube. The inner tube diameter was 42 mm; the maximum jet velocities were 8.2 and 10.6 m/s; and disks and cones of 10 and 15 mm diameter were located at 10 and 75 mm from the jet-exit plane. Profiles of the axial and radial mean velocity components, rms of the three fluctuating components of velocity and shear stress were obtained. The measurements indicate for disk and cone of 10 mm diameter, recirculation length of 1.35 d and 1.60 d respectively. It increases with baffle diameter, is independent of initial velocity and slightly decreases with the increase of the distance from the jet exit to the baffle. The turbulence intensity in the recirculation region is never less than 30 percent and strongly anisotropic. Periodic oscillations corresponding to Strouhal number of 0.18 were found. Author

A84-30802#
AERODYNAMIC RESPONSE OF AIRFOILS IN SINUSOIDAL OBLIQUE GUST
T. NAGASHIMA and Y. TANIDA (Tokyo, University, Tokyo, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 302-308. refs

Previously cited in issue 05, p. 577, Accession no. A83-16457

A84-30803#
THE USE OF A PANEL METHOD IN THE PREDICTION OF EXTERNAL STORE SEPARATION
G. J. VAN DEN BROEK (South African Council for Scientific and Industrial Research, National Institute for Aeronautics and Systems Technology, Pretoria, Republic of South Africa) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 309-315. refs

A computer program, developed to predict the separation characteristics of external stores after release from the carrier aircraft, is discussed. The aircraft is represented by panel singularity distributions along the line of Woodward's USSAERO code. In order to treat external stores of arbitrary geometry, the store is represented in the same manner. Computer times per trajectory are reduced drastically by employing a flow grid method in combination with approximations regarding the aircraft-store interaction. These approximations are compared with the exact solution. Computations are presented regarding the flowfield below a carrier aircraft and the aerodynamic loads on an external store close to the aircraft. Store separation predictions are presented also. The agreement with experimental data is satisfactory and the store separation predictions compare favorably with those obtained with the Nielsen-Goodwin-Dillenius separation computer code. Author

A84-30804#
SHOCK-INDUCED DYNAMIC STALL
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 316-321. refs

Previously cited in issue 05, p. 588, Accession no. A83-16782

A84-30805#
THE FLUID MECHANICS OF SLENDER WING ROCK
L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 322-328. refs

Previously cited in issue 17, p. 2454, Accession no. A83-38643

A84-30810#
SHORT, MULTI-STEP, AFTERBODY FAIRINGS
J. A. C. KENTFIELD (Calgary, University, Calgary, Alberta, Canada) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 351, 352.

Wind-tunnel drag measurements indicate that a stepped afterbody can be an effective device for fairing bodies of revolution, particularly when it is necessary to minimize the length of the afterbody. The tests show that the minimum drag attained using a stepped afterbody is only 33 percent greater than that obtained using a conical afterbody of 2.4 times the length. It may be possible to improve the results obtained with stepped afterbodies by careful optimization of the configuration geometries. V.L.

A84-30918
SOME NEW RESULTS FOR THE INTEGRO-DIFFERENTIAL EQUATION OF JET-FLAP THEORY
D. A. SPENCE (Imperial College of Science and Technology, London, England) IMA Journal of Applied Mathematics (ISSN 0272-4960), vol. 32, Jan.-May 1984, p. 289-309. refs

It is pointed out the jet flap is a system for augmenting the lift on an airfoil by ejecting a narrow stream of high velocity air with a downward deflection over a flap at the trailing edge. Present applications involve carrier-based and STOL aircraft. Spence (1956) formulated a 'thin jet' model of the system in which the jet was represented by a stream of fluid with infinite velocity, zero thickness, and finite momentum, emerging from the trailing edge at an angle of deflection to the airfoil. Spence (1961) provided also an expansion of the solution in powers of 1/(lambda). The present investigation is concerned with a continuation of the earlier studies. An asymptotic solution is obtained for the case in which the parameter lambda is much less than 1. G.R.

A84-31015
RADIATIVE HEAT TRANSFER IN THE SHOCK LAYER IN THREE-DIMENSIONAL FLOW AROUND BLUNT BODIES [LUCHISTYI TEPLOOBMEN V UDARNOM SLOE PRI PROSTRANSTVENNOM OBTEKANII ZATUPLENNYKH TEL]
A. A. KOSTUZIK and A. N. RUMYNSKII Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 24, March 1984, p. 435-441. In Russian. refs

The fluid here is a hypersonic, inviscid, non-heat-conducting gas that is selectively radiating and absorbing. The transfer of radiant energy is calculated in a manner that allows for the curvature of the shock layer and the spatial inhomogeneity in the distribution of thermodynamic gas parameters behind the shock wave. Allowance is also made for the interaction between the radiation and gasdynamic fields. Calculations show that the error incurred in determining the radiative heat flux toward the surface of the body in a model of the layer is not directly related to the magnitude of the ratio of the flow along the body's generatrix to the flow along the normal to the body's surface. C.R.

A84-31117
WEAK NONLINEAR SHOCK WAVES IN STEADY TWO-DIMENSIONAL FLOW OF A NON-EQUILIBRIUM GAS ALONG A CURVED WALL
H. TAKIGAMI (Doshisha High School, Kyoto, Japan) and Z. HASIMOTO (Ritsumeikan University, Kyoto, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 53, Jan. 1984, p. 123-133. refs

The behavior of the characteristic solution in the neighbohood of the first frozen Mach line is investigated for the two-dimensional steady supersonic flow of a nonequilibrium gas along a curved wall. It is assumed that the gas is in nonequilibrium with a finite

reaction rate and various transport effects are negligible. It is found that when the wall is a continuous curved bend, the first spatial derivatives of gas properties at the first frozen Mach line depend on the relaxation length and the curvature of the wall shape at the beginning of the bend. The position of breakdown of the solution and the conditions necessary for no shock to form on the first frozen Mach line are obtained. For a concave wall with a sharp corner, a frozen shock wave emanating from the corner is formed. The shape of this frozen shock wave and the solution in the linearized case are obtained. Author

A84-31122#
THE VALIDITY CONDITIONS IN THREE-DIMENSIONAL SUPERSONIC LINEAR AERODYNAMICS
T. D. AN (Bucuresti, Universitatea, Bucharest, Rumania) Revue Roumaine de Mathematiques Pures et Appliquees (ISSN 0035-3965), vol. 29, no. 3, 1984, p. 215-223. refs

In this paper the validity conditions for general solution of the problem of the three-dimensional supersonic motion in an ideal fluid are determined. The case of the supersonic motion round the circular cone is considered. In this case the validity conditions give the connection between the aperture of the body and the Mach number in the case without incidence, or the connection between the incidence and the free stream Mach number in the case of incidence. Author

A84-31289* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A RAPID BLADE-TO-BLADE SOLUTION FOR USE IN TURBOMACHINERY DESIGN
E. R. MCFARLAND (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, April 1984, p. 376-382. refs
(ASME PAPER 83-GT-67)

A rapid technique for solving the blade-to-blade turbomachinery flow problem was developed. Approximate governing flow equations, which include the effects of compressibility, radius change, rotation, and variable stream sheet thickness are solved using a panel method. The development and solution of these equations are described. Sample calculations are presented to illustrate the method's capabilities and accuracy. Previously announced in STAR as N83-13077 Author

A84-31290
EXPERIMENTAL STUDY OF CENTRIFUGAL IMPELLER DISCHARGE FLOW IN VANELESS AND VANED DIFFUSERS
M. INOUE (Komatsu, Ltd., Hiratsuka, Kanagawa, Japan) and N. A. CUMPSTY (Cambridge University, Cambridge, England) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, April 1984, p. 455-467. Research supported by the Ministry of Defence (Procurement Executive). refs

The interaction between the vaned diffuser and the impeller is investigated. Unsteady measurements of velocity and wall static pressure are made at numerous positions in a vaned diffuser using an on-line data logging system. Experiments are performed at a range of flow coefficients for three diffusers with 10, 20, and 30 vanes set at each of three different radius ratios: 1.04, 1.1, and 1.2. A limited number of experiments are also performed with restaggered diffuser vanes; as a reference case, extensive measurements are made in a vaneless diffuser build. The impeller is run at low speed after modification to make its overall diffusion equivalent to that at the high speed for which it was designed. The circumferential distortion from the impeller is attenuated very rapidly in the entrance region of the diffuser vanes and has only minor effects on the flow inside the vaned diffuser passage. C.R.

A84-31685*# Informatics General Corp., Palo Alto, Calif.
EFFECTS OF VISCOSITY AND MODES ON TRANSONIC AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF WINGS
G. P. GURUSWAMY (Informatics General Corp., Palo Alto, CA), H. T. Y. YANG (Purdue University, West Lafayette, IN), P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA), and J. W. MARSTILLER IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1-16. refs
(AIAA PAPER 84-0870)

The unsteady transonic aerodynamic and aeroelastic behavior of a rectangular wing with a NACA 64A010 profile and a swept-back wing with a supercritical MBB-A3 profile is investigated analytically, applying 2D analysis of viscous effects to the 3D case. The results are presented in graphs and tables and discussed. It is found that the inclusion of viscous effects increases the flutter speed of the wings. T.K.

A84-31686*# Informatics General Corp., Palo Alto, Calif.
AN EFFICIENT COORDINATE TRANSFORMATION TECHNIQUE FOR UNSTEADY, TRANSONIC AERODYNAMIC ANALYSIS OF LOW ASPECT-RATIO WINGS
G. P. GURUSWAMY (Informatics General Corp., Palo Alto, CA) and P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 17-26. refs
(AIAA PAPER 84-0872)

An efficient coordinate transformation technique is presented for constructing grids for unsteady, transonic aerodynamic computations for delta-type wings. The original shearing transformation yielded computations that were numerically unstable and this paper discusses the sources of those instabilities. The new shearing transformation yields computations that are stable, fast, and accurate. Comparisons of those two methods are shown for the flow over the F5 wing that demonstrate the new stability. Also, comparisons are made with experimental data that demonstrate the accuracy of the new method. The computations were made by using a time-accurate, finite-difference, alternating-direction-implicit (ADI) algorithm for the transonic small-disturbance potential equation. Author

A84-31687#
SEPARATED FLOW UNSTEADY AERODYNAMICS FOR PROPFAN APPLICATIONS
R. M. CHI (United Technologies Research Center, East Hartford, CT) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 27-37. Research sponsored by the United Technologies Corp. refs
(AIAA PAPER 84-0874)

A relatively simple two-dimensional subsonic unsteady aerodynamic theory has been developed to take into account the effect of flow separation on unsteady airloads for high incidence angles of thin airfoil sections approximately. The theory is an extension of the classical linear potential flow theory for thin airfoils with proper boundary conditions applied to the flow separation region along the airfoil surface. The mixed boundary value problem for the lifting unsteady aerodynamics is translated into two singular integral equations that are solved by using the collocation method. Very encouraging correlation has been obtained between the calculated and experimental pitch damping values for a thin airfoil section typical of Hamilton Standard propeller blade at large angles of attack. Author

A84-31688*# Massachusetts Inst. of Tech., Cambridge.
MODELING OF UNSTEADY SMALL DISTURBANCE TRANSONIC FLOW USING PARAMETRIC DIFFERENTIATION, PSEUDOSPECTRAL ANALYSIS AND FINITE-DIFFERENCING
M. BROWN and W. L. HARRIS (MIT, Cambridge, MA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 38-45. refs
(Contract N00014-82-K-0311; NAG1-60)
(AIAA PAPER 84-0875)

A procedure for solving the nonlinear unsteady small disturbance transonic equation is formulated. This procedure is a synthesis of a pseudospectral method, parametric differentiation, and finite differencing. It is equally applicable to lifting and nonlifting airfoils. The procedure is particularly well suited to aeroelastic stability studies that may require a set of affine solutions. Author

A84-31754*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A METHOD FOR COMPUTING THE KERNEL OF THE DOWNWASH INTEGRAL EQUATION FOR ARBITRARY COMPLEX FREQUENCIES
R. N. DESMARAIS (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) and W. S. ROWE (Boeing Commercial Airplane Co., Renton, WA) AIAA, ASME, ASCE, and AHS Structures, Structural Dynamics, and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984 and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984. 16 p. refs
(AIAA PAPER 84-0983)

For the design of active controls to stabilize flight vehicles, which requires the use of unsteady aerodynamics that are valid for arbitrary complex frequencies, algorithms are derived for evaluating the nonelementary part of the kernel of the integral equation that relates unsteady pressure to downwash. This part of the kernel is separated into an infinite limit integral that is evaluated using Bessel and Struve functions and into a finite limit integral that is expanded in series and integrated termwise in closed form. The developed series expansions gave reliable answers for all complex reduced frequencies and executed faster than exponential approximations for many pressure stations. J.N.

A84-31769
THE AERODYNAMIC AND THERMAL CHARACTERISTICS OF STAR-SHAPED BODIES AROUND WHICH HYPERSONIC RAREFIED GAS FLOWS AT THE ANGLE OF ATTACK [AERODINAMICHESKIE I TEPLOVYE KHARAKTERISTIKI ZVEZDCHATYKH TEL, OBTEKAEMYKH POD UGLOM ATAKI GIPERZVUKOVYM POTOKOM RAZREZHENNOGO GAZA]
A. I. BUNIMOVICH and V. I. KUZMENKO *Moskovskii Universitet*, Vestnik, Seriia 1 - Matematika, Mekhanika (ISSN 0579-9368), Mar.-Apr. 1984, p. 74-77. In Russian. refs

Bunimovich's (1973) 'locally hypothesis' is used in determining the principal aerodynamic characteristics of bodies whose leading edge is in the form of a rectilinear star with the number of points denoted by b; the points are smoothly linked with the trailing edge according to the method outlined by Gusarov et al. (1979). The characteristics are determined for flight at various heights in the earth's atmosphere over a wide range of angles of attack. From an analysis of the characteristics obtained, the range of variability of the elongation and number of star points is determined for optimal stellate configurations given different levels of atmospheric rarefaction. C.R.

A84-31777#
FINITE ELEMENT ANALYSIS OF TRANSONIC FLOW IN NOZZLES WITH SMALL THROAT-WALL RADIUS OF CURVATURE
H. SHEN, C. LIN, M. JI, and J. SUN Northwestern Polytechnical University, Journal, vol. 2, Jan. 1984, p. 13-20. In Chinese, with *abstract in English*.

An improved version of the finite element method proposed by Shen et al. (1982) for calculating the transonic flow field in a nozzle is presented. The basic equations of aerodynamics are used directly as the governing differential equations. A finite element discretization is used in both the space and the time dimensions. The finite element equations are obtained by the least squares method. The nodal parameters belonging to time t+dt are obtained from those pertaining to t. The results calculated for a hyperbolic nozzle are in good agreement with a published perturbation solution. Excellent agreement is found between experimental data and the calculated results for two nozzle with *small throat-wall radius of curvature and with local wall curvature* discontinuity. C.D.

A84-31806#
REMARKABLE L/D ACHIEVED BY SHORT-SPAN TAILLESS SAILPLANE. II
P. BOWERS Canadian Sport Aviation Magazine, Spring 1984, p. 38-46.

Attention is given to the aerodynamic efficiency and control stability improvements gained through the application of several novel design features to a relatively low aspect ratio, taperless 'flying wing' sailplane. An L/D of 29.6:1 is claimed for the design, which employs an unconventional outboard elevon/wingtip rudder configuration. The aerodynamic principles responsible for the high efficiency and stability thereby obtained are discussed. O.C.

A84-32156
AN ANALYSIS OF FLOW CHARACTERISTICS FOR THE CASE OF UNIFORM INJECTION OF A HOMOGENEOUS GAS AT THE REAR OF A BODY [K RASCHETU KHARAKTERISTIK TECHENIIA PRI RAVNOMERNOM VDUVE ODNORODNOGO GAZA V KORMOVOI OBLASTI TELA]
I. S. BELOTSERKOVETS and V. I. TIMOSHENKO PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Jan.-Feb. 1984, p. 76-81. In Russian. refs

An analytical solution is presented for the problem of supersonic flow past a body with uniform subsonic injection of a homogeneous gas at its rear. In the nonviscous region, the gasdynamic parameters are determined by integrating the Euler equations, whereas in the viscous region, boundary layer equations are used to describe the flow. A system of three differential equations is then derived to describe the viscous-nonviscous interaction. The approach proposed here is illustrated by an example. V.L.

A84-32157
SUPERSONIC FLOW OF A GAS PAST BODIES OF REVOLUTION IN THE PRESENCE OF STRONG LOCALIZED TWO-PHASE INJECTION FROM THE BODY SURFACE [SVERKHZVUKOVOE OBTEKANIE TEL VRASHCHENIIA POTOKOM GAZA PRI NALICHII SIL'NOGO LOKALIZOVANNOGO DVUKHFAZNOGO VDUVA S EGO POVERKHNOSTI]
V. A. ANTONOV, V. D. GOLDIN, and A. M. GRISHIN PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Jan.-Feb. 1984, p. 82-89. In Russian. refs

Supersonic flow of a pure gas past an axisymmetric blunt body is investigated analytically and numerically for the case where a mixture of a gas with solid particles is injected through a permeable portion of the side surface of the body. An analysis of the particle paths suggests ambiguity in flow parameters near the line separating the incoming flow and the injected two-phase mixture. The analytically determined necessary conditions for the ambiguity are in good agreement with numerical computations. It is shown that for particles of sufficiently small diameters, an increase in the weight fraction of the particles in the injected mixture from 0.1 to

0.6 produces a change in the drag of the body of not more than 10 percent. V.L.

A84-32158
THE METHOD OF SUCCESSIVE APPROXIMATIONS IN CALCULATING THE INTERACTION OF A SUPERSONIC GAS FLOW WITH A LAMINAR BOUNDARY LAYER IN THE PRESENCE OF A SEPARATION ZONE [METOD POSLEDOVATEL'NYKH PRIBLIZHENII V RASCHETE VZAIMODEISTVIIA SVERKHZVUKOVOGO POTOKA GAZA S LAMINARNYM POGRANICHNYM SLOEM PRI NALICHII SRYVNOI ZONY]
D. O. LYZHIN PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Jan.-Feb. 1984, p. 89-93. In Russian. refs

The interaction between a supersonic gas flow and a laminar boundary layer in the presence of a separation region is investigated numerically using an iteration procedure based on the method of successive approximations. In the case of nonseparated flow, the traditional marching integration procedure is applied to the initial equations, whereas separated flows are calculated using a relaxation method with a variable direction scheme. Computations performed for flows over compression corners are found to be in good agreement with experimental results. V.L.

A84-32315
EFFECT OF FREE STREAM TURBULENCE ON THE FLOW AROUND BLUFF BODIES
P. W. BEARMAN (Imperial College of Science and Technology, London, England) and T. MOREL Progress in Aerospace Sciences (ISSN 0376-0421), vol. 20, no. 2-3, 1983, p. 97-123. refs

The interaction between mean high-Reynolds-number flow around bluff bodies and freestream turbulence (FST) is characterized in a review of experimental and theoretical studies. Three interaction mechanisms (which may themselves interact) are defined: acceleration of turbulence transition in shear layers, enhancement of mixing and entrainment, and distortion of FST by mean flow. Typical data are summarized in graphs and tables, illustrating the impact of FST scale and intensity on the overall characteristics of the flow and indicating the flows for which further studies are needed. T.K.

A84-32476
APPLICATION OF LABORATORY FREE-FLIGHT EXPERIMENTAL TECHNIQUES TO AERODYNAMIC IDENTIFICATION [TECHNIQUES D'ESSAIS DE VOL LIBRE EN LABORATOIRE APPLIQUEES AL'IDENTIFICATION AERODYNAMIQUE]
P. COTON and P. DARSES Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 38 p. In French. refs
(AAAF PAPER NT 83-03)

The complete aerodynamic identification of aircraft configurations using experimental free-flight data is discussed and demonstrated on the basis of data obtained at the facility of the Institut de Mechanique des Fluides de Lille, which permits 50-m flights of 25-cm-chord models weighing 10-25 kg at 15-40 m/sec. The principles of the method are reviewed, the onboard and ground instrumentation is described, and the data-processing logic is explained. Data are presented in graphs for a rigid transport aircraft (steady characteristics, derivatives of stability and control effectiveness, effects of gusts) and for the active gust-alleviation system developed by DFVLR for the Do 28 aircraft. T.K.

A84-32484
UNSTEADY AERODYNAMIC CHARACTERIZATION OF A MILITARY AIRCRAFT IN VERTICAL GUSTS [CARACTERISATION AERODYNAMIQUE INSTATIONNAIRE D'UN AVION D'ARMES EN RAFALES VERTICALES]
A. LE BOZEC (Avions Marcel Dassault-Breguet Aviation, Vaucresson, Hauts-de-Seine, France) and J.-L. COCQUEREZ (Lille I, Universite, Villeneuve-D'Ascq, Nord; France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 47 p. In French. refs
(AAAF PAPER NT 83-16)

The effects of 2.5-m/sec vertical gusts on the flight chracteristics of a 1:8.6 scale model of a Mirage 2000 aircraft in free flight at 35 m/sec over a distance of 30 m are investigated. The wind-tunnel setup and instrumentation are described; the impulse-response and local-coefficient-identification analysis methods applied are discussed in detail; and the modification and calibration of the gust-detection probes are reviewed. The results are presented in graphs, and good general agreement is obtained between model calculations using the two analysis methods and the experimental measurements. T.K.

A84-32485
UNSTEADY HOT-X-WIRE MEASUREMENTS IN A SCHEMATIC AIR INTAKE [MESURES INSTATIONNAIRES AU FIL CHAUD EN X DANS UNE ENTREE D'AIR SCHEMATIQUE]
J. VERRIERE (Toulouse, Centre d'Essais Aeronautique, Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 52 p. In French.
(AAAF PAPER NT 83-17)

Five series of experiments on turbulent flow in a 236-mm-diameter cylindrical air intake at high angles of attack, undertaken using hot X-wire probes in the S5 low-speed wind tunnel at the Centre d'Essais Aeronautique de Toulouse since 1980, are summarized, with an emphasis on the measurement and calculation techniques. A fictive rotational velocity is added to the circular velocity to simulate the effects of a compressor on angle-of-attack fluctuations. The experimental parameters are presented in a table, and results are shown in graphs, including the stationary flow field, the turbulence field, spatial correlations, spectral analysis, conditional probabilities, and the time evolution of anomalous fluctuations. T.K.

A84-32488
ANALYSIS OF THE APEX VORTEX ON A SWEPTBACK WING [ANALYSE DU TOURBILLON D'APEX SUR UNE AILE EN FLECHE]
J. TENSI (Poitiers, Universite, Poitiers, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 40 p. In French. refs
(AAAF PAPER NT 83-20)

The breakdown of vortices on a 55-deg-sweptback ONERA D wing profile is investigated experimentally in the 50 x 50-cm section of the S50 closed-circuit wind tunnel at ENSMA, Poitiers, France, at angle of attack 16 deg, velocity 28 m/sec, and Reynolds number 560,000. Vortex-flow problems are reviewed, and the theoretical approaches used to predict vortex breakdown are examined. The experimental results are presented graphically, including flow visualizations and Kp, mean-velocity-field, and Reynolds-stress measurements. T.K.

A84-32489
APPLICATION OF LASER VELOCIMETRY TO THE STUDY OF THE FLOW BEHIND A SPOILER [APPLICATION DE LA VELOCIMETRIE LASER AL'ETUDE DE L'ECOULEMENT DERRIERE UN SPOILER]
P. MEYER and G. KOERBER (Saint-Louis, Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 22 p. In French. Sponsorship: Direction des Recherches, Etudes et Technique. refs
(Contract DRET-82-318)
(AAAF PAPER NT 83-21)

The flow around an Aerospatiale RA16-SC1 supercritical wing profile equipped with a spoiler is investigated experimentally using a laser Doppler velocimeter (LDV) in the 70 x 90-cm working section of the wind-tunnel facility at the Institut Franco-Allemand de Recherches de Saint-Louis. Experiment parameters include wig-profile angle of incidence zero, spoiler deflection 10, 20, or 40 deg, Mach number 0.11, and Reynolds number 400,000. The 2D LDV employs 514.5-nm and 488-nm beams from an 8-W Ar laser and has a measurement volume with diameter about 100 microns. The results are presented graphically and discussed: at 10-deg deflection, a single separation bubble is observed and good agreement is obtained with simple calculations using a perfect-fluid model; at 20 and 40 deg, two bubbles are found. T.K.

A84-32585#
DISTRIBUTIONS OF INTENSITY AND SCALE OF TURBULENCE AROUND ROTOR BLADES (IN CONNECTION WITH TURBULENT NOISE FROM A FAN)
T. FUKANO, K. UTO, Y. TAKAMATSU, and Y. KODAMA Kyushu University, Technology Reports (ISSN 0023-2718), vol. 56, Dec. 1983, p. 825-830. In Japanese, with abstract in English . refs

The multiple sampling method is used to measure the time-averaged flow field around a rotor. The time-varying component of the flow is obtained and used to determine the intensity and the scale of turbulence. The relation of the results to the factors which cause turbulent noise measured in the far field is discussed. C.D.

A84-32599
VISCOUS-INVISCID INTERACTIONS ON AXISYMMETRIC BODIES OF REVOLUTION IN SUPERSONIC FLOW
A. KLUWICK, P. GITTLER (Wien, Technische Universitaet, Vienna, Austria), and R. J. BODONYI (Indiana University; Purdue University, Indianapolis, IN) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 140, March 1984, p. 281-301. refs

Using the method of matched asymptotic expansions, the interaction between axisymmetric laminar boundary layers and inviscid supersonic external flows is investigated in the limit of large Reynolds numbers. The resulting triple-deck equations are solved numerically for two different cases of body shapes: a cylinder-cone configuration and a configuration consisting of two concentric cylinders which are connected by a smooth curve. Solutions to the linearized as well as the fully nonlinear equations are presented. Author

A84-32601#
UNSTEADY NEWTON-BUSEMANN FLOW THEORY. IV - THREE DIMENSIONAL
W. H. HUI (Waterloo, University, Waterloo, Ontario, Canada) and H. J. VAN ROESSEL AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 577, 578. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

Previously cited in issue 19, p. 2970, Accession no. A82-39088

A84-32602*# Princeton Univ., N. J.
HOT-WIRE INVESTIGATION OF AN UNSEPARATED SHOCK-WAVE/TURBULENT BOUNDARY-LAYER INTERACTION
K. HAYAKAWA, A. J. SMITS, and S. M. BOGDONOFF (Princeton University, Princeton, NJ) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 579-585. refs
(Contract F49620-81-K-0018; NAGW-240)

Previously cited in issue 15, p. 2345, Accession no. A82-31948

A84-32606*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SUPERSONIC SEPARATED FLOW PAST A CYLINDRICAL OBSTACLE ON A FLAT PLATE
O. OZCAN (NASA, Ames Research Center, Moffett Field; California, University, Berkeley, CA) and M. HOLT (California, University, Berkeley, CA) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 611-617. refs
(Contract NGR-05-003-451)

An experimental investigation of three-dimensional boundary-layer separation on a flat plate ahead of a circular cylinder at Mach 2.36 was made. Emphasis was given to the laminar flow regime and to the flow region upstream of the cylinder. The heights and diameters of the cylinders used in the study were larger than the undisturbed boundary-layer thickness at the cylinder location. Data were obtained by oil flow visualization, Schlieren observations, static pressure measurements, and laser anemometry. Oil flow visualization revealed three separation lines on the flat plate ahead of the cylinder. A postulated flowfield structure, which was suggested by this skin-friction pattern, could not be confirmed by the velocity measurements. Velocity measurements indicated an unsteady flow structure. Author

A84-32607#
CONICAL, NONCIRCULAR, SECOND-ORDER, POTENTIAL THEORY OF SUPERSONIC FLOW
L. DEVAN (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 618-623. Navy-supported research. refs

Previously cited in issue 05, p. 586, Accession no. A83-16728

A84-32620#
DUSTY HYPERSONIC FLOW PAST THICK WEDGES
R. M. BARRON and J. T. WILEY (Windsor, University, Windsor, Ontario, Canada) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 713, 714. Sponsorship: Natural Sciences and Engineering Research Council of Canada. refs
(Contract NSERC-A-4484)

The effect of dust particles on the hypersonic flow (with attached shock wave) over a thick symmetric airfoil is investigated analytically, extending the Newtonian-approximation method of Barron and Wiley (1981). Explicit results for the wedge airfoil are given on the basis of the detailed equations of Wiley (1979); boundary conditions include the Rankine-Hugoniot conditions across the shock wave, no disturbance for upstream, flow tangency at the body surface, and dust-particle-property continuity. In the presence of dust particles, the shock wave is bent toward the wedge surface, and the surface pressure increases linearly with distance from the wedge vertex. T.K.

A84-32650
AERODYNAMIC CHARACTERISTICS OF NACA 0012 AIRCRAFT IN RELATION TO WIND GENERATORS
G. BERGELES, N. ATHANASSIADIS (Athens, National Technical University, Athens, Greece), and A. MICHOS Wind Engineering (ISSN 0309-524X), vol. 7, no. 4, 1983, p. 247-262. refs

A84-32756#
ON VORTEX SHEDDING FROM CIRCULAR CYLINDER WITH STEP
M. YAGITA (Tokyo Institute of Technology, Tokyo, Japan), Y. KOJIMA (Osaka Gas Co., Ltd., Osaka, Japan), and K. MATSUZAKI (Nachi Fujikoshi Co., Ltd., Ishikane, Toyama, Japan) JSME, Bulletin (ISSN 0021-3764), vol. 27, March 1984, p. 426-431. refs

This paper treats the flow around a circular cylinder with a step in a uniform flow. Vortex-shedding frequency was measured for diameter ratios d/D 0 to 1.0, length/diameter ratios L/D 10 to 27, and Reynolds numbers 800 to 10,000. Strouhal number decreases with decreasing d/D and L/D, especially at low Reynolds numbers. The decrease in measured shedding frequency is explained by the effects of the downwash of a free stream from the step. The structure of vortex street was observed by visual means and six hot-wire anemometers. The three-dimensional effects due to the step were studied, and a Y-shape connection of vortex filaments was found for d/D greater than or equal to 0.8. Author

A84-32758#
POSSIBILITY OF VARIOUS AIRFOIL SHAPE MODES AND THEIR STEADY STATE STABILITY OF SINGLE MEMBRANE SAILWING
H. MURAI (Tohoku University, Sendai, Japan) and S. MARUYAMA JSME, Bulletin (ISSN 0021-3764), vol. 27, March 1984, p. 450-457. refs

The sailwing has various special characteristics due to its flexible structure. In order to estimate a variety of airfoil shape modes and steady-state stability of the single-membrane sailwing as a representative of the lift characteristics of a sailwing, a systematical method of analysis is presented in three different trailing-edge conditions. Through calculation examples, various modes of airfoil shapes and the steady-state stability of each mode of the sailwing for each trailing-edge condition are shown. The relationship between these characteristics and the parameters of the sailwing which account for elasticities such as initial tension is also demonstrated. These characteristics are related to an abrupt change in airfoil shape and C(L)-alpha curves of the single-membrane sailwings. Author

A84-32790
HYPERSONIC LARGE-DEFLECTION SIMILITUDE FOR QUASI-WEDGES AND QUASI-CONES
K. GHOSH (Indian Institute of Technology, Kanpur, India) Aeronautical Journal (ISSN 0001-9240), vol. 88, March 1984, p. 70-76. refs

Ghosh's (1977) large deflection hypersonic similitude and piston theory for plane flows has been extended to axisymmetric flows; a new piston motion in conico annular space as an extension to Sedovs (1943) axisymmetric piston has been proposed, and a set of ordinary differential equation for one-dimensional unsteady motion obtained. Wedge and cone flow solutions are obtained without the constant-density assumption of the earlier theory; the pressure ratio is expressed as a closed form function of the similarity parameter, whereas the previous constant density theory gave an iterative procedure. The present theory unifies small disturbance theory and constant density theory. Author

A84-33138*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL AERODYNAMICS AND SUPERCOMPUTERS
W. F. BALLHAUS, JR. (NASA, Ames Research Center, Moffett Field, CA) Institute of Electrical and Electronics Engineers, COMPCON '84, International Conference, 28th, San Francisco, CA, Feb. 27-Mar. 1, 1984, Paper. 13 p. refs

Some of the progress in computational aerodynamics over the last decade is reviewed. The Numerical Aerodynamic Simulation Program objectives, computational goals, and implementation plans are described. Previously announced in STAR as N84-16139 Author

A84-33150#
THE ACTIVE AND PASSIVE INFLUENCING OF SHOCK BOUNDARY LAYER INTERFERENCE AT SUPERCRITICAL AIRCRAFT WINGS [AKTIVE UND PASSIVE BEEINFLUSSUNG DER STOSS-GRENZSCHICHT-INTERFERENZ AN UEBERKRITISCHEN TRAGFLUEGELN]
P. KROGMANN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany) and P. THIEDE (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) Deutsche Gesellschaft fuer Luft- und Raumfahrt, Fachsymposium ueber Stroemungen mit Abloesung, 4th, Goettingen, West Germany, Oct. 10-12, 1983. 25 p. In German. refs
(DGLR PAPER 83-059; MBB-VFW-45-83-OE)

The effect of various steps undertaken to actively and passively influence the shock boundary layer interference in supercritical flow around a profile has been studied in a 1 m x 1 m transonic wind tunnel. Using measurements of the pressure distribution, wakes, and boundary layers as well as schlieren observations, it is shown that local boundary layer control in the shock region using single or double slits or perforated strips can delay the shock-induced flow separation and markedly improve the aerodynamic characteristics of the profile. The use of double slits and perforated strips with an underlying chamber enables significant improvements to be attained without the need for control. C.D.

N84-22529 Princeton Univ., N. J.
TRANSONIC FLOW CALCULATIONS USING TRIANGULAR FINITE ELEMENTS Ph.D. Thesis
R. B. PELZ 1983 135 p Previously announced as A83-39376
Avail: Univ. Microfilms Order No. DA8402695

A description is given of a technique for finding the numerical solution of the Full Potential equation for steady transonic flow about airfoils. The exterior but finite domain is discretized by breaking it up into triangles. Difference equations are formulated using variational principle and a formula for the derivative in a arbitrary polygon. The iterative schemes include multigrid-ADI for structured grids and modified checkerboard for more arbitrary grids. Results show consistency and compare favorably with codes using quadrilateral elements. Author (IAA)

N84-22531 Virginia Polytechnic Inst. and State Univ., Blacksburg.
CALCULATION OF THE FLOW OVER A STALLED AIRFOIL Ph.D. Thesis
J. M. HILL 1983 134 p
Avail: Univ. Microfilms Order No. DA8402794

An approximate method for calculating the steady, incompressible, viscous flow over an airfoil, including regions of separated flow, is presented. The finite-difference equations resulting from an integral method for the laminar and turbulent boundary layers are solved simultaneously in a line-relaxation procedure with the equations for the outer, inviscid flow. These coupled equations allow direct interaction between the viscous and inviscid regions, thus eliminating the mathematical difficulties usually associated with separation. A distributed source on the upper surface of the airfoil provides an outflow to simulate the displaced boundary, and a distributed sink downstream of the trailing edge closes the wake. Computed results, which are compared with measurements for an NACA 4412 airfoil, are quite satisfactory for engineering purposes. Dissert. Abstr.

N84-22532*# 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 Apr. 1984 47 p refs
(NASA-TM-85938; A-9695; NAS 1.15:85938) Avail: NTIS HC A03/MF A01 CSCL 01A

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.
A.R.H.

N84-22533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REDESIGN AND CASCADE TESTS OF A SUPERCRITICAL CONTROLLED DIFFUSION STATOR BLADE-SECTION
J. F. SCHMIDT, T. F. GELDER, and L. F. DONOVAN 1984 13 p refs Proposed for presentation at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83635; E-2077; NAS 1.15:83635) Avail: NTIS HC A02/MF A01 CSCL 01A

A supercritical stator blade section, previously tested in cascade, and characterized by a flat-roof-top suction surface Mach number distribution, has been redesigned and retested. At near design conditions, the losses and air turning were improved over the original blade by 50 percent and 7 percent respectively. The key element in the improved performance was a small blade reshaping. This produced a continuous flow acceleration over the first one-third chord of the suction surface which successfully prevented a premature laminar separation bubble. Several recently available inviscid analysis and one fully viscous (Navier-Stokes) analysis code were used in the redesign process. The validity of these codes was enhanced by the test results. Author

N84-22534*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE DESIGN AND OPERATIONAL DEVELOPMENT OF SELF-STREAMLINING 2-DIMENSIONAL FLEXIBLE WALLED TEST SECTIONS Ph.D. Thesis
S. W. D. WOLF Mar. 1984 281 p refs
(Contract NSG-7172)
(NASA-CR-172328; NAS 1.26:172328) Avail: NTIS HC A13/MF A01 CSCL 01A

Self streamlining two dimensional flexible walled test sections eliminate the uncertainties found in data from conventional test sections particularly at transonic speeds. The test section sidewalls are rigid, while the floor and ceiling are flexible and are positioned to streamline shapes by a system of jacks, without reference to the model. The walls are therefore self streamlining. Data is taken from the model when the walls are good streamlines such that the inevitable residual wall induced interference is acceptably small and correctable. Successful two dimensional validation testing at low speeds has led to the development of a new transonic flexible walled test section. Tunnel setting times are minimized by the development of a rapid wall setting strategy coupled with on line computer control of wall shapes using motorized jacks. Two dimensional validation testing using symmetric and cambered aerofoils in the Mach number range up to about 0.85 where the walls are just supercritical, shows good agreement with reference data using small height-chord ratios between 1.5 and unity.
M.A.C.

N84-22535*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATION OF THE TIP VORTEX OFF A LOW-ASPECT-RATIO WING AT TRANSONIC SPEED
N. N. MANSOUR (Stanford Univ., Calif.) Apr. 1984 36 p refs
(NASA-TM-85932; A-9693; NAS 1.15:85932) Avail: NTIS HC A03/MF A01 CSCL 01A

The viscous transonic flow around a low aspect ratio wing was computed by an implicit, three dimensional, thin-layer Navier-Stokes solver. The grid around the geometry of interest is obtained numerically as a solution to a Dirichlet problem for the cube. A low aspect ratio wing with large sweep, twist, taper, and camber is the chosen geometry. The topology chosen to wrap the mesh around the wing with good tip resolution is a C-O type mesh. The flow around the wing was computed for a free stream Mach number of 0.82 at an angle of attack of 5 deg. At this Mach number, an oblique shock forms on the upper surface of the wing, and a tip vortex and three dimensional flow separation off the wind surface are observed. Particle path lines indicate that the three dimensional flow separation on the wing surface is part of the roots of the tip vortex formation. The lifting of the tip vortex before the wing trailing edge is observed by following the trajectory of particles release around the wing tip. E.A.K.

N84-22536*# 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 Apr. 1984 38 p refs
(NASA-TM-85937; A-9690; NAS 1.15:85937) Avail: NTIS HC A03/MF A01 CSCL 01A

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 relate to minimum drag, wave drag, high angle of attack characteristics, and power induced effects. E.A.K.

N84-22537*# United Technologies Research Center, East Hartford, Conn.
ALESEP: A COMPUTER PROGRAM FOR THE ANALYSIS OF AIRFOIL LEADING EDGE SEPARATION BUBBLES
R. L. DAVIS, V. N. VATSA, and J. E. CARTER Apr. 1984 69 p refs
(Contract NAS1-16585)
(NASA-CR-172310; NAS 1.26:172310) Avail: NTIS HC A04/MF A01 CSCL 01A

The ALESEP program for the analysis of the inviscid/viscous interaction which occurs due to the presence of a closed laminar transitional separation bubble on an airflow is presented. The ALESEP code provides a iterative solution of the boundary layer equations expressed in an inverse formulation coupled to a Cauchy integral representation of the inviscid flow. This interaction analysis is treated as a local perturbation to a known solution obtained from a global airfoil analysis. Part of the required input to the ALESEP code are the reference displacement thickness and tangential velocity distributions. Special windward differencing may be used in the reversed flow regions of the separation bubble to accurately account for the flow direction in the discretization of the streamwise convection of momentum. The ALESEP code contains a forced transition model based on a streamwise intermittency function and a natural transition model based on a solution of the integral form of the turbulent kinetic energy equation. Instructions for the input/output, and program usage are presented. E.A.K.

N84-22538# Aerospace Corp., El Segundo, Calif. Vehicle Engineering Div.
THREE-DIMENSIONAL, TWO-PHASE SUPERSONIC NOZZLE FLOWS Final Report, Oct. 1980 - Jan. 1982
I. S. CHANG 1 Oct. 1983 54 p
(Contract F04701-83-C-0084)
(AD-A138649; TR-0084(9975)-2) Avail: NTIS HC A04/MF A01 CSCL 20D

Fully coupled two-phase supersonic flows inside three-dimensional nozzles of various configurations are studied, and the behavior of flows with and without solid particles is compared and discussed. The presence of solid particles in the supersonic flow delays gas-phase expansion and alters the imbedded compressive gas-phase shock strength. The results from the present study for an axisymmetric nozzle are compared with those of the well-known SPP code. Isometric projection of three-dimensional contour plots is used for concise interpretation for the computed results of a Mach 3 inlet one- and two-phase flow under various operating conditions. Author (GRA)

N84-22539# George Washington Univ., Washington, D.C. School of Engineering.
ENERGETICS OF VORTEX RING FORMATION Interim Report
J. Z. IRDUMSA and C. A. GARRIS Nov. 1983 7 p
(Contract F49620-80-C-0043; AF PROJ. 2307)
(AD-A138795; AFOSR-84-0110TR) Avail: NTIS HC A02/MF A01 CSCL 20D

This paper presents an experimental investigation comparing the mass and energy content of fully formed laminar vortex rings in air with that of the original pulse which generated them for a variety of initial and boundary conditions. In particular, the fractional entrainment of mass and the partition of initial energy between kinetic energy of translation and kinetic energy of rotation is studied. It is found that a large degree of control can be exercised for the determination of the vortex energetics, as well as its final configuration. A technique is presented which enables calculation of kinetic energy of rotation from movie sequences. The ratio of characteristic translational speed to characteristic rotational speed is shown to be a useful parameter for correlation of data. Data on vortex size and speed are presented using this correlation and it is seen that all data, regardless of initial and boundary conditions, fall on a single curve. A theoretical curve is derived and it is seen that the data compare well with it. Author (GRA)

N84-22540# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
AN EXPERIMENTAL AND ANALYTIC STUDY OF THE FLOW SUBSONIC WIND TUNNEL INLETS Final Report, Jan. 1981 - Jun. 1983
S. M. BATILL, M. J. CAYLOR, and J. J. HOFFMAN
Wright-Patterson AFB, Ohio AFWAL Oct. 1983 173 p
(Contract F33615-81-K-3008; AF PROJ. 2307)
(AD-A138865; AFWAL-TR-83-3109) Avail: NTIS HC A08/MF A01 CSCL 20D

This report documents an experimental and numerical study of the aerodynamic behavior of three dimensional subsonic wind tunnel inlets. The purpose of the study was to develop a rational procedure for the aerodynamic design of high contraction ratio, subsonic wind tunnel inlets. Of particular concern were those factors associated with the inlet design which would influence the use of smoke flow visualization techniques. This three-phased study included the following tasks: (1) The development and assessment of aerodynamic calculation techniques suitable for subsonic wind tunnel inlet flow-field predictions. Both a surface panel technique and a finite difference field solution were developed, (2) The design and fabrication of an indraft tunnel inlet which could be used to visualize the flow within the inlet, (3) The development of design criteria based on the numerical prediction techniques for three dimensional inlets with contraction ratios in a range of 10-40. Four basic parameters were used to characterize the inlet flow fields and a series of design charts are presented for matched cubic wall geometries. GRA

N84-22541# Sandia Labs., Albuquerque, N. Mex.
PRELIMINARY RESULTS OF THE EFFECTS OF SEWING, PACKING AND PARACHUTE DEPLOYMENT ON MATERIAL STRENGTH
R. H. ERICKSEN, W. B. PEPPER, and L. D. WHINERY 1984 8 p refs Presented at the 8th AIAA Aerodyn. Decelerator and Balloon Technol. Conf., Hyannis, Mass., 2 Apr. 1984
(Contract DE-AC04-76DP-00789)
(DE84-006464; SAND-83-1753C; CONF-840496-1) Avail: NTIS HC A02/MF A01

Ribbon parachute fabrics of a 24 ft parachute, and after 2.5 years ambient exposure at several storage sites were tested. The effects of sewing, packing, and parachute deployment on material strength were obtained in the 1000 lb Kevlar ribbon after moisture exposure during packing, and when packed parachutes absorbed moisture or were thermal cycled. Individual yarn samples from the low strength ribbons exhibited little change in strength indicating that the material itself had not degraded. Factors leading to the change in ribbon strength are discussed. Considering all materials, there have been no indications to date of any uncontrollable changes in material strength that would limit the use of Kevlar in parachute applications. DOE

N84-22542 Princeton Univ., N. J.
DATA ACQUISITION AND AERODYNAMIC COEFFICIENT ESTIMATION AT HIGH ANGLES OF ATTACK Ph.D. Thesis
M. SRI-JAYANTHA 1983 238 p
Avail: Univ. Microfilms Order No. DA8402704

Aerodynamic coefficients of a Schweizer 2-32 sailplane are estimated from actual flight test data for angles of attack (alpha) up to 30 deg and sideslip angles (beta) to 17 deg. The comprehensive nonlinear aerodynamic model is identified by applying the Estimation-Before-Modeling (EBM) technique to flight data derived from fifteen maneuvers including stalls and post-stall gyrations. The static, dynamic, and control coefficients and sensitivities that are identified in 50 (alpha, beta) subspaces provide valuable insight into the problems of flight in the stalled regime. Static lift characteristics show gradual loss of lift beyond stall, while drag rises continuously with an increasing gradient. The sideslip angle contributes significantly to the lift coefficient in the post-stall regime, where the maximum lift and the maximum-lift-angle-of-attack increase with the sideslip angle. Pitch rate and elevator inputs contribute considerably to the total lift. A stable nosedown pitching moment is evident; the pitch damping and pitch control derivatives decreases with increasing angle of attack but remain effective into the post-stall regime.
Dissert. Abstr.

N84-22543 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THREE-DIMENSIONAL NONEQUILIBRIUM VISCOUS SHOCK-LAYER FLOWS OVER COMPLEX REENTRY VEHICLES Ph.D. Thesis
S. SWAMINATHAN 1984 118 p
Avail: Univ. Microfilms Order No. DA8402809

A computer program for predicting the three-dimensional nonequilibrium viscous shock-layer flows over blunt sphere-cones, straight and bent multiconics at angle-of-attack has been developed. The method used is the viscous shock-layer approach for nonequilibrium, multi-component ionizing air. A seven species chemical reaction model with single ionizing species and an eleven species chemical reaction model with five ionizing species are used to represent the chemistry. The seven species model considers 7 reactions whereas the eleven species model considers 26, reactions and the results obtained using these models are compared with perfect gas and equilibrium air results. This code is capable of analyzing shock-slip or no-shock-slip boundary conditions and equilibrium or non-catalytic wall boundary conditions. In this study the diffusion model is limited to binary diffusion. A sphere-cone-cylinder-flare with moderate flare angle, a straight biconic, and a bent biconic with seven deg. bend angle and a sphere-cone at various flight conditions are analyzed using this method. Dissert. Abstr.

N84-22544 Virginia Polytechnic Inst. and State Univ., Blacksburg.
EXPERIMENTAL INVESTIGATION OF THE INTERNAL FLOW FIELD IN STOL ENGINE INLETS Ph.D. Thesis
A. B. MATHUR 1983 262 p
Avail: Univ. Microfilms Order No. DA8402801

The internal flow structure in two 2-D inlet models designed for STOL aircraft applications is investigated through wind tunnel testing. The two-dimensional configuration for the models is chosen to facilitate use of flow visualization techniques such as Schlieren and Shadowgraph photography. In the design of such inlets, a major criterion is the avoidance of internal flow separation, particularly the kind that creates an unacceptable total pressure loss in the diffuser as well as severe flow distortion at the fan or compressor face. The main focus of this study is on identifying the various mechanisms that promote or lead to flow separation. An experimental parametric study involving the contraction ratio, the angle of incidence, the throat Mach number (weight flow through the inlet) and the freestream velocity has been carried out in the

Virginia Tech 6 ft. x 6 ft. Low Speed Stability Wind Tunnel. Flow separation is delayed in general by an increase in the Contraction Ratio. Dissert. Abstr.

N84-22628# Calspan Advanced Technology Center, Buffalo, N.Y. Dept. of Physical Sciences.
MACH NUMBER AND DENSITY EFFECTS IN THE MIXING OF SUPERSONIC JETS
C. PADOVA, D. W. BOYER, and W. H. WURSTER (Wilson Greatbach Ltd., Buffalo, N.Y.) *In* APL The 14th JANNAF Plume Technol. Meeting, Vol. 1 p 107-116 Nov. 1983 refs
(Contract F04611-80-C-0011)
Avail: NTIS HC A07/MF A01 CSCL 01A

The results presented describe the turbulent mixing of coaxial supersonic jets for a variety of relative Mach numbers and density ratios. Jet Mach numbers of 2, 3 and 4 were obtained with interchangeable nozzles and a supply apparatus housed within the large-scale Calspan Ludwig Tube wind tunnel. The jets were discharged either into an outer stream having a Mach number of 2 or into a quiescent ambient. Molecular weight and temperature of the inner jets were varied to provide ambient-to-jet density ratios ranging from 0.6 to 10. Detailed measurements of pressure, temperature and gas composition obtained at various axial distances from the exhaust plane were used to describe the trends in the supersonic mixing behavior when jet density and Mach number are varied. Author

N84-22686# California Inst. of Tech., Pasadena.
NUMERICAL ANALYSIS OF AN UNSTEADY SHOCK IN AN INLET DIFFUSER
V. YANG and F. E. C. CULICK *In* APL The 20th JANNAF Combust. Meeting, Vol. 1 p 629-634 Oct. 1983 refs
(Contract AF-AFOSR-0265-80)
Avail: NTIS HC A99/MF A01 CSCL 01A

A finite difference scheme with a shock-fitting algorithm has been used to investigate the unsteady flow with a shock in a inlet diffuser. The flow field is separated into supersonic and subsonic regions by a normal shock. The response of a shock wave to various disturbances has been studied, including large amplitude periodic oscillations and pulse perturbations. To make the model more realistic, the analysis has been extended to include viscous boundary layer effects treated with an integral method. The shock wave/boundary layer interactions is described by a simple phenomenological model. Calculated mean flow fields were compared with the experimental results reported at McDonnell Douglas Research Laboratory. Good agreement was obtained. No experimental data is available for comparison with the results for unsteady flows. Author

N84-22687*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NUMERICAL PREDICTIONS OF RESIDENCE TIMES BEHIND A REARWARD FACING STEP WITH TRANSVERSE INJECTION
R. C. ROGERS and E. H. WEIDNER *In* APL The 20th JANNAF Combust. Meeting, Vol. 1 p 635-652 Oct. 1983 refs
Avail: NTIS HC A99/MF A01 CSCL 01A

A numerical investigation of the two-dimensional recirculation zone formed between a rear-ward facing step and a transverse hydrogen jet in a supersonic flow is presented. Calculations were made using an elliptic flow computer code with a time-relaxation finite difference integration algorithm. Cases were examined for jet static pressures between 2 and 5 times mainstream with jets located 3 to 7 step heights downstream of the step. Nominal mainstream flow conditions were Mach 2.4 air at 1 atm pressure and 1000K (1800R) static temperature. Results in the form of mean properties in the recirculation zone and residence time are presented. Calculations of the decay of hydrogen mass from the steady state are presented for selected cases. The combustion potential for each case is assessed by comparison of computed conditions in the recirculation zone with the results from a well-stirred reactor theory. Author

N84-22786# Joint Publications Research Service, Arlington, Va.
MORE PRECISE NUMERICAL SIMULATION OF TRANSSONIC FLOW THROUGH PASSAGES IN TURBOMACHINES Abstract Only
M. D. KREMENTSKIY and R. M. YABLONIK *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 11 17 Apr. 1984 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Energetika (Minsk), no. 12, Dec. 1983 p 63-67
Avail: NTIS HC A03/MF A01

A method of solving boundary-value problems in gas dynamics by numerical simulation is proposed which retains the equations of motion in a rigorously conservative form even in any nonstationary system of curvilinear coordinates. It is based on transforming the fundamental system of equations for an ideal gas in divergence form from a stationary Cartesian system of coordinates to a moving system of curvilinear coordinates by tensor formalism. The main feature of this system of equations in the new form is that the momentum equation was projected onto the axes of the original Cartesian system and thus absolute Cartesian components of the velocity vector were selected as unknown functions. Any other choice of projections would detract from the rigorous conservatism and consequently degrade the numerical simulation. For illustration, the flow through passages between blades in a ring array of an axial turbine is described in this way in a system of curvilinear coordinates moving with the blades. Description of a three-dimensional flow is derived as a special case. R.J.F.

N84-22790# Joint Publications Research Service, Arlington, Va.
EXACT SOLUTION TO PROBLEM OF INTERACTION BETWEEN WEDGE MOVING AT SUPERSONIC VELOCITY AND INTERFACE OF TWO GASEOUS MEDIA Abstract Only
R. Y. TUGAZAKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 13 17 Apr. 1984 Transl. into ENGLISH from Zh. Prikl. Mekhan. Tekhn. Fiz. (Novosibirsk, USSR), no. 5, Sep. - Oct. 1983 p 94-98
Avail: NTIS HC A03/MF A01

Motion of a wedge at supersonic velocity toward a boundary separting two gaseous media is analyzed, considering a compression shock wave but not a rarefaction wave reflected by that boundary as the wedge approaches. The shock wave is assumed to return to the wedge normally to its face. The state of the gas in both regions is described with boundary conditions at their interface including the velocity discontinuity, in a system of coordinates fixed at the triple point and moving at constant velocity with the wedge. The velocities in the two gaseous regions cannot be equal, the pressures and the velocities on both sides of the contact discontinuity surface at the wedge must be respectively equal, and the streams at that surface must be parallel upon their deflections behind the forward wave and the reflected wave respectively. The problem is formulated mathematically with the aid of 12 available relations at the three pressure jumps in the system. On this basis is then calculated the compression ratio as function of the Mach number of the oncoming stream, for a fixed adiabatic exponent and various wedge angles, and as function of the adabatic exponent over the k = 0-2.0 range at a fixed Mach number (M = 2.4). R.J.F.

N84-22791# Joint Publications Research Service, Arlington, Va.
THEORY OF HYPERSONIC THREE-DIMENSIONAL FLOW OF NONSTEADY GAS STREAM WITH RELAXATION PAST THIN WING WITH ARBITRARY ASPECT RATIO Abstract Only
M. M. KUZNETSOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 14 17 Apr. 1984 Transl. into ENGLISH from Zh. Prikl. Mekhan. Tekhn. Fiz. (Novosibirsk, USSR), no. 5, Sep. - Oct. 1983 p 88-93 Previously announced in IAA as A84-21120
Avail: NTIS HC A03/MF A01

The three-dimensional uniform hypersonic flow over the windward side of a slender wing with a time-dependent surface configuration and at a constant angle of attack is examined. It is considered tha the flow in the shock layer is accompanied by physico-chemical changes and is of a relaxing character. The

thickness of the shock lyer is taken to be proportional to the small parameter epsilon, which is equal to the characteristic value of the density ratio at the head shock ave front. The thin shock layer method is applied to a wing of arbitrary aspct ratio to obtain exact particular solutions for the direct and inverse problems of unsteady nonuniform gas flow around a wing. The direct problem is formulated for a numerical-integration solution. R.J.F.

N84-22792# Joint Publications Research Service, Arlington, Va.
EXCITATION OF TOLLMIN-SCHLICHTING WAVES IN BOUNDARY LAYER AT VIBRATING SURFACE OF INFINITE-SPAN SWEPTBACK WING Abstract Only
A. M. TUMIN *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 15 17 Apr. 1984 Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Novosibirsk, USSR), no. 5, Sep. - Oct. 1983 p 70-74 Previously announced in IAA as A84-21117
Avail: NTIS HC A03/MF A01

The excitation of instability waves in a three-dimensional boundary layer of a compressible gas on the vibrating surface of a swept wing of infinite span is analyzed. The linearized Navier-Stokes equations, accounting for the equation of state after a time Fourier transform, are given. The solution of these equations for the case of a weakly nonuniform flow in the x-direction is presented in the form of a biorthogonal system of vectors. Attention is given to the resonance case, when the frequency and wave number characterizing the vibrating surface coincide with corresponding parameters for unstable excitation at the point of stability loss. A symmetric NACA 0012 foil section at zero angle of attack and a sweep angle of 30 degrees in analyzed. R.J.F.

N84-22794# Joint Publications Research Service, Arlington, Va.
INTERACTION OF UNSTEADY SPATIAL BOUNDARY LAYER WITH HYPERSONIC FLOW NEAR RAPIDLY HEATED PORTION OF SURFACE Abstract Only
A. V. KAZAKOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 16 17 Apr. 1984 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti i Gaza (Moscow), no. 5, May 1983 p 65-72
Avail: NTIS HC A03/MF A01

Unsteady three-dimensional flow is produced by heating a small portion of the surface of a flat plate in a hypersonic flow. The distance from the leading edge of the plate to the portion of the surface whose temperature is increased by an amount on the order of the initial surface temperature by means of any internal or external energy source is approximately the same as the distance from the side edges of the plate. The interaction of the laminar boundary layer with the external hypersonic flow is slight. The gas is ideal with a constant specific heat. An analysis of the resulting Navier-Stokes equations shows that with steady planar and three-dimensional flows, three characteristic regions can be distinguished near the heated section. Region 1 is the perturbed portion of the nonviscous hypersonic flow; in region 2, whose thickness is on the order of the unperturbed boundary layer in front of the interaction region, the flow is nonviscous with vortical turbulence. Region 3 is a viscous layer near the wall in which the perturbations of the velocity and enthalpy are on the order of these quantities at the surface of the obstacle itself in the unperturbed boundary layer. Author

N84-22795# Joint Publications Research Service, Arlington, Va.
HYPERSONIC FLOW AROUND FLAT BODY IN CASE OF INTENSE RADIATIVE HEAT EXCHANGE Abstract Only
I. V. NEMCHINOV and S. P. POPOV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 17 17 Apr. 1984 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti i Gaza (Moscow), no. 5, May 1983 p 126-129
Avail: NTIS HC A03/MF A01

Radiant heat flow modes using numerical estimates are applied to flat bodies entering a planetary atmosphere. The steady state two dimensional problem of a hypersonic flow of a nonviscous radiating gas around a flat thermally insulated body is solved numerically taking into account the radiative energy transport. The occurrence of a heated region around the body with dimensions that are an order of magnitude greater than the size of the solid itself is noted. The temperature here proves to be practically equalized while the gas velocity is close to that of the incident flow (the heated gas flow has a Mach number of from 3 to 6). A narrow region of strongly compressed gas is produced immediately ahead of the solid. At the higher incident gas velocities, the flow far from the body can be approximated by replacing it with a heat source having a specific power described by a simple analytical expression. The proposed procedure makes it possible to determine the detailed flow pattern around such bodies in these radiation modes, where radiative heat conductivity is dominant; the pattern proves to be quite different from the usual gas dynamic modes. M.A.C.

N84-22796# Joint Publications Research Service, Arlington, Va.
TRANSONIC FLOW AROUND PROTRUDING CORNER WITH FREE STREAMLINE Abstract Only
V. N. DIYESPEROV *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 17-18 17 Apr. 1984 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti Gaza (Moscow), no. 5, May 1983 p 130-137
Avail: NTIS HC A03/MF A01

An ideal gas flow parallel to a plane encounters a turning point where the plane breaks back acutely away from the flow. The transonic gas flow around this corner is described by an asymptotic analysis of a system of Navier-Stokes equations when the Reynolds number approaches infinity in the viscinity of the corner point. The ultimate flow is the free streamline from the vertex of this corner angle, at which the speed of sound is achieved. The equations describing the boundary layer flow near this trailing edge are written and solved assuming that the coefficient of viscosity is a linear function of temperature and that the surface of the angle is thermally insulated. M.A.C.

N84-22797# Joint Publications Research Service, Arlington, Va.
WAVE DRAG OF ELONGATED ASTROID BODIES AT MODERATE SUPERSONIC FLIGHT VELOCITIES Abstract Only
M. I. FOLLE *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 18 17 Apr. 1984 Transl. into ENGLISH from Izv. Akad. Nauk SSSR: Mekhan. Zhidkosti i Gaza (Moscow), no. 5, May 1983 p 146-151
Avail: NTIS HC A03/MF A01

The wave drag can be described by a formula which reduces the three dimensional problem to a plane boundary value problem. The given formula is written as a function of parameters which include the number of sides of the star, 2n; the Mach number, M, and B(2) = (M(2)-1)(1/2), the half-angle at the vertex of one of the extremities formed by a line running from the center of the body to this vertex. For any combinations of the parameters RB (R is the maximum thickness of the body), n, the vertex half-angle and yet a fourth parameter which describes the longitudinal contour of the body, the astroid configuration is superior in terms of drag to the equivalent axially symmetric form (equivalent with respect to the midsection area and aspect ratio). This is illustrated graphically for six slender shapes; a circle, pentagon, square, triangle and two five-pointed stars. M.A.C.

N84-23570# Calspan Field Services, Inc., Arnold Air Force Station, Tenn. Propulsion Wind Tunnel Facility.
A REVIEW AND AN UPDATE OF THE FDP SPECIALISTS MEETING (LONDON) ON WALL INTERFERENCE IN WIND TUNNELS
T. W. BINION, JR. and E. M. KRAFT *In* Agard Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The work reported at the Fluid Dynamics Prediction London Specialists meeting on wall interference in wind tunnels is reviewed. While there are many outstanding issues still to be resolved, a final solution to the wind tunnel interference problem does appear achievable. Wall interference research has taken on renewed interest in recent years pushed by more stingent accuracy requirements for vehicle performance predictions. The reseach is

directed toward increased prediction accuracy, particularly for ventilated tunnels operating at transonic conditions, development of interference assessment techniques from model and/or tunnel boundary measurement and interference avoidance via various adaptive wall schemes. In addition, since wall interference cannot be separated readily from the effects of other inherent tunnel and test properties such as wall boundary layers, noise, turbulence, model fidelity, etc., some research is being conducted to quantify the effect of other phenomena in order to verify the wall interference effects once they are identified. R.J.F.

N84-23571# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.

A SHORT NOTE ON RECENT ADVANCES IN THE ADAPTIVE WALL TECHNIQUE FOR 3D-MODEL TESTS AT THE TU-BERLIN

U. GANZER *In* Agard Wind Tunnels and Testing Tech. 2 p Feb. 1984 refs Sponsored in part by the German Minister of Research and Technology (BMFT) and The German Research Association (DFG)

Avail: NTIS HC A22/MF A01

In the test section with eight flexible walls the first successful wall adaptations were carried out for a lifting wing body configuration at transonic speeds. The adaptive wall technique is an iterative procedure in which the boundary conditions at the test section walls are adjusted to the conditions of an unlimited flow field. In the TU-Berlin test section eight flexible walls are individually shaped such that a (nearly) streamlined three dimensional wall configuration is formed. The starting configuration was the aerodynamically plane wall, i.e. the one which leads to constant Mach number along the empty test section (without model but with quadrant). The model in the test section creates a pressure distribution along each wall different from C sub P = 0. The wall shape can be used as a boundary condition for an external flow field calculation e.g. with a three dimensional panel method. The pressure distribution calculated this way can then be compared with the measured pressure distribution. Only if the measured and calculated pressures are the same the test section flow may be considered free of wall interference. The test results given demonstrate in principle the feasibility of the adaptive wall technique for three dimensional model tests. R.J.F.

N84-23573# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

DISTURBANCES FROM VENTILATED TUNNEL WALLS IN AEROFOIL TESTING

M. C. P. FIRMIN and P. H. COOK *In* Agard Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs

Avail: NTIS HC A22/MF A01

Evidence is presented which indicates that inflow through the slots of a slotted walled wind tunnel, when testing an aerofoil at conditions similar to those found in flight on wings, can penetrate into the tunnel flow to an extent which makes the determination of suitable homogeneous boundary conditions very difficult. The measurements show that the flow field generated by a lifting aerofoil causes low energy air from the plenum chamber to be drawn into the wind tunnel through the slots in the region of the upper surface of the aerofoil and that this air spreads into the working section downstream of the aerofoil. Suggestions are made for avoiding the difficulty in any future design of wind tunnel. Author

N84-23575*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

HIGH REYNOLDS NUMBER TESTS OF THE CAST 10-2/DOA2 TRANSONIC AIRFOIL AT AMBIENT AND CRYOGENIC TEMPERATURE CONDITIONS

E. STANEWSKY (DFVLR, Goettingen, West Germany), F. DEMURIE (DFVLR, Goettingen, West Germany), E. J. RAY, and C. B. JOHNSON *In* Agard Wind Tunnels and Testing Tech. 13 p Feb. 1984 refs

Avail: NTIS HC A22/MF A01 CSCL 01A

The transonic airfoil CAST 10-2/DOA2 was investigated in several major transonic wind tunnels at Reynolds numbers ranging from Re=1 million six hundred thousand to forty five million at ambient and cryogenic temperature conditions. The main objective was to study the degree and extent of the effects of Reynolds on both the airfoil aerodynamic characteristics and the interference effects of various model-wind-tunnel systems. the initial analysis of the 10-2 airfoil results revealed appreciable real Reynolds number effects on this airfoil and, moreover, showed that wall interference, can be significantly affected by changes in Reynolds number thus appearing as true Reynolds number effects. R.J.F.

N84-23581# Lockheed Missiles and Space Co., Sunnyvale, Calif.

PRACTICAL SOLUTIONS TO SIMULATION DIFFICULTIES IN SUBSCALE WIND TUNNEL TESTS

L. E. ERICSSON and J. P. REDING *In* AGARD Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs

Avail: NTIS HC A22/MF A01

Reynolds number scaling and support interference are the two main problems encountered in wind tunnel tests with subscale models. In the past, when the designer was striving to maintain attached flow over the vehicle, neither problem was very difficult to solve. The use of boundary layer trips often could solve the scaling problem and only the clumsiest of model support design would cause any interference beyond the easily corrected base drag effect. However, when the aerodynamics are dominated by separated flow effects, which often is the case for present day high performance aircraft and missiles, both problems become formidable. Practical means through which the test engineer can resolve these difficulties are described. Author

N84-23582# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Lab.

RECENT DEVELOPMENTS AND FUTURE DIRECTIONS IN DYNAMIC STABILITY RESEARCH AT NAE, OTTAWA

K. J. ORLIK-RUECKEMANN, E. S. HANFF, and M. E. BEYERS *In* AGARD Wind Tunnels and Testing Tech. 6 p Feb. 1984 refs

Avail: NTIS HC A22/MF A01

A review is presented of recent developments in the field of dynamic stability research in the Unsteady Aerodynamics Laboratory of the NAE. The developments include design and construction of several new oscillatory apparatuses, conceptual studies of some additional ones and thoughts about the future direction of the activities in this field. A method to account for sting oscillation effects on direct derivatives measured in a pitch oscillation experiment is briefly described, and some representative oscillatory results recently obtained on the so called Standard Dynamics Model are discussed. Author

N84-23588# National Aerospace Lab., Amsterdam (Netherlands).

HALF-MODEL TESTING IN THE NLR HIGH SPEED WIND TUNNEL HST: ITS TECHNIQUE AND APPLICATION

S. J. BOERSEN and A. ELSENAAR *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs

Avail: NTIS HC A22/MF A01

The half model test technique which is based on a systematic comparison of half model test results with the corresponding full model data was evaluated. It is shown that the most important problems with this technique originate from half model mounting and wall interference effects. The effects are determined empirically by use of the full model test results as a reference. It is shown that the pressure distribution on the wing and the off design boundaries are well represented in the half-model tests. Some typical applications of this technique, in which half model test results are used on a relative basis, are presented. E.A.K.

N84-23590*# General Dynamics/Convair, San Diego, Calif.
DESIGN OF ADVANCED TECHNOLOGY MANEUVERING AIRCRAFT MODELS FOR THE NATIONAL TRANSONIC FACILITY
S. A. GRIFFIN, A. A. MCCLAIN, and A. P. MADSEN (General Dynamics, Fort Worth, Tex.) *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs Sponsored by NASA. Langley Research Center
Avail: NTIS HC A22/MF A01 CSCL 01A

The need for a large High-Reynolds-Number Transonic Wind Tunnel which will provide a tool to study phenomena sensitive to Reynolds number is discussed. The National Transonic Facility (NTF), is in the calibration phase and the desired capability. Its usefulness, however, will be influenced by the ability of industry to develop model systems capable of withstanding the severe operating environment of the facility so necessary to achieve full scale Reynolds number, without degradation of accuracy, and at reasonable cost. The feasibility of designing models of advanced aerodynamic technology maneuvering aircraft and to achieve full scale Reynolds number for each configuration in the NTF are determined. It is concluded that the facility does not offer the potential for making tunnel to full scale data correlations for this type of aircraft configuration. E.A.K.

N84-23591# Aeritalia S.p.A., Torino (Italy). Gruppo Velivoli da Combattimento.
DESIGN OF A WIND TUNNEL AFTERBODY MODEL FOR THE DEVELOPMENT OF A TRANSONIC COMBAT AIRCRAFT
G. BERTOLONE and E. FARINAZZO *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

A single engine combat aircraft, complete afterbody model was designed and tested in transonic wind tunnel for integration of the experimental results obtained from the unpowered models. The model was designed with potential capability to investigate the tailplane effectiveness and the effects of the secondary jet outlets, tail fairings, excrescences, and aerials. The general arrangement of the model are described. The necessity of an accurate sealing between the fixed and the weighed parts with the minimum mechanical interference to obtain reliable results in terms of afterbody drag is stressed. E.A.K.

N84-23592# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.
TRANSONIC NOZZLE-AFTERBODY FLOW FIELD MEASUREMENTS USING A LASER DOPPLER VELOCIMETER
F. L. HELTSLEY, B. J. WALKER (Army Missile Command, Redstone Arsenal, Ala.), and R. H. NICHOLS (AEDC) *In* AGARD Wind Tunnels and Testing Tech. 14 p Feb. 1984 refs Sponsored by AEDC
Avail: NTIS HC A22/MF A01

Nonintrusive laser Doppler velocimeter (LDV) flow field measurements for several nozzle afterbody configurations with cold nitrogen exhaust jets is described. Information about the test facility and instrumentation is presented. The test articles including one with a 15 deg. boattail afterbody and two having blunt bases are described. The two color, two component LDV optical package and data acquisition system used for the flow field measurements are discussed. The effects of particle dynamics upon the LDV measurement uncertainty are reviewed. Fluorescent seeding was used in conjunction with multiple techniques to gain a more complete understanding of the complex flow interactions in the model base region. Test results are summarized and selected data are presented. E.A.K.

N84-23595# Aircraft Research Association Ltd., Bedford (England).
RECENT DEVELOPMENTS IN STORE SEPARATION AND GRID SURVEY TECHNIQUES USING THE ARA TWO-STING RIG
M. E. WOOD *In* AGARD Wind Tunnels and Testing Tech. 13 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The Two Sting Rig system provides captive trajectory and grid survey testing in the ARA 2.74 m x 2.44 m transonic wind tunnel, on models of the order of 10% scale. The system is used primarily in the captive trajectory mode to predict release characteristics for a wide range of stores/aircraft. The improvements to and developments of the system that have arisen from experiences gained during the last two years of its operational use are described. A brief description is given of the general arrangement of the rig. Improvements to performance, simulation capabilities and to wind tunnel productivity are described together with current design studies for new applications. An appraisal of the overall performance of the method against 3 other ground based techniques is used to illustrate its merits and defects, using results from recent Two Sting Rig wind tunnel tests and flight. M.A.C.

N84-23599# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NEW METHODS OF EXCITATION, ACQUISITION AND DATA REDUCTION ABOUT UNSTEADY WIND TUNNEL TESTS
A. GRAVELLE and R. DESTUYNDER *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

The unsteady wind tunnel tests performed by the structures department at Office National a'Etude et de Recherches Aerospatiales (ONERA) consist in measuring unsteady pressure fields and forces during rigid body motions of the models, control surfaces motions, as well as in acceleration measurements in the case of flutter models. The different types of model installation, excitation devices, data acquisition and data reduction methods and units are described herein. Different examples and results are given. M.A.C.

N84-23601# Royal Aircraft Establishment, Bedford (England).
RECENT DEVELOPMENTS IN THE MEASUREMENT OF TIME-DEPENDENT PRESSURES
B. L. WELSH, C. R. PYNE, and B. E. CRIPPS *In* AGARD Wind Tunnels and Testing Tech. 17 p Feb. 1984
Avail: NTIS HC A22/MF A01

For flutter tests, involving time dependent force measurement, frequency sweep excitation is currently used to reduce tunnel running times, and minimize the risk of losing the model due to prolonged exposure to oscillatory conditions. This method is used to measure the time-dependent pressures on a wing oscillating in pitch using improved measurement and recording equipment. Wherever the system under test displays a linear response the raid sweep technique is in good agreement with the much slower method of discrete sinusoidal excitation. Where the system is non liner, eg in unsteady tunnels, significant differences between the techniques are expected and observed. The techniques and data from recent test are discussed. M.A.C.

N84-23603# Aeronautical Research Labs., Melbourne (Australia).
A FLOW VISUALISATION STUDY OF TIP VORTEX FORMATION
D. H. THOMPSON Nov. 1983 48 p refs
(ARL-AERO-NOTE-421; AR-002-988) Avail: NTIS HC A03/MF A01

The process by which a wing or rotor blade tip vortex is generated has been studied in a water tunnel using dye and hydrogen flow visualization techniques. In particular, the effects of the shape of the lateral tip edge on vortex formation have been examined. Three edge shapes were tested - a square tip, a square tip with bevelled fairing. The square tip was found to have the most complicated vortex system, with vortices forming on the tip

edge face as well as above the wing. The observed flow features were generally similar to those proposed in the literature on the basis of pressure measurements, velocity measurements, and surface flow visualization in wind tunnels and on whirl towers. The vortex systems for the rounded and bevelled tips were less complicated. The shape of the tip edge has a significant effect on the structure of the tip vortex system, and may thus influence the tip loading characteristics. Verification of this will require further testing. Author

N84-23604# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AERODYNAMIC FORCES ON AN AIRSHIP HILL IN ATMOSPHERIC TURBULENCE

M. J. B. LAGRANGE Apr. 1984 112 p refs

(UTIAS-277; ISSN-0082-5255) Avail: NTIS HC A06/MF A01

The aerodynamic forces acting on an airship placed in a turbulence flow field inside the UTIAS boundary layer wind tunnel were measured. This provided a data base upon which theoretical simulation of the airship's response to turbulence could be evaluated. The slender body theory, as used in this report, has failed to predict the behavior of a bare airship hull in turbulence. An extended three-dimensional slender body theory is also included. Although slightly better predictions were obtained, the extended theory is still far from providing accurate simulation. In general the slender body theory is an extremely conservative means of evaluating modern airship behavior in atmospheric turbulence. The method of simulation should be reevaluated. B.W.

N84-23605*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PHYSICAL ASPECTS OF COMPUTING THE FLOW OF A VISCOUS FLUID

U. B. MEHTA Apr. 1984 50 p refs

(NASA-TM-85893; A-9650; NAS 1.15:85893) Avail: NTIS HC A03/MF A01 CSCL 01A

One of the main themes in fluid dynamics at present and in the future is going to be computational fluid dynamics with the primary focus on the determination of drag, flow separation, vortex flows, and unsteady flows. A computation of the flow of a viscous fluid requires an understanding and consideration of the physical aspects of the flow. This is done by identifying the flow regimes and the scales of fluid motion, and the sources of vorticity. Discussions of flow regimes deal with conditions of incompressibility, transitional and turbulent flows, Navier-Stokes and non-Navier-Stokes regimes, shock waves, and strain fields. Discussions of the scales of fluid motion consider transitional and turbulent flows, thin- and slender-shear layers, triple- and four-deck regions, viscous-inviscid interactions, shock waves, strain rates, and temporal scales. In addition, the significance and generation of vorticity are discussed. These physical aspects mainly guide computations of the flow of a viscous fluid. Author

N84-23606*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WATER-TUNNEL STUDY OF TRANSITION FLOW AROUND CIRCULAR CYLINDERS

D. ALMOSNINO and K. W. MCALISTER May 1984 35 p refs

(NASA-TM-85879; A-9606; NAS 1.15:85879; AVSCOM-TM-84-A-1) Avail: NTIS HC A03/MF A01 CSCL 20D

The recently reported phenomenon of asymmetric flow separation from a circular cylinder in the critical Reynolds number regime has been confirmed in a water-tunnel experiment. For the first time, an attempt was made to visualize the wake of the cylinder during the transition from subcritical to critical flow and to correlate the visualizations with lift and drag measurements. The occurrence of a dominant asymmetric-flow state was quite repeatable, both when increasing and decreasing the Reynolds number, resulting in a mean lift coefficient of C sub L approx 1.2 and a shift in the angle of the wake by about 12 deg. A distinctive step change in the drag and shedding frequency was also found to occur. A hysteresis was confirmed to exist in this region as the Reynolds number was cycled over the transition range. Both boundaries of the asymmetry appear to be supercritical bifurcations in the flow. The asymmetry was normally steady in the mean; however, there were instances when the direction of the asymmetry reversed and remained so for the duration of the Reynolds number sweep through this transition region. A second asymmetry was observed at a higher Reynolds number; however, the mean lift coefficient was much lower, and the direction of the asymmetry was not observed to reverse. Introducing a small local disturbance into the boundary layer was found to prevent the critical asymmetry from developing along the entire span of the cylinder. Author

N84-23607*# National Aeronautics and Space Administration, Washington, D. C.

COMPUTATION OF VISCOUS FLOWS OVER AIRFOILS, INCLUDING SEPARATION, WITH A COUPLING APPROACH

J. C. LEBALLEUR Jun. 1983 78 p refs Transl. into ENGLISH of "Calcul des Ecoulements a Forte Interaction Visqueuse au Moyen de Methoes de Couplage" rept. AGARD-CP-291 AGARD, Paris, Feb. 1981 36 p Presented at the Computation of Viscous-Inviscid Interaction Symp., Colorado Springs, 29 Sep. - 1 Oct. 1980 Original language document was announced as N81-26048 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASW-3541)

(NASA-TM-77079; NAS 1.15:77079) Avail: NTIS HC A05/MF A01 CSCL 01A

Viscous incompressible flows over single or multiple airfoils, with or without separation, were computed using an inviscid flow calculation, with modified boundary conditions, and by a method providing calculation and coupling for boundary layers and wakes, within conditions of strong viscous interaction. The inviscid flow is calculated with a method of singularities, the numerics of which were improved by using both source and vortex distributions over profiles, associated with regularity conditions for the fictitious flows inside of the airfoils. The viscous calculation estimates the difference between viscous flow and inviscid interacting flow, with a direct or inverse integral method, laminar or turbulent, with or without reverse flow. The numerical method for coupling determines iteratively the boundary conditions for the inviscid flow. For attached viscous layers regions, an underrelaxation is locally calculated to insure stability. For separated or separating regions, a special semi-inverse algorithm is used. Comparisons with experiments are presented. A.R.H.

N84-23608*# Boeing Military Airplane Development, Seattle, Wash.

FURTHER DEVELOPMENT OF XTRAN3S COMPUTER PROGRAM Final Report, 10 Sep. 1982 - 10 Feb. 1984

C. J. BORLAND May 1984 72 p refs

(Contract NAS1-17072)

(NASA-CR-172335; NAS 1.26:172335) Avail: NTIS HC A04/MF A01 CSCL 01A

This report describes modifications and enhancements to XTRAN3S, a computer program for aerodynamic, static aeroelastic, and dynamic aeroelastic analysis of three-dimensional wings in the transonic speed regime. Modifications to the program include incorporation of a viscous boundary layer, modified coefficient and generalized force integration, direct input of airfoil surface coordinates and slopes, variable dimensions of computational arrays and a modified grid mapping transformation to improve computational stability for highly swept and tapered planforms. Results obtained with the modified program are included. Modifications discussed but not incorporated include a state matrix integration method, enhanced vectorization, and use of a cartesian physical mesh. Author

N84-23609# New York Univ., Westbury.
INVESTIGATION OF AERODYNAMICS OF NON AXISYMMETRIC PROJECTILES Final Report, 1 Mar. 1982 - 30 Nov. 1983
V. ZAKKAY, A. AGNONE, and B. PRAKASAM Jan. 1984 39 p
(Contract DAAG29-82-K-0075)
(AD-A139107; ARO-19305.2-EG) Avail: NTIS HC A03/MF A01
CSCL 20D

An experimental and analytical investigation of boattail projectile drag reduction was performed. The experiments were conducted at Mach 6.3, and at a free stream Reynolds number based on the cylinder diameter Re = 3.7 million. Heat transfer measurements were also performed, and the results indicate that the flow field was predominantly laminar upstream of the boattail. The results of the analysis indicate that inviscid codes may be used to provide guidelines for possible three-dimensional geometric configurations for the reduction in the drag. The discrepancies between experimental results and theoretical predictions are significant towards the end. Both the experimental and theoretical results indicate that the triangular boattail yields the largest drag reduction. Since the predominant drag of the boattail is the base drag, it is essential for future research that accurate measurements be performed in the base region of the model in order to have a better comparison between the various boattail configurations. GRA

N84-23610# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FLIGHT DATA ON LIQUID-FILLED SHELL FOR SPIN-UP INSTABILITIES Final Report
W. P. DAMICO Feb. 1984 52 p
(Contract DA PROJ. 1L1-62618-AH-80)
(AD-A139136; AD-F300388; ARBRL-MR-03334; ARBRL-IMR-778)
Avail: NTIS HC A04/MF A01 CSCL 19D

The stability of a spinning projectile can be adversely affected when a liquid payload is present. Due to the impulsive launch of a spin-stabilized projectile, the liquid payload is subjected to unsteady and time-dependent processes. For example, the liquid must adjust to the rapid spin of the projectile casing. This process is normally called liquid spin-up. For many projectiles, the liquid spin-up process encompasses a large portion of the trajectory, and in fact many flight instabilities have occurred during this spin-up time frame. Flight data for spin-up instabilities of 155mm projectiles are presented and qualitatively discussed with respect to a recently developed model for yaw moments during spin-up. GRA

N84-23611# Michigan Univ., Ann Arbor. Interferometry Lab.
INTFL-8401 COMPUTER TOMOGRAPHY FOR INTERFEROMATIC AERODYNAMIC MEASUREMENTS Final Report, 20 Oct. 1980 - 31 Dec. 1983
C. M. VEST 1984 40 p
(Contract DAAG29-81-K-0015)
(AD-A139591; ARO-17698.4-EG) Avail: NTIS HC A03/MF A01
CSCL 09B

Under this research program the author has studied and developed several topics associated with the use of multidirectional holographic interferometry with data analysis by computer tomography for application to complex aerodynamic flows. In this technique, interferometer data are recorded virtually instantaneously by pulsed laser holographic interferometry and later are read out photometrically, digitized, and then processed by a computer to produce density maps in a set of planar cross sections of a three-dimensional flow. This program has included development of computer tomography codes of a new type, development of a microcomputer-controlled system for scanning interferograms and preprocessing the data, initial development of a new (non-holographic) hybrid optical/digital technique for recording information equivalent to that normally recorded on an interferogram of a flow, the execution of a simple prototype experiment, and considerable progress toward development of instrumentation for three-dimensional density measurement in a low-speed wind tunnel. Author (GRA)

N84-23612# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NUMERICAL AERODYNAMIC ANALYSIS OF A FREE FALLING AUTOROTATING PLATE Ph.D. Thesis
C. R. GALLAWAY Oct. 1983 144 p
(Contract AF PROJ. 2307)
(AD-A138900; AFIT-DS/AA/83-2) Avail: NTIS HC A07/MF A01
CSCL 01B

A computational method coupling the three degrees of freedom flight mechanics equations and the two dimensional Navier-Stokes equations was developed which could be used to predict the flight path of a free falling, autorotating, two dimensional flat plate. The two dimensional incompressible Navier-Stokes equations were cast in a body fixed coordinate system. The corresponding velocities were cast in an inertial reference system. The equations were represented by backward-time-central-space finite differences and solved using a successive-over-relaxation iteration technique. The resulting aerodynamic coefficients were entered into the three degrees of freedom flight mechanics equations. The system of ordinary differential equations was solved using an Adams open formula to predict the movement of the plate. New boundary conditions for the Navier-Stokes equations solver were derived from the movement of the plate. The process was repeated to advance the solution in time. The computation method was used to calculate the flow field around a flat plate forced to rotate at nondimensional angular velocities of 1.0, 2.0, and 4.0. Finally, the flight path of a free falling autorotating plate was predicted using the computational procedure. The validity of the overall approach was demonstrated by comparison with experiment. GRA

N84-24186# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
ARTIFICIAL MASS CONCEPT AND TRANSONIC VISCOUS FLOW EQUATION
G. S. DULIKRAVICH and P. NIEDERDRENK *In* Army Res. Office Trans. of the 1st Army Conf. on Appl. Math. and Computing p 259-268 Feb. 1984
(AD-P002946) Avail: NTIS HC A99/MF A01 CSCL 12A

By varying the grid clustering on the surface of an airfoil, it was observed that symmetric shocked solutions develop with a nonunique shock strength and location when numerically solving the full potential equation. It is shown analytically that the conventional form of artificial density (or viscosity) produces a number of truly nonlinear terms which are suspected to be the cause of the nonuniqueness for all the finite grid sizes. A concept of artificial mass flow is shown to be suitable for analytically evaluating a new exact form of the switching function that eliminates all the nonlinear terms for any value of the local Mach number. The resulting expanded full potential equation then becomes a third order partial differential equation of permanently parabolic type resembling Sichel's transonic viscous flow equation. Consequently, our expanded full potential equation does not require the introduction of the customarily-used artificial time concept. Author (GRA)

03

AIR TRANSPORTATION AND SAFETY

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

A84-30949
SURVIVING AIRLINER CRASHES - THE RECORD IMPROVES, BUT MORE RESEARCH IS NEEDED
D. WOOLLEY Interavia (ISSN 0020-5168), vol. 39, April 1984, p. 317-319.

A discussion is presented on the research and development initiatives taken by the U.S. Federal Aviation Administration and British Civil Aviation Authority to increase airliner crash survival

rates through more exacting regulation of seat upholstery fabrics and cushion foams. Also studied are the prospects for improved fuel system emergency management and the modification of kerosene characteristics to delay or suppress conflagrations. Airport crash/fire/rescue services are another important element in crash survival rate improvements. O.C.

A84-32962
A PARACHUTE OPENING SHOCK [OTEVIRACI RAZ PADAKU]
D. SEJNOST Zpravodaj VZLU (ISSN 0044-5355), no. 5, 1983, p. 207-215. In Czech. refs

A method is presented for analyzing the parachute opening process with the objective of determining the maximum forces acting on the parachutist and on the parachute. The analysis employs a step-by-step procedure that can be carried out using a programmable hand-held calculator. The procedure is illustrated by an example. V.L.

N84-22545# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A GENERALIZED ESCAPE SYSTEM SIMULATION (GESS) COMPUTER PROGRAM: GESS USER'S GUIDE, VERSION 2, VOLUME 1 Final Report
L. A. DAULERIO and D. A. FENDER Sep. 1983 178 p
(Contract W1100)
(AD-A138844; NADC-83111-60) Avail: NTIS HC A09/MF A01
CSCL 01C

The Generalized Escape System Simulation (GESS) program is a computerized mathematical model for dynamically simulating the performance of existing or developmental aircraft ejection seat systems. The program generates six-dimensional trajectory predictions of the aircraft, seat/occupant, occupant alone, and seat alone by calculating the forces and moments imposed on these elements by the seat catapults, rails, rockets, stabilization, and recovery systems included in most escape system configurations. User options are provided to simulate the performance of all conventional escape system designs under most environmental conditions and aircraft attitudes or trajectories. This GESS User's Guide describes the elements and events occurring in typical escape systems, the theory and formulation of the simulation model, and the procedures necessary to successfully prepare, execute, and utilize this and the related ACT and DRAS programs. The GESS Programmer's Manual, a companion guide, lists the annotated FORTRAN-IV program code, and represents the second of two volumes of GESS documentation.
Author (GRA)

N84-23613# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT. EASTERN AIR LINES, INCORPORATED, LOCKHEED L-1011, N334EA, MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA, MAY 5, 1983
9 Mar. 1984 70 p
(NTSB/AAR-84/04) Avail: NTIS HC A04/MF A01

At 0856, on May 5, 1983, Eastern Air Lines, Inc., Flight 855, a Lockheed L-1011, N334EA, with 10 crewmembers and 162 passengers on board, departed Miami International Airport enroute to Nassau, Bahamas. About 0915.15, while descending through 15,000 feet, the low oil pressure light on the No.2 engine illuminated. The No. 2 engine was shut down, and the captain decided to return to Miami to land. The airplane was cleared to Miami and began a climb to FL 200. While en route to Miami, the low oil pressure lights for engines Nos. 1 and 3 illuminated. At 0928:20, while at 16,000 feet, the No. 3 engine flamed out. At 0933:20, the No. 1 engine flamed out while the flightcrew was attempting to restart the No. 2 engine. The airplane descended without power from about 13,000 feet to about 4,000 feet, at which time the No. 2 engine was restarted. The airplane made a one-engine landing at Miami International Airport at 0946. There were no injuries to the occupants. Author

N84-23614# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PHYSIOLOGICAL ACCEPTABILITY TESTS OF THE MODIFIED SJU-5/A EJECTION SEAT FOR THE F-18 AIRCRAFT Report, May - Jun. 1983
K. MILLER Jan. 1984 26 p
(AD-A139416; NADC-84009-60) Avail: NTIS HC A03/MF A01
CSCL 05E

The program was conducted to demonstrate physiological acceptability of the Martin-Baker SJU-5/A (modified) Escape System planned for installation in the Navy's F-18 aircraft. Twenty ejection tests were run on the Naval Air Development Center Ejection Tower Facility using both anthropomorphic dummies and human volunteer test subjects. As a result of this program the seat was found to be physiologically acceptable. GRA

N84-23615# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PASSIVE ARM RESTRAINT CURTAIN (PARC) FOR NAVY AIRCRAFT EJECTION SEATS Phase Report, period ending CY 1983
T. J. ZENOBI Nov. 1983 30 p
(Contract ONR PROJ. W05-84)
(AD-A139435; NADC-83138-60) Avail: NTIS HC A03/MF A01
CSCL 01C

In an effort related to reducing arm flail injuries due to ejection windblast, the Navy is evaluating a passive arm restraint system for retrofit on Navy aircraft ejection seats. The term passive implies that the system will operate without the crewmember having to perform tasks other than what he currently performs (in a seat without an arm restraint system) to ready himself for flight. The Passive Arm Restraint Curtain (PARC) is designed to not only prevent arm flail but also to be cost effective and easily retrofitted. Prototypes have been fabricated and attached to current Navy ejection seats where they have been subjected to function feasibility testing and human factors evaluations. Preliminary results show the PARC to be a viable approach for providing passive arm restraint, but more development and testing is required to refine the design to insure operational acceptability. Author (GRA)

N84-23616# Naval Submarine Medical Research Lab., Groton, Conn.
A TEST OF ELECTROLUMINESCENT PANELS FOR A HELICOPTER EMERGENCY ESCAPE LIGHTING SYSTEM Interim Report
B. L. RYACK, S. M. LURIA, and V. ROBBINS 16 Feb. 1984 14 p
(AD-A139478; NSMRL-1018) Avail: NTIS HC A02/MF A01
CSCL 01C

The effectiveness of a lighting system composed of electroluminescent panels and proposed for use in illuminating escape hatches was tested. It was visible to light-adapted subjects in turbid water at the distance and viewing angles required by the Naval Air Development Center. GRA

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A84-30520#
THE EVOLUTION OF SECONDARY SURVEILLANCE RADAR
G. GALATI (Selenia S.p.A., Rome; Calabria, Universita, Cosenza, Italy), C. BENEDETTI, E. GIACCARI, and M. MOMO (Selenia S.p.A., Rome, Italy) IETE, IEEE, SEE, and Institution of Engineers of India, International Radar Symposium, Bangalore, India, Oct. 9-12, 1983, Paper. 9 p. refs

The monopulse secondary surveillance radar (SSR) Mode S system, which employs a novel message format, an air-ground data link, and a unique aircraft address, has as its advantages the reduction of transmission power, the frequency-separation of radar interrogations from replies, and the transmission of identity and altitude data. A development history is given for SSR Mode S in Italy. O.C.

A84-30521#
UNAMBIGUOUS RANGE ESTIMATION IN A PULSE DOPPLER AIRBORNE RADAR
S. SABATINI and F. A. STUDER (Selenia S.p.A., Rome, Italy) IETE, IEEE, SEE, and Institution of Engineers of India, International Radar Symposium, Bangalore, India, Oct. 9-12, 1983, Paper. 7 p.

The possibility of achieving an unambiguous range estimate by means of a multiple pulse Doppler radar technique is shown. An algorithm is presented which is an improved version of the 'chinese remainder algorithm' and is characterized by a low sensitivity to measurement errors as well as fair capability of rejecting wrong correlations. A flexible range-extractor logic to handle the time-sequence of measurements and estimates is outlined. The algorithm's ranging and estimation accuracy is tested in the presence of measurement errors, and its performance is found to be comparable with those of radars operating in nonambiguous conditions. The estimation logic is flexible enough to cope with different operating conditions and system requirements. C.D.

A84-31167
NEW DIGITAL-RF TECHNOLOGY AIDS AIRBORNE WEATHER RADAR
G. A. LUCCHI (Sperry Corp., Phoenix, AZ) Microwaves & RF (ISSN 0745-2993), vol. 23, April 1984, p. 95, 97, 99, 110.

It is shown that the airborne weather radar can be a very useful tool for the pilot of an aircraft. However, it is necessary that the pilot will be trained to be aware of its limitations. Attention is given to the Rain Echo Attenuation Compensation Technique used by radars, the aid provided to radar by new digital RF technology, the implementation of two methods of spectrum-spread processing, the attenuation of radar returns from distant storms, returns from a storm cell, the separation of rain returns from terrain backscatter, the regions of high radar signal reflectivity, and the design of a solid-state transmitter. G.R.

A84-31336
TOMCAT SEES THROUGH LONG RANGE EYES
Delft Systems Review and Military Communications, vol. 1, Nov. 1983, p. 36-38.

The Television Camera Set (ICS) with which F-14s are to be provided will allow the identification of targets at standoff distances, and with greater accuracy than is possible with radar at comparable ranges. The TCS image represents a 10:1 improvement over the unaided eye, as a result of the gyrostabilization of the high magnification dual-TV camera system used. Narrow and wide field-of-vision viewing is possible. O.C.

A84-31547
GLOBAL POSITIONING SYSTEMS IMPROVES TACTICAL BOMBING ACCURACY
M. K. DOSH (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, IA) Defense Systems Review and Military Communications, vol. 2, Feb. 1984, p. 32, 34.

A Global Positioning Satellite (GPS) test system has been installed aboard an operational A6-E carrier-based bomber. The GPS weapons delivery mode involves the performing of ballistics calculations in the GPS receiver, which generates an appropriately timed release pulse. It is estimated that the GPS would enhance A-6 weapons delivery capability to the extent of 16-m and 0.1 m/sec spherical error probabilities, allowing precision bombing of any fixed coordinate on the globe. Since neither the target nor the attacking aircraft need radiate signals, inexpensive conventional bombs may be used instead of weapons with sensors or in-flight guidance. In missions where targets are designated by sensors, the accuracy of the existing system is improved by ballistic calculations using GPS velocities. Attention is given to GPS receiver interfaces with the A-6 pilot and navigator. O.C.

A84-31549
GPS IMPLEMENTATION MAY EXPERIENCE SOME PROBLEMS
L. JACOBSON (Interstate Electronics Corp., Anaheim, CA) Defense Systems Review and Military Communications, vol. 2, Feb. 1984, p. 43-45.

The Navstar Global Positioning System (GPS) subject to constraints of two major kinds: technical, such as the need for an unobstructed line of sight between user and satellite, or for submerged vessels' exposure of receiving antennas, and political/economic. Attention is presently given to the latter class of difficulties. From the viewpoint of potential civilian users, GPS's primarily military design and development guidelines have tended to raise associated radio equipment costs far above the maximum for existing civilian equipment. In addition, system deployment is expected to take 8-10 years. It is suggested that the application of VHSIC technology may control costs. User charges among the NATO military, and the total number of military and civilian users, may favorably influence equipment costs. O.C.

A84-32145
EXPERIMENTAL DETERMINATION OF THE PROPAGATION VELOCITY OF VLF SIGNALS OF THE OMEGA NAVIGATION SYSTEM ON THE BASIS OF PHASE MEASUREMENTS [EKSPERIMENTAL'NOE OPREDELENIE SKOROSTI RASPROSTRANENIIA SDV-SIGNALOV RADIONAVIGATSIONNOI SISTEMY 'OMEGA' PO FAZOVYM IZMERENIIAM]
S. I. KOTIASHKIN Radiotekhnika i Elektronika (ISSN 0033-8494), vol. 29, April 1984, p. 795-797. In Russian. refs

A84-32326
CIVIL NAVIGATION AIDS IN ITT
S. H. DODINGTON (ITT, New York, NY) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 251-255. refs

The current development status of radio navigation systems for commercial and general aviation is reviewed. The systems currently in use are listed in a table and characterized, and systems under development are examined in detail: mode-S SSR, traffic-alert and collision-avoidance system (TCAS), and the Navstar/GPS satellite system. Predictions for the year 2000 include increased use of self-contained and digital systems, military and some civilian use of GPS, continued use of all present systems, continuing dominance of ILS over MLS, and little implementation of mode-S and TCAS. T.K.

A84-32327
SECOND GENERATION VORTAC EQUIPMENT
A. H. LANG (ITT, ITT Avionics Div., Nutley, NJ) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 256-262.

The modifications being introduced in the Vortac and VOR/DME systems of the FAA to extend their operation beyond 1995 are

summarized and illustrated. All-solid-state equipment provides up to 5 kW of power with greater reliability and availability; microprocessor-based technology permits remote maintenance, monitoring, certification testing, and control. The overall effect of the improvements is lower life-cycle cost and better service. T.K.

A84-32328
GROUND-BASED AIR TRAFFIC CONTROL COMMUNICATION EQUIPMENT
D. W. WALTERS (ITT, ITT Aerospace/Optical Div., Fort Wayne, IN) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 263-269.

Ground-based UHF/VHF voice-communication radio systems for ATC use are discussed, with a focus on the systems currently available from or under development by the Aerospace/Optical Division of ITT. The technical problems associated with the colocation of transmitters (T) and receivers (R) at an ATC facility are examined, including T-T intermodulation; R desensitization caused by front-end overload, T wide-band noise, or R local-oscillator noise; R crossmodulation; R intermodulation; T harmonics and spurious outputs; and R spurious responses. The performance specifications of ITT Ts and Rs are given in tables, and the development of components such as remote-control units and electronically tunable filters for future ATC requirements is sketched. T.K.

A84-32329
SYSTEM 4000 NAVIGATION AIDS
H. KLEIBER, N. KNOPPIK, and H. VOGEL (Standard Elektrik Lorenz AG, Stuttgart, West Germany) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 270-276. Research supported by the Bundesministerium fuer Forschung und Technologie. refs

The design of the System 4000 ILS, VOR, and DVOR transmitters and antennas developed by Standard Elektrik Lorenz in cooperation with the FRG flight-safety authority is discussed and illustrated with photographs, block diagrams, and tables of parameters. Major features examined include microprocessor control and monitoring, digital analog-signal generation, modular hardware and software design, plug-in equipment boards, built-in keyboard and display facilities, and a variety of antennas providing omnidirectional, figure-eight, bidirectional, dipole, and specialized patterns. T.K.

A84-32330
HARDWARE AND SOFTWARE STRUCTURES FOR SYSTEM 4000 NAVIGATION AIDS
F. LIMBACH and K. PAEHLIG (Standard Elektrik Lorenz AG, Stuttgart, West Germany) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 277-282.

The modular design of the microprocessor-based control and monitoring hardware and software of the System 4000 ILS/VOR/DVOR transmitters developed by Standard Elektrik Lorenz is explained and illustrated with block diagrams. Virtually identical hardware using low-frequency signal-processing and high-frequency modules is used to perform ILS, VOR, and DVOR functions, while the radiated and standby transmitter signals are monitored by a 16-bit microprocessor. The main program and program modules of the ILS software are described in detail. T.K.

A84-32331
NEW FAMILY OF TACAN AND DME EQUIPMENT
G. BERTOCCHI (Industrie FACE Standard, S.p.A, Milan, Italy) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 289-292.

The current generation of Tacan/DME transmitter systems built by Industrie FACE Standard is characterized. Improved performance, reliability, and maintainability are achieved by applying synchronous digital circuits, solid-state RF technology, modular design, and system integration. Block diagrams and photographs of the major components (including dual transponders and monitors, control units, and programmable built-in test equipment) are provided. T.K.

A84-32332
CIVIL USE OF TACAN
E. LAZZARONI (Industrie FACE Standard, S.p.A., Milan, Italy) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 293-298.

The use of modern Tacan systems in civilian air-navigation applications such as helicopter traffic to offshore oil rigs is proposed. The performance parameters of current helicopter navigation systems are compared in a table, and the advantages of Tacan systems in reliability, redundancy, and area navigation are indicated. Current solid-state transmitters and antenna systems are shown to make Tacan systems technologically superior to other methods of comparable cost. T.K.

A84-32333
SCANNING PENCIL BEAM PRECISION APPROACH RADAR
R. E. JOHNSON (ITT Gilfillan, Van Nuys, CA) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 299-304.

The PAR-80 scanning-pencil-beam ATC radar system is characterized and illustrated with drawings, photographs, block diagrams, and graphs of performance data. The PAR-80 antenna is a 3.81 x 2.13-m 85 x 176-element array of slotted waveguides with phase shifters (for + or - 15-deg azimuth steering) and a planar three-skin transmission-type circular polarizer; it provides improved coverage, resolution, accuracy, and clutter performance with 46-dB gain. The other components include a single-conversion superheterodyne receiver, a coaxial-magnetron transmitter (9.0-9.16 GHz, peak power 180 kW, pulse width 240 nsec, repetition rate 3450 pulses/sec), a time-compression video processor, and display hardware (18.5-km logarithmic and 37-km linear range scales). Selected environmental and operational test results are shown. T.K.

A84-32334
FURTHER DEVELOPMENT OF THE DPS TECHNIQUE FOR PRECISION DME
G. CORAZZA (Bologna, Universita, Bologna, Italy) and F. VATALARO (Industrie FACE Standard, S.p.A., Pomezia, Italy) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 305-309. refs

The application of the double-pulse-shaping (DPS) technique to precision DME devices for MLS is discussed in the light of the standards and recommended practices issued for conventional and VTOL/STOL operations by the ICAO All Weather Operations Panel in 1982. The accuracy requirements and pulse specifications of the 2-pulse/2-mode approach adopted are reviewed and analyzed, and their basic compatibility with the DPS technique is demonstrated. Particular attention is given to an experimental system which uses baseband receive-path DPS filtering to achieve 18-dB attenuation with a partial risetime of 220 nsec. T.K.

A84-32335
RF SUBSYSTEMS FOR PRECISION DME
F. ARDEMAGNI, P. BASILE, and A. CLEMENTI (Industrie FACE Standard, S.p.A., Laboratorio Centrale, Pomezia, Italy) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 310-313. refs

The designs of a mechanically tuned low-noise front end and high-power transmitters for L-band precision DME are presented and illustrated with photographs, block diagrams, and graphs. The front end comprises a 2-stage bipolar amplifier, a fifth-order comb-line filter, a Schottky-diode balanced mixer, an IF preamplifier, and a steep IF filter. The 200-W ground and 700-W airborne transmitters are based on the design of Graziani (1975) and comprise a class-AB preamplifier, a predistorted-pulse-modulated driver, and a pseudolinear power amplifier. The RF circuits of all designs utilize microstrip technology in soft high-permittivity teflon-based substrates to reduce size. T.K.

A84-32337
OFF-SHORE HELICOPTER RADIO NAVIGATION USING DME-BASED POSITIONING SYSTEM
M. BOEHM (Standard Elektrik Lorenz AG, Stuttgart, West Germany) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 319-325. refs

The application of DME to helicopter navigation to off-shore oil rigs under extreme weather conditions is examined. The difficulties encountered with the systems presently used in the North Sea are outlined; the characteristics of various DME systems are compared; and an L-band positioning system comprising the present ICAO DME, precision DME, a DME-based azimuth system (DAS), and a helicopter approach system combining DAS with direction finding for elevation is characterized in detail and illustrated with diagrams. The onboard and rig-based equipment and the enroute, TMA, and final-approach operation of the DME-based positioning system are described. Improved performance and safety without cost and payload penalties are predicted. T.K.

A84-32340
PRECISION DISTANCE MEASURING EQUIPMENT FOR THE MICROWAVE LANDING SYSTEM
K. BECKER, A. MUELLER, and H. VOGEL (Standard Elektrik Lorenz AG, Stuttgart, West Germany) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 336-343.

The precision DME components being developed at Standard Elektrik Lorenz to meet the standards set by the ICAO All Weather Operations Panel for the future MLS are characterized. The system concept and general technical features (broadband receiver branch, FA-mode thresholding technique, and steep pulse modulation) are reviewed; and the 300-W-EIRP ground transponder, the 3.5-MHz-processing-bandwidth receiver, the 100-W transmitter, the 32-MHz-clock frequency calibration-pulse module, and the flexible airborne equipment (permitting both normal and precision DME operation) are described and illustrated with block diagrams and photographs. Availability of the first production models is scheduled for 1986. T.K.

A84-32341
LORAN-C NAVIGATION SYSTEM FOR SAUDI ARABIA
W. J. GARMANY, V. L. JOHNSON, and W. J. ROMER (ITT, ITT Avionics Div., Nutley, NJ) Electrical Communication (ISSN 0013-4252), vol. 58, no. 3, 1984, p. 344-351.

The two-chain Loran-C maritime navigation system scheduled to begin operation in Saudi Arabia (with coverage of the Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, and Persian Gulf) in 1984 is described and illustrated with maps, photographs, and diagrams. The basic principles of Loran-C are reviewed; the configuration of the seven high-power transmitter stations and three monitor stations is explained; and the transmitter-equipment and signal-analysis sets, the data-analysis equipment, and the remote-control set are characterized. The system will provide 0.1-0.2-nautical-mile repeatable fix accuracy in the most congested waters with signal availability of at least 99.5 percent. T.K.

A84-32405
INTERFACES TO TELEMETRY SYSTEMS
R. NICOLAIS (Aydin Corp., Vector Div., Newtown, PA) and D. H. ELLIS (Aero Systems Associates, Huntsville, AL) IN: ITC/USA/'82; Proceedings of the International Telemetering Conference, San Diego, CA, September 28-30, 1982 . Research Triangle Park, NC, Instrument Society of America, 1982, p. 81-91.

In connection with the increasing use made of digital techniques in aircraft equipment, analog point-to-point wire bundles soon proved to be an inefficient means of interconnecting the various subsystems and components of the avionics systems. A serial digital multiplex data bus was developed to eliminate this difficulty. MIL-STD-1553 describes this bus. The 1553 multiplex data bus provides integrated, centralized system control, and a standard interface for all equipment connected to the bus. Attention is given to an overview concerning the data bus, the word formats, message formats, typical aircraft system applications, considerations for processing MIL-STD-1553 data, and the programmable data bus monitor, PBM-1553. G.R.

A84-32694#
ELECTRONIC WARFARE - NEW PRIORITY FOR NEXT-GENERATION FIGHTERS
R. HERRON (USAF, Washington, DC) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 64-67.

The importance of electronic warfare (EW) systems for the next generation fighter aircraft is discussed. EW (non-lethal electronic countermeasures such as jamming and radar disruption) is shown to have been effective in reducing fighter aircraft attrition and its success in recent years is emphasized. Performance and design requirements for future EW systems are presented, and a concept for an Integrated New Electronic Warfare System (INEWS) is described. INEWS will be designed to detect, avoid, counter, distract and confuse enemy weapons and associated emitters or sensors operating anywhere in the electromagnetic spectrum. It will incorporate such technology as highly integrated circuits (VHSIC/VLSI), millimeter wave sensors, and artificial intelligence algorithms. The project will be closely coordinated with the development of te Advanced Tactical Fighter (ATF) to ensure that the EW system is fully integrated with ATF fire-control, avionics, flight control and sensor subsystems. A block diagram is provided of the Advanced Protection Jammer to be installed in the F-16 aircraft in 1985. I.H.

A84-32709#
TARGET ACCELERATION MODELING FOR TACTICAL MISSILE GUIDANCE
P. L. VERGEZ and R. K. LIEFER (USAF, Armament Laboratory, Eglin AFB, FL) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 315-321. refs

Previously cited in issue 06, p. 806, Accession no. A82-17910

A84-32714*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PILOTED SIMULATION OF AN ONBOARD TRAJECTORY OPTIMIZATION ALGORITHM
D. B. PRICE (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, VA), A. J. CALISE, and D. D. MOERDER (Drexel University, Philadelphia, PA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 355-360. refs

Previously cited in issue 07, p. 975, Accession no. A82-20296

A84-33022
BREAKING THE PRECISION BARRIER FOR AIRCRAFT INERTIAL SYSTEMS
G. W. ADAMS and M. J. HADFIELD (Honeywell, Inc., Military Avionics Div., Clearwater, FL) Navigation (ISSN 0028-1522), vol. 30, Winter 1983-1984, p. 301-308.

It is shown that by adding improved accelerometer resolution and gyro speed control modifications to the SPN/GEANS electrically suspended gyro (ESG) navigation system, and by maintaining the system in a premission powered-up calibration/alignment mode, the accelerometer and gyro error contributions may be reduced 5-10 fold. Advances in gravity compensation techniques permit a long-term CEP error rate of 0.02 nm/hr. Three analysis methods were employed to evaluate the potential navigation accuracy of the mechanization and calibration approach to this four-gimbal space-stable inertial navigation system: (1) a standard 38 state Kalman optimal filter covariance analysis conducted for ground alignment and unaided navigation over a 12-hour great circle flight path; (2) a sensitivity analysis to separate the contributions of various error sources; and (3) a suboptimal filter analysis of a real 15 state filter to check Kalman filter design assumptions. J.N.

A84-33025
FLIGHT TEST RESULTS FOR AN EXPERIMENTAL GPS C/A-CODE RECEIVER IN A GENERAL AVIATION AIRCRAFT
S. D. CAMPBELL and R. R. LAFREY (MIT, Lexington, MA) Navigation (ISSN 0028-1522), vol. 30, Winter 1983-1984, p. 350-368. Sponsorship: U.S. Department of Transportation. refs (Contract DOT-FA77WA-1757; DOT-FA78WA-4216)

The design and flight test results of an experimental Global Positioning System receiver installed in a Rockwell AeroCommander 500A are reported. The design includes the use of a dual-channel C/A-code receiver and the tracking of all satellites in view. Two DEC LSI-11/23 computers perform position fixing and receiver control, and navigation and data recording tasks. Pilot displays include a conventional course deviation indicator, omni-bearing selector, and intelligent control and display unit. The results of testing at a large urban airport, at several small airports, and over mountainous terrain show that the system accuracy was well within the two-dimensional requirements of FAA Advisory Circular 90-45A. The system accuracy of 333 ft for general aviation operations appears consistent with the Federal Radionavigation Plan. The system design is compatible with current ATC procedures and aircrew practices. J.N.

N84-22546* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NAVIGATION SYSTEM AND METHOD Patent
R. E. TAYLOR (Howard Univ., Washington, D.C.) and J. W. SENNOTT, inventors (to NASA) (Howard Univ., Washington, D.C.) 24 Apr. 1984 20 p Filed 22 May 1981 Sponsored by NASA (NASA-CASE-GSC-12508-1; US-PATENT-4,445,118; US-PATENT-APPL-SN-266253; US-PATENT-CLASS-343-357; US-PATENT-CLASS-343-356) Avail: US Patent and Trademark Office CSCL 17G

In a global positioning system (GPS), such as the NAVSTAR/GPS system, wherein the position coordinates of user terminals are obtained by processing multiple signals transmitted by a constellation of orbiting satellites, an acquisition-aiding signal generated by an earth-based control station is relayed to user terminals via a geostationary satellite to simplify user equipment. The aiding signal is FSK modulated on a reference channel slightly offset from the standard GPS channel. The aiding signal identifies satellites in view having best geometry and includes Doppler prediction data as well as GPS satellite coordinates and identification data associated with user terminals within an area being served by the control station and relay satellite. The aiding signal significantly reduces user equipment by simplifying spread spectrum signal demodulation and reducing data processing functions previously carried out at the user terminals.
Official Gazette of the U.S. Patent and Trademark Office

N84-22547# Defence Research Establishment, Ottawa. (Ontario).
PERFORMANCE EVALUATION OF A MAGNAVOX GPS (GLOBAL POSITIONING SYSTEM) Z-SET
M. F. VINNINS Apr. 1983 26 p
(AD-A138569; DREO-TN-83-3) Avail: NTIS HC A03/MF A01 CSCL 17G

A Magnavox Global Positioning System (GPS) Z-Set Receiver was obtained on loan from the United States NAVSTAR/GPS Joint Program Office for evaluation. Tests were carried out in an electronically-equipped trailer, on-board a naval research vessel and in a Twin Otter flying laboratory. Data was manually recorded during static positioning tests and waypoint navigation tests. Results indicated a static positioning accuracy consistantly better than 100 feet in both latitude and longitude under 4-satellite availability.
Author (GRA)

N84-22548# Mitre Corp., McLean, Va. Metrek Div.
SYSTEM SAFETY STUDY OF MINIMUM TCAS II (TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM) Final Report
J. E. LEBRON, A. D. ZEITLIN, N. A. SPENCER, J. W. ANDREWS, and W. H. HARMAN Dec. 1983 366 p
(Contract DTFA01-84-C-0001)
(AD-A138674; MTR-83W241; DOT/FAA/PM-83/36) Avail: NTIS HC A16/MF A01 CSCL 01B

A System Safety study was conducted to assess the overall safety characteristics associated with use of the airborne collision avoidance system called minimum TCAS II (Traffic Alert and Collision Avoidance System). The limitations imposed by incomplete transponder equipage, altimetry instrumentation errors, and suddenly maneuvering intruders were quantified. Other failure mechanisms, including those related to human factors, were also assessed. The role of visual acquisition and a quantitative evaluation of it was explored. The impact on system safety caused by the failure modes and their interrelations was evaluated by means of a fault free analysis. Author (GRA)

N84-22549# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.
FAA (FEDERAL AVIATION ADMINISTRATION) AVIATION FORECASTS -FISCAL YEARS 1984-1995
M. OLSON, G. MERCER, R. BOWLES, C. MOLES, and A. SCHWARTZ Feb. 1984 81 p
(AD-A138759; FAA-APO-84-1) Avail: NTIS HC A05/MF A01 CSCL 01B

This report contains the Fiscal Years 1984-1995 Federal Aviation Administration (FAA) forecasts of aviation activity at FAA facilities. These include airports with FAA control towers, air route traffic control centers, and flight service stations. Detailed forecasts were made for the four major users of the national aviation system: air carriers, air taxi/commuters, general aviation and the military. The forecasts have been prepared to meet the budget and planning needs of the constituent units of the FAA and to provide information that can be used by state and local authorities, by the aviation industry and the general public. The overall outlook for the forecast period is for strong economic growth relatively stable real fuel prices, and moderate inflation. Based upon these assumptions, aviation activity is forecast to increase by Fiscal Year 1995 by 79 percent at towered airports (commuters, 73 percent; air carrier, 23 percent; general aviation, 101 percent; military, 0 percent), 45 percent at air route traffic control centers (commuters, 110 percent; air carriers, 25 percent; general aviation, 74 percent; military, 0 percent), and 60 percent in flight services performed. Hours flown by general aviation is forecast to increase 60 percent and helicopter hours 67 percent. Scheduled domestic revenue passenger miles (RPM's) are forecast to increase 81 percent, with scheduled international RPM's forecast to increase by 79 percent and commuter RPM's forecast to increase by 195 percent. GRA

N84-22550# Kaiser Electronics, San Jose, Calif.
EN ROUTE/TERMINAL ATC (AIR TRAFFIC CONTROL) OPERATIONS CONCEPT Final Report
H. AMMERMAN, C. FLIGG, JR., W. PIESER, G. JONES, and K. TISCHER 28 Oct. 1983 435 p
(Contract DTFA01-83-Y-10554)
(AD-A138991; FAA-AP-83-16) Avail: NTIS HC A19/MF A01 CSCL 17G

This document captures in one place the information processing tasks of the en route and terminal controller. This will serve to aid the engineer and designer to the future Advanced Automation System (AAS) with some insight into the why, what and how of current Air Traffic Control operations. The AAS will see the integration and consolidation of terminal and en route processes into what is termed the Area Control Facility (ACF). This document takes an operational view of the current systems and presents data on how the controller does his perceptual, cognitive and motor functions. The analysis approach is to treat the controller as a human information processor who interacts with a variety of ATC systems to perform the tasks of expediting, separating, and controlling air traffic. Specific methods and techniques are

employed to rigorously identify and characterize these functions, or information processing/handling tasks. From this, one can infer, study, analyze and eventually develop in the AAS the capabilities for aiding and improving controller productivity. In addition, this document preserves, for the purposes of transition to the ACF, the design information that is applicable to the activities on a controller. These are the set of activities and information processing tasks performed at the Radar Positions in terminal approach control and en route centers. The focus of this document is on the composition and analysis of controller tasks, and not on the machine functions described in NAS Stage A3d2 and ARTS II, III Technical documentation. GRA

N84-23552# Joint Publications Research Service, Arlington, Va.
MINISTRY OFFICIAL ON IMPROVING ALL-WEATHER AVIATION CAPABILITIES
T. ANODINA *In its* USSR Rept.: Transportation (JPRS-UTR-84-004) p 1-5 24 Feb. 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 12, Dec. 1983 p 14-15
Avail: NTIS HC A04/MF A01

An overview of research aimed at improving all-weather aviation capabilities is presented. Glideslope radio beacons, airport lighting equipment, on-board equipment, metric and centrimetric-wave landing systems, and takeoff-run monitoring are discussed. Problems associated with the integration of new systems are addressed along with the economic and safety issues. M.G.

N84-23617*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA-FAA HELICOPTER MICROWAVE LANDING SYSTEM CURVED PATH FLIGHT TEST
H. N. SWENSON, J. R. HAMLIN, and G. W. WILSON Feb. 1983 21 p refs Prepared in cooperation with Army Research and Technology Lab.
(NASA-TM-85933; A-9670; NAS 1.15:85933; USAAVSCOM-TR-84-A-14) Avail: NTIS HC A03/MF A01 CSCL 17G

An ongoing series of joint NASA/FAA helicopter Microwave Landing System (MLS) flight tests was conducted at Ames Research Center. This paper deals with tests done from the spring through the fall of 1983. This flight test investigated and developed solutions to the problem of manually flying curved-path and steep glide slope approaches into the terminal area using the MLS and flight director guidance. An MLS-equipped Bell UH-1H helicopter flown by NASA test pilots was used to develop approaches and procedures for flying these approaches. The approaches took the form of Straight-in, U-turn, and S-turn flightpaths with glide slopes of 6 deg, 9 deg, and 12 deg. These procedures were evaluated by 18 pilots from various elements of the helicopter community, flying a total of 221 hooded instrument approaches. Flying these curved path and steep glide slopes was found to be operationally acceptable with flight director guidance using the MLS. Author

N84-23618# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL AVIATION TCAS (TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM) AVIONICS (GATCAS)
R. L. BRIGGS, J. DIBARTOLO, D. I. UNDERWOOD, and D. J. CALLAHAN 17 Feb. 1984 102 p
(Contract DOT-FA72WAI-877; F19628-80-C-0002)
(AD-A139145; ATC-115; DOT/FAA/RD-82/86) Avail: NTIS HC A06/MF A01 CSCL 17G

Experimental Traffic Alert and Collision Avoidance System (TCAS) avionics developed for the FAA at M.I.T. Lincoln Laboratory are described. The objective of the program under which this equipment was developed was to assess the feasibility of providing a small, low-cost unit for general aviation usage. The experimental general aviation TCAS (GATCAS) avionics incorporates a new system architecture using a microprogrammed sequencer, a 16-bit microprocessor and a low-power, solid state transmitter appropriate to the class of aircraft expected to employ GATCAS. The general aviation unit is designed to operate below 10,000 feet in densities of up to 0.02 aircraft/nmi2, and to provide a pilot warning time (TAU sub R) of 25 seconds. Assuming a track acquisition time of 10 seconds and a maximum closing speed of 300 knots, the required theoretical range of GATCAS is 3.4 nmi. The report includes (as an appendix) a cost analysis for general aviation TCAS avionics. Author (GRA)

N84-23619# Oak Ridge National Lab., Tenn.
EVALUATION OF ARCTIC TEST OF TRITIUM RADIOLUMINESCENT LIGHTING Final Report, Jan. - Feb. 1983
K. W. HAFF, J. A. THOMPKINS, and F. N. CASE Aug. 1983 65 p
(Contract AF PROJ. 2054)
(AD-A139176; AFESC/ESL-TR-83-35) Avail: NTIS HC A04/MF A01 CSCL 17G

The arctic test of radioluminescent (RL) lighting was conducted on response to the Alaskan Air Command (AAC) mission requirement for a self-sustaining airfield light system suitable for arctic deployment. The test showed durability and dependability of tritium lights. It also showed the system, as now designed, can support the operations of small, slow-moving type aircraft. For larger, faster-moving aircraft the lights offer only marginal performance and would have to be supported with other lighting aids to be totally acceptable. Author (GRA)

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A84-30424
A STRENGTH ANALYSIS OF A FAN-SHAPED WING WITH AN ALLOWANCE MADE FOR TEMPERATURE DEFORMATIONS AND CREEP DEFORMATIONS [RASHET NA PROCHNOST' VEEROOBRAZNOGO KRYLA S UCHETOM TEMPERATURNYKH DEFORMATSII I DEFORMATSII POLZUCHESTI]
IU. A. KASHFRAZIEV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 85-88. In Russian. refs

Consideration is given to an airfoil in which the spars are arranged in the shape of a fan. A thin skin covers the airfoil. Reference is made to a study by Pavlov (1972), which determined, for an elastic formulation, the stress-strain state in designs of this type. A determination of the stress-strain state that allows for temperature and creep deformations is seen as having both theoretical and practical value. The problem is considered in a physically nonlinear formulation on the assumption that there are no ribs. It is assumed that only flows of tangential forces act along the lines of contact between the skin and the spars. Another assumption is that the flow of tangential forces along the nonparallel sides of the trapezoidal skin panels changes according to the hyperbolic law discussed by Feofanov (1958). The spars with skin attached are designed to withstand bending loads. C.R.

A84-30431
A DETERMINATION OF THE PARAMETERS OF CUP-SHAPED LANDING GEAR [OPREDELENIE PARAMETROV CHASHECHNOI OPORY SAMOLETNOGO SHASSI]
A. K. CHURUSOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 105-108. In Russian.

Rounded skis which take the form of cups, concave upward, with the axis of rotation at an angle to the vertical are discussed. The point of contact between the cup and the ground is to the side of the axis of rotation. In this way, the cup rotates instead of skidding. This type of landing gear was first proposed by Voronov (1958). Owing to the flatness of the cup, contact with the ground involves only a slight depression. The cup is treated mathematically as a paraboloid. It is assumed that the pressure exerted on the cup by the ground does not vary with the depth of the depression

and that the ground is devoid of flow and elasticity parameters. The analysis shows that circular, cup-shaped skis are extremely effective in allowing the aircraft to move over the ground. C.R.

A84-30806#
WIND TUNNEL CORRELATION STUDY OF AERODYNAMIC MODELING FOR F/A-18 WING-STORE TIP-MISSILE FLUTTER
W. E. TRIPLETT (McDonnell Aircraft Co., St. Louis, MO) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 329-334. refs

Wind tunnel testing of the F/A-18 wing with underwing stores and tip missile discovered several cases of flutter for which acceptable correlation was not obtained by adjustment of stiffness and mass. Studies were conducted to evaluate the effect of aerodynamic modeling on three of the uncorrelated cases using the doublet-lattice theory. Results are presented showing the effect of individual system components on flutter. Acceptable correlation is shown for total models of the wing-rack-store-missile configuration, although models with air acting on the missile but not on the underwing store are also satisfactory. Author

A84-30948
BUSINESS TWIN TURBOPROPS - A WIDER, BUT MORE COMPLEX, CHOICE
M. GRANGIER Interavia (ISSN 0020-5168), vol. 39, April 1984, p. 305-308.

A discussion is conducted concerning the design features and comparative performance advantages of current advanced and next-generation twin-engine turboprop general aviation and commuter aircraft. Several of the next-generation craft employ pusher propeller canard configurations for aerodynamic efficiency, and incorporate advanced composite primary structure components. Attention is given to passenger accomodations and projected cruise speeds and ranges for a given level of fuel consumption. O.C.

A84-31307
ADVANCED COCKPIT DESIGNS FOR HELICOPTERS
S. D. ROY (Westland Helicopters, Ltd., Yeovil, England) Future, Winter 1983, p. 2-10.

Progress in the development of the next generation of helicopter cockpits is discussed. The design strategy guiding research and development of helicopter cockpits is to improve the interface between the pilot and aircraft instrumentation, and to reduce costs. The areas of electronic display, data entry and extraction and voice control are currently the most active areas of flight simulator studies. Rugged shadow mask CRT tubes are being developed to provide full-color electronic display with rasters for shadowing particular display areas or radar symbology. A multifunction control and display unit is considered which will be software programmable, increasing control flexibility and reducing cockpit clutter. A hardware preprocessor is described which compresses speech input into a series of phonetic features. These features are then matched to a set of commands stored in the memory of a 16-bit microprocessor which carries out the desired control command. In a series of color diagrams different cockpit design configurations for both military and civilian aircraft in the 1990's are presented. Flat panel displays attached to the seats are expected to replace interseat and overhead consoles, thus simplifying the activity of the pilot and reducing cost. I.H.

A84-31308
THE MODAL APPROACH TO STRUCTURAL MODIFICATION
S. P. KING (Westland Helicopters, Ltd., Yeovil, England) Future, Winter 1983, p. 11-19. refs

An algorithm has been developed which estimates the changes to the normal modes and natural frequencies of a system when modified by the addition of mass, stiffness or mass-spring absorbers. New modes are expressed as linear combinations of datum modes, thereby permitting a determination of the degree of coupling introduced by the structural change. Results from a two-dimensional lumped parameter model with 39 modes and a large finite-element test case are compared with those of the algorithm and are found to be in satisfactory agreement. The algorithm was also used to estimate the effect of fitting a dynamic absorber to the main rotor head of a Westland 30 helicopter. In a comparison with flight test data for the helicopter with and without the absorber fitting, it was found that while there were some discrepancies between theoretical and flight test results, the algorithm was generally useful in assessing the effectiveness of dynamic absorbers. I.H.

A84-31316
ADVANCEMENTS IN THE AERODYNAMIC INTEGRATION OF ENGINE AND AIRFRAME SYSTEMS FOR SUBSONIC AIRCRAFT
J. T. KUTNEY (General Electric Co., Fairfield, CT) International Journal of Turbo and Jet-Engines, vol. 1, no. 1, 1983-1984, p. 29-43.

A comparative study is conducted for the relative aerodynamic advantages or penalties of subsonic aircraft wing- and fuselage-mounted nacelle installations. Both short duct and long duct nacelles are considered, and theoretical treatments for the phenomenon of interference drag are compared with wind tunnel data which illustrate the importance of such diagnostic test results in the isolation of the integration problem and the reduction of installed drag. Attention is given to parasitic drag component breakdowns for engine core cowl, pylon scrubbing, and plug scrubbing, as well as external friction and pressure drag, together with the phenomena of nacelle-fuselage and nacelle-wing channel flow areas and interference drag. O.C.

A84-31334
HELICOPTERS ADAPT TO MULTIPLE BATTLEFIELD NEEDS
Defense Systems Review and Military Communications, vol. 1, Oct. 1983, p. 35-38.

The U.S. Army is scheduled to have over 1500 attack helicopters by the end of fiscal year 1988; two-thirds of this force will consist of AH-1S Cobra helicopters. The Cobra will be modified in the coming years to conform with NATO commonality requirements, in the form of the PAH-2 antitank helicopter variant. The multimission helicopter for the period in question will be the UH-60A Black Hawk. Future developments encompass the Light Helicopter Family, designated LHX, which is expected to take the form of a tilt-rotor aircraft configuration. Other advanced helicopter technology development programs are discussed. O.C.

A84-31335
SELF-DESTRUCTING DRONE DESIGN COSTS CHALLENGE ENGINEERS
M. L. HILL (Johns Hopkins University, Baltimore, MD) and M. TAYLOR (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) Delft Systems Review and Military Communications, vol. 1, Nov. 1983, p. 32-35. Navy-Army-supported research.

The small drone designated 'AIR-EXJAM' is being developed to perform electronic countermeasures missions in a land warfare environment, transporting a 10-15 lb payload to a predesignated area forward of the battle line and hovering there for up to 2 hr. The dash to target area and loiter phases of the mission respectively use dead reckoning and RF direction-finding navigation. The AIR-EXJAM airframe is of delta flying wing configuration and employs polystyrene foamcore sandwich construction. O.C.

A84-31691#
EVALUATION OF FLUTTER IMPACT FOR REPAIRED T-38 STABILIZERS
H. C. BRIGGS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 67-72. refs
(AIAA PAPER 84-0904)

The results of application of the NASTRAN flutter analysis to repaired T-38 horizontal stabilizers are presented. Verification and

tuning of the structural and aerodynamic models was accomplished using multiple sets of experimental data and advanced optimization techniques. Several repairs within the current field level repair limits were evaluated for their effect and none were found to significantly lower the computed flutter speed. Discussions of the novel and difficult features of the problem as well as the major assumptions are presented. Author

A84-31695#
LIMIT CYCLE OSCILLATIONS OF A NONLINEAR ROTORCRAFT MODEL
B. TONGUE (Georgia Institute of Technology, Atlanta, GA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 102-111. refs
(Contract NSF MEA-81-19883)
(AIAA PAPER 84-0923)

The limit cycle behavior of a rotorcraft model having a nonlinear damping characteristic is examined. The effect of parameter variations on the system's response is discussed and differences between a linear and nonlinear model are presented. It is shown that, for the model examined, the nonlinear analysis yields qualitatively different results from the linear case. Author

A84-31713*# California Univ., Los Angeles.
UNSTEADY AERODYNAMICS IN TIME AND FREQUENCY DOMAINS FOR FINITE TIME ARBITRARY MOTION OF ROTARY WINGS IN HOVER AND FORWARD FLIGHT
M. A. H. DINYAVARI and P. P. FRIEDMANN (California, University, Los Angeles, CA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 266-282. refs
(Contract NAG2-209)
(AIAA PAPER 84-0988)

Several incompressible finite-time arbitrary-motion airfoil theories suitable for coupled flap-lag-torsional aeroelastic analysis of helicopter rotors in hover and forward flight are derived. These theories include generalized Greenberg's theory, generalized Loewy's theory, and a staggered cascade theory. The generalized Greenberg's and staggered cascade theories were derived directly in Laplace domain considering the finite length of the wake and using operational methods. The load expressions are presented in Laplace, frequency, and time domains. Approximate time domain loads for the various generalized theories, discussed in the paper, are obtained by developing finite state models using the Pade approximant of the appropriate lift deficiency functions. Three different methods for constructing Pade approximants of the lift deficiency functions were considered and the more flexible one was used. Pade approximants of Loewy's lift deficiency function, for various wake spacing and radial location parameters of a helicopter typical rotor blade section, are presented. Author

A84-31776#
LONGITUDINAL STABILITY ANALYSIS OF ELASTIC VEHICLES
S. CHEN, X. CHEN, H. YAN, and X. HUO Northwestern Polytechnical University, Journal, vol. 2, Jan. 1984, p. 1-11. In Chinese, with abstract in English. refs

Longitudinal stability problems of elastic vehicles are studied taking the effect of aeroelasticity into account. Transfer functions and equations for longitudinally disturbed motion in elastic vehicles are obtained for the first, second, and third elastic modes. The effect of aeroelasticity on the longitudinal stability of the vehicle is discussed, and a method for choosing the proper gyro position is proposed. Finally, the aeroelastic effect on the values of aerodynamic derivatives is estimated. C.D.

A84-32471#
AEROMECHANICAL ASPECTS IN THE DESIGN OF HINGELESS/BEARINGLESS ROTOR SYSTEMS
V. KLOEPPEL, K. KAMPA, and B. ISSELHORST (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) Associazione Industrie Aerospaziali and Associazione Italiana di Aeronautica ed Astronautica, European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983, Paper. 26 p. refs
(MBB-UD-403-83-OE)

Theoretical models are used in a discussion of the pronounced torsion-flap-lag coupling shown by hingeless/bearingless rotors which significantly influences general aeromechanical characteristics of the helicopter. The analysis uses an equivalent system technique, where the position of the blade relative to the control axis is determined with the help of the blade-to-beam angle, Beta-BB. Because the built-in value of this parameter may change elastically depending on flight condition, the actual size of the effective Beta-BB has to be estimated beforehand using a specialized beam theory or finite element method. In the design stage, Beta-BB and the control stiffness provide pitch-lag coupling which can be used to increase the lead-lag damping in the rotating and in the fixed system for ground and air resonance conditions. Theoretical results are verified by whirl tower and flight test data for the BO105 hingeless rotor and the bearingless tail rotor on BK117. J.N.

A84-32473#
HELICOPTER PERFORMANCE EVALUATION FOR CERTIFICATION
H. HUBER and G. POLZ (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) Associazione Industrie Aerospaziali and Associazione Italiana di Aeronautica ed Astronautica, European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983, Paper. 22 p.
(MBB-UD-401-83-OE)

Helicopter performance criteria are considered, with emphasis on areas of performance that pertain to FAA certification. Analytical methods and simulation models are described for determining helicopter performance while hovering, climbing, at takeoff, at landing, and in the limiting height-speed envelope (HV-diagram). Major influential parameters such as gross weight, altitude, and temperature effects are discussed, and a correlation is made between calculated data and flight test results over a wide range of ambient conditions for different helicopters. It is found that the calculated data are in good agreement with the flight test results, and that the simulation method presented for determining helicopter performance in height-speed envelopes (HV-diagram) is valid over an extended range of conditions. It is expected that the empirical methods will be a suitable means of evaluating helicopter performance for FAA certification. I.H.

A84-32474#
STRUCTURAL AND DYNAMIC TAILORING OF HINGELESS/BEARINGLESS ROTORS
G. SEITZ and G. SINGER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) Associazione Industrie Aerospaziali and Associazione Italiana di Aeronautica ed Astronautica, European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983, Paper. 23 p. refs
(MBB-UD-404-83-OE)

This paper presents a realization of a concept for bearingless main and tail rotors by using special fibreglass flexural torsion-bending elements. The dynamic and structural requirements concerning the torsional stiffness as well as the stiffness inplane and out-of-plane of the rotor are discussed in detail. Special analytical and experimental activities were carried out for the development of flexible elements, blade lead-lag elastometric dampers, hub design with composite materials, pitch control system and blade attachment. Theoretical solutions and test results for a four-bladed main and tail rotor are reported and critically compared. Author

A84-32490
ROTATING AERODYNAMIC EXCITER [EXCITATEUR AERODYNAMIQUE ROTATIF]
B. PENNACCHIONI (Centre d'Essais en Vol, Base d'Essais d'Istres, Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 21 p. In French.
(AAAF PAPER NT 83-22)

Preliminary results on an excitation system for light-aircraft airborne flutter tests are reported. The device developed comprises a small vane rotating at constant speed about its span axis and mounted on the aircraft via a set of force gages. The effectiveness of the exciter is demonstrated by measurements of the alternating forces and torques, using a T-33 aircraft as the test bed; but further analysis and experimentation are considered necessary to elucidate the physical mechanisms responsible for the unusual aerodynamic phenomena observed. T.K.

A84-32689#
ACTIVE LANDING GEAR SMOOTHS THE RIDE
V. WIGOTSKY Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 42-44.

An active landing gear that can reduce gear-induced fatigue damage is described. The gear uses a servo loop and microprocessor to reduce impact loads transmitted to the wings as an aircraft lands. The microprocessor converts the aircraft's sink rate into vertical kinetic energy and compares it to the amount of energy the gear can absorb. Taken from a 3000 kg twin-engine general aviation aircraft, the gear has a stroke of 9 in., of which the control is set to use 85 percent or 7.6 in. Tests on ground rigs have demonstrated 9 to 32 percent reduction in transmitted impact loads compared to a passive gear, and improvement is greater at higher sink speeds. It is estimated that active landing gear control could reduce gear-induced fatigue damage by as much as 90 percent. I.H.

A84-32691#
HISTORY BENEFITS NEXT-GENERATION FIGHTER DESIGN
A. J. CHAPUT (General Dynamics Corp., Fort Worth, TX) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 48-52.

Design requirements for the next generation of fighter aircraft are discussed with respect to pilot compatibility and weapon effectiveness on the basis of comparisons drawn from the loss-exchange ratios of the major air battles of the last 15 years. It is predicted that the fighter aircraft designs of the future will build on the pilot compatible qualities of the F-15 and the F-16; training costs will be lowered as the aircraft will be easier to fly; and sensor integration and maneuver tolerant cockpits will increase the pilots' ability to manage information. Weapon effectiveness which includes reliability, post launch independence, launch-parameter expansion, and conformal weapons systems are viewed as the second most important design consideration. Also, speed and directability will be important, but primarily so in their expansion of the capabilities of the pilot. I.H.

A84-32692#
F-15E - DUAL-ROLE FIGHTER
D. BANHOLZER (USAF, Washington, DC) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 54-58.

The design modifications incorporated in the latest version of the F-15 fighter aircraft (F-15E) are discussed. Th F-15E is a dual-role, multimission aircraft capable of round-the-clock operation in all weather environments. Low Altitude Navigation and Targeting for Night (LANTIRN) and High Resolution Radar (HRR) mapping systems are expected to satisfy requirements for long range precision and targeting and lethal weapon delivery at night. Conformal Fuel Tanks (CFTs) will increase the unrefueled ferry range of the aircraft by 50 percent over the F-15D. CFTs also increase weapons carriage space, allowing the aircraft to take advantage of new Advanced Medium Range Air-to-Air Missile (AMRAAM) and AIM Sidewinder missile systems. A missionized cockpit makes the aircraft easier to fly at night, and wide view of field displays provide 'head-up' visibility. I.H.

A84-32695#
AUTOMATING TACTICAL-FIGHTER COMBAT
D. W. MILAM (USAF, Washington, DC) and F. R. SWORTZEL (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 68-70.

Developments in the Advanced Fighter Technology Integration (AFTI/F-16) program of the USAF are discussed. The object of the program is to develop technologies to improve lethality, increase survivability and decrease pilot workload in a F-16 testbed aircraft. Integrated Digital Flight Control System (DFCS) technology and Automated Maneuvering Attack Systems (AMAS) are the main areas of research. In tests on a quadruplex DFCS, it was found that the system offers major improvements in capabilithy without compromising aircraft size, weight, and performance, and can reduce lifecycle cost by as much as 20 percent, compared to a triplex digital control system. Automated Maneuvering Attack Systems integrate software for attack sensors, fire control, pilot/vehicle interface, and weapons interface. The system is structured around three Mil-Std 1553 digital multiplex buses (MUX) and provides subsystem communications for Avionics (AMUX), Display (DMUX), and Weapons (WMUX). The operation of the system in the testbed aircraft is expected to provide valuable experience for engineers designing highly integrated control systems for fighter aircraft. I.H.

A84-32697*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ENERGY EFFICIENT TRANSPORT - TECHNOLOGY IN HAND
D. B. MIDDLETON, D. W. BARTLETT, and R. V. HOOD (NASA, Langley Research Center, Hampton, VA) Aerospace America (ISSN 0740-722X), vol. 22, May 1984.

Technologies developed through NASA's Energy Efficient Transport Program are described. The program was charged with research in advanced aerodynamics and active controls, with the goal of increasing the fuel efficiency of transport aircraft by 15 to 20 percent. Research in aerodynamics was directed toward the development of high-aspect-ratio supercritical wings, winglets, computational design methodology, high-lift devices, propulsion airframe integration, and surface coatings. The active control portion of the program investigated Wing Load Alleviation (WLA) through the use of active controls, drag reduction, and the effect of active pitch controls on fuel consumption. It was found that applying active control functions at the beginning of the aircraft design cycle brings the best benefit, and that if active control and advanced aerodynamic airframe configurations are applied to transport aircraft design concurrently with new lightweight materials, fuel consumption can be reduced by as much as 40 percent. I.H.

A84-32874
INDIANS FROM ARIZONA
Air International (ISSN 0306-5634), vol. 26, May 1984, p. 224-228; 248-252.

The Advanced Attack Helicopter program was begun immediately after the Army canceled development of the AH-56A Cheyenne. Rather than providing aerial fire support, the helicopter was to be deisgned for antiarmor attack. The AH-64A (Apache) has been designed to operate during the day and at night. It can also operate in adverse weather conditions. It can strike an enemy target with high accuracy and can be easily maintained in the field. Design specifications are given, and the development program is traced. C.R.

A84-32875
HIND - OVERPOWERING OR OVERRATED?
Air International (ISSN 0306-5634), vol. 26, May 1984, p. 229-232; 251, 252.

It is emphasized that the Soviet Mil Mi-24 assault support helicopter is not an optimized attack vehicle in the western sense

of the term. It has no equivalent and is in a class by itself. Conceived as a battlefield helicopter with a variety of roles, its design was strongly influenced by a troop-carrying task. A primary mission requirement was the ability to deposit an eight-member combat team in the enemy's rear. The ordnance carried was to be sufficient to clear a path through obstacles en route to its landing zone. The design team, headed by Marat N. Tishchenko, consciously sacrificed agility and good low-speed and hover performance in order to achieve maximum possible speed and enhanced survivability. Eventually, however, the primary requirement became that of attack, with troop-carrying capability relegated to a secondary role. The Mi-24 was restyled as a full-capability assault support platform, but its basic design was not changed. Specifications of the Hind-E are given, and the various versions of the Hind are described. C.R.

A84-32964
SIMULATION OF THE AEROELASTIC PROPERTIES OF AIRCRAFT [SIMULACE AEROELASTICKYCH VLASTNOSTI LETADEL]
Z. SKODA and V. PREJZEK Zpravodaj VZLU (ISSN 0044-5355), no. 6, 1983, p. 271-277. In Czech. refs

A method is proposed for the computer simulation of the motion of an elastic aircraft. Aerodynamic data for the simulation are obtained by determining the aerodynamic transition characteristics. The approach proposed here yields sufficiently accurate results in a relatively short period of time. The method is illustrated by an example in which the first two natural vibration modes of a wing and a combination of its four natural vibration modes are computed for the symmetric and antisymmetric cases. V.L.

A84-32967
FLIGHT TEST AND MANAGEMENT OF A CONTRACTOR-DEVELOPED FIGHTER THE F-20 TIGERSHARK
A. P. METZ (Northrop Corp., Los Angeles, CA) Cockpit (ISSN 0742-1508), vol. 19, Jan.-Feb.-Mar. 1984, p. 5-20.

Attention is given to the flight test research management practices brought to bear on the F-20 derivative of the F-5 series of fighter aircraft. The F-20's novel features include integrated all-digital avionics, 'shark' radome contours, a wing inboard leading edge extension, maneuvering flaps, and a single engine which is more powerful than the combined (two-engine) thrust characteristic of the F-5. Flight test objectives were primarily to establish the safety of F-20 operation by pilots having no previous F-5 experience, the identification of potential problem areas with the novel design features, and the verification of the operation of all systems. Handling qualities have in due course been verified to 30 deg angle-of-attack. O.C.

A84-32968
DESIGN GUIDELINES AND FLIGHT TEST COMMENTS XH-16
L. J. LAVASSAR Cockpit (ISSN 0742-1508), vol. 19, Jan.-Feb.-Mar. 1984, p. 21-26.

Attention is given to the development history and design validation flight testing of the XH-16 long range search and rescue helicopter, with emphasis on the operational restrictions and advantages associated with the unprecedentedly large dimensions of this rotorcraft. Exceptional handling characteristics in gusts due to aircraft inertia, and low airframe vibration levels despite the absence of vibration isolation devices, were noted during the flight test program. This experimental aircraft was lost in a crash due to faulty instrumentation. O.C.

A84-33137*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TECHNOLOGY DEVELOPMENTS FOR LAMINAR BOUNDARY LAYER CONTROL ON SUBSONIC TRANSPORT AIRCRAFT
R. D. WAGNER, D. V. MADDALON, and M. C. FISCHER (NASA, Langley Research Center, Hampton, VA) NATO, AGARD, Symposium on Improvement of Aerodynamic Performance Through Boundary Layer Control and High Lift Systems, Brussels, Belgium, May 21-23, 1984, Paper. 14 p. refs

The development of laminar-flow technology for commercial transport aircraft is discussed and illustrated in a review of studies undertaken in the NASA Aircraft Energy Efficiency (ACEE) program since 1976. The early history of laminar-flow-control (LFC) techniques and natural-laminar-flow (NLF) airfoil designs is traced, and the aims of ACEE are outlined. The application of slotted structures, composites, and electron-beam-perforated metals in supercritical LFC airfoils, wing panels, and leading-edge systems is examined; wind-tunnel and flight test results are summarized; studies of high-altitude ice effects are described; and hybrid LFC/NLF designs are characterized. Drawings and photographs are provided. T.K.

N84-22551* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SLOTTED VARIABLE CAMBER FLAP Patent
D. G. ANDREWS, inventor (to NASA) (Boeing Commercial Airplane Co., Seattle) 24 Apr. 1984 8 p Filed 30 Oct. 1981 Sponsored by NASA
(NASA-CASE-LAR-12541-1; US-PATENT-4,444,368; US-PATENT-APPL-SN-315588; US-PATENT-CLASS-244-216; US-PATENT-CLASS-244-215; US-PATENT-CLASS-244-219; US-PATENT-CLASS-244-212) Avail: US Patent and Trademark Office CSCL 01C

Variable camber actuator assemblies broaden the range of speeds at which lift to drag performance is maximized for slotted flap wings. Lift is improved over a broader range of cruising speeds by varying wing camber with rotational flap movements that do not introduce wing slots and induced drag. Forward flaps are secured to forward flange links which extended from, and are a part of forward flap linkage assemblies. The forward flaps rotate about flap pivots with their rotational displacement controlled by variable camber actuator assemblies located between the forward flaps and the forward flange links. Rear flaps are held relative to the forward flaps by rear flap linkage assemblies which may act independently from the forward flap linkage assemblies and the variable camber actuator assemblies. Wing camber is varied by rotating the flaps with the variable camber actuator assemblies while the flaps are in a deployed or tucked position. Rotating the flaps in a tucked position does not introduce significant wing surface discontinuities, and reduces aircraft fuel consumption on most flight profiles.

Official Gazette of the U.S. Patent and Trademark Office

N84-22552 North Carolina State Univ., Raleigh.
MODEL IDENTIFICATION AND PARAMETER ESTIMATION OF THE POWER, LIFT, AND DRAG OF LIGHT AIRCRAFT FROM A SINGLE MANEUVER Ph.D. Thesis
B. E. KARLIN 1983 195 p
Avail: Univ. Microfilms Order No. DA8402105

The development and implementation of a procedure to extract power, drag, and lift from a single dynamic aircraft maneuver is presented. The procedure was tested for simulated and real data. Difficulties due to ill-conditioning, noise, and data incompatibility required incorporating in the procedures algorithms to identify and deal with these problems. The simulated data was corrupted with errors, showing that the procedure can handle data with noise and inconsistencies. The experimental dataset exhibited some distinct extraneous signals. Some of these signals cannot be removed from the dataset, and since they are not part of the aircraft dynamics, they distort the process to the point where elaborate models cannot be identified. The procedure gives good results for simplified models. Dissert. Abstr.

N84-22553*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT AND ANALYSIS OF A STOL SUPERSONIC CRUISE FIGHTER CONCEPT
S. M. DOLLYHIGH, W. E. FOSS, JR., S. J. MORRIS, JR., K. B. WALKLEY (Kentron International, Inc., Hampton, Va.), E. E. SWANSON (Kentron International, Inc., Hampton, Va.), and A. W. ROBINS (Kentron International, Inc., Hampton, Va.) Mar. 1984 86 p refs
(NASA-TM-85777; NAS 1.15:85777) Avail: NTIS HC A05/MF A01 CSCL 01C

The application of advanced and emerging technologies to a fighter aircraft concept is described. The twin-boom fighter (TBF-1) relies on a two dimensional vectoring/reversing nozzle to provide STOL performance while also achieving efficient long range supersonic cruise. A key feature is that the propulsion package is placed so that the nozzle hinge line is near the aircraft center-of-gravity to allow large vector angles and, thus, provide large values of direct lift while minimizing the moments to be trimmed. The configurations name is derived from the long twin booms extending aft of the engine to the twin vertical tails which have a single horizontal tail mounted atop and between them. Technologies utilized were an advanced engine (1985 state-of-the-art), superplastic formed/diffusion bonded titanium structure, advanced controls/avionics/displays, supersonic wing design, and conformal weapons carriage. The integration of advanced technologies into this concept indicate that large gains in takeoff and landing performance, maneuver, acceleration, supersonic cruise speed, and range can be acieved relative to current fighter concepts. Author

N84-22554# Texas Univ., Austin. Austin Dept. of Mechanical Engineering.
QUANTIFICATION OF SUBJECTIVE RATINGS THROUGH CONJOINT MEASUREMENT ANALYSIS Final Report
D. E. GREENE 8 Nov. 1983 39 p
(Contract AF-AFOSR-0220-82; AF PROJ. 2313)
(AD-A138810; AFOSR-84-0126TR) Avail: NTIS HC A03/MF A01 CSCL 01B

Conjoint measurement theory is examined through a prototype example in which a fighter aircraft is subjectively rated on two factors. As a first step, a multifactor ordinal scale is developed. This ordinal scale provides a meaningful measure of aircraft quality. Interval scales of aircraft quality are produced by the basic analysis of variance model and two conjoint measurement methods: delta scaling and the computer algorithm MONANOVA. These methods produce interval scales that differ by constant factors, as guaranteed by the theorem for additive conjoint measurement. The interval scale does not appear to be an improvement over the ordinal scale in the prototype example. There is no assurance that a specific conjoint measurement model can be used to improve the data. Major changes in the interval scales are caused by small perturbations in the rating matrix. Author (GRA)

N84-22555# Dayton Univ., Ohio. Research Inst.
A REVIEW STUDY OF NONDESTRUCTIVE TEST TECHNIQUES FOR RESIDUAL STRESSES IN AIRCRAFT TRANSPARENCIES Final Technical Report, Jun. - Dec. 1982
B. B. RAJU Wright-Patterson AFB, Ohio AFWAL Jan. 1984 88 p
(Contract F33615-80-C-3401; AF PROJ. 1926)
(AD-A138930; UDR-TR-83-70; AFWAL-TR-83-3108) Avail: NTIS HC A05/MF A01 CSCL 14B

The main objectives of this program are to conduct review studies on candidate nondestructive test techniques for determining residual stresses in aircraft transparencies; identify and recommend nondestructive test techniques having potential for further laboratory development and field use. The program consisted of three primary tasks: a comprehensive general literature review of over 150 publications on holography, X-rays, moire', scattered-light, thermal methods, ultrasonic techniques, acoustic emission, magneto-photoelasticity, integrated photoelasticity, laser diffraction, and eddy current techniques; a detailed literature review on scattered light photoelasticity, ultrasonic technique 1 based on the Rayleigh surface waves, ultrasonic technique 2 based on the ultrasonic energy reflection at a liquid-solid interface magneto-photoelasticity, and laser diffraction; detailed review studies on scattered-light techniques and ultrasonic techniques 1 and 2. The studies revealed that the basic principles and experimental procedure of ultrasonic technique 1 based on Rayleigh surface waves is fairly well developed. GRA

N84-22556# Naval Postgraduate School, Monterey, Calif.
EDUCATIONAL AIDS IN AIRCRAFT COMBAT SURVIVABILITY M.S. Thesis
P. G. COX Dec. 1983 156 p
(AD-A139090) Avail: NTIS HC A08/MF A01 CSCL 05I

This thesis presents four additions prepared for the textbook 'The Fundamentals of Aircraft Combat Survivability Analysis and Design' by Professor Robert E. Ball. A set of homework problems with solutions was developed for the textbook to provide the user with a means of measuring student progress. An index, a lexicon of terminology, and a formulary were also developed to enhance the usability of the textbook. GRA

N84-23574# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
GROUND/FLIGHT TEST TECHNIQUES AND CORRELATION
P. POISSON-QUINTON *In* Agard Wind Tunnels and Testing Tech. 14 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

Wind-tunnel usefulness and shortcomings during the development of a new Aircraft Project are discussed, taking into account progress on wind tunnel validity and cost/effectiveness, on the increasing role of the computer in the loop, and on the competition between computational fluid dynamics and wind-tunnel approaches for aerodynamic characteristics prediction. Lastly, the new role of the wind-tunnel in the Aircraft is advocated. R.J.F.

N84-23589# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.
TEST TECHNIQUES FOR JET EFFECTS ON FIGHTER AIRCRAFT
E. A. PRICE, JR. and W. L. PETERS *In* AGARD Wind Tunnels and Testing Tech. 17 p Feb. 1984 refs Sponsored by AEDC
Avail: NTIS HC A22/MF A01

Efforts to improve test techniques for jet effects on fighter type aircraft are described. Defining the levels of aerodynamic interference on aircraft afterbodies from three types of model support systems, a prediction technique for hot jet effects on afterbody drag, and a hot versus cold jet experiment on target type thrust reversers is summarized. Support system interference from a strut, sting, and wingtip support on the afterbody axial force of the same jet effects model are compared over the Mach number range from 0.6 to 1.5. A technique for predicting hot jet effects on afterbody drag from ambient temperature jet data is presented and evaluated at Mach numbers 0.6, 0.9, and 1.2. Two distinctly different flow regimes characterized by flow attached to or detached from the surface of the afterbody are shown. Significant differences were found in the conditions for flow attachment for the hot and cold jet flows. E.A.K.

N84-23597# British Aerospace Aircraft Group, Brough (England).
THE ACCELERATED LIGHT MODEL TECHNIQUE OF STORE SEPARATION AS DEVELOPED AND USED AT BRITISH AEROSPACE, BROUGH
R. E. BURNS *In* AGARD Wind Tunnels and Testing Tech. 12 p Feb. 1984
Avail: NTIS HC A22/MF A01

The light model technique developments for use in the Brough High Speed Wind Tunnel, which succeeded in producing a reliable and practical method of virtually eliminating errors due to the usual compromises are examined. The theoretical concepts are described in detail, and results from a typical wind tunnel jettison test are

presented. The method employed is light model scaling, with parent model acceleration to compensate for the gravitational deficiency inherent in this technique. A detailed analysis of residual errors in simulation has led to a method of minimizing the most significant of these (i.e. induced incidence deficiency), which has now been incorporated into the techniques. M.A.C.

N84-23620*# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
A STUDY OF AEROELASTIC AND STRUCTURAL DYNAMIC EFFECTS IN MULTI-ROTOR SYSTEMS WITH APPLICATION TO HYBRID HEAVY LIFT VEHICLES Final Report, 1981 - 1983
P. P. FRIEDMANN Apr. 1984 12 p
(Contract NAG2-116)
(NASA-CR-173505; NAS 1.26:173505) Avail: NTIS HC A02/MF A01 CSCL 01C

An aeroelastic model suitable for the study of aeroelastic and structural dynamic effects in multirotor vehicles simulating a hybrid heavy lift vehicle was developed and applied to the study of a number of diverse problems. The analytical model developed proved capable of modeling a number of aeroelastic problems, namely: (1) isolated blade aeroelastic stability in hover and forward flight, (2) coupled rotor/fuselage aeromechanical problem in air or ground resonance, (3) tandem rotor coupled rotor/fuselage problems, and (4) the aeromechanical stability of a multirotor vehicle model representing a hybrid heavy lift airship (HHLA). The model was used to simulate the ground resonance boundaries of a three bladed hingeless rotor model, including the effect of aerodynamic loads, and the theoretical predictions compared well with experimental results. Subsequently the model was used to study the aeromechanical stability of a vehicle representing a hybrid heavy lift airship, and potential instabilities which could occur for this type of vehicle were identified. The coupling between various blade, supporting structure and rigid body modes was identified. M.A.C.

N84-23621*# Kentron International, Inc., Hampton, Va. Aerospace Technologies Div.
APPLICATION OF NEAR-TERM TECHNOLOGY TO A MACH 2.0 VARIABLE-SWEEP-WING, SUPERSONIC-CRUISE EXECUTIVE JET
F. L. BEISSNER, JR., W. A. LOVELL, A. W. ROBINS, and E. E. SWANSON Mar. 1984 60 p refs
(Contract NAS1-16000)
(NASA-CR-172321; NAS 1.26:172321) Avail: NTIS HC A04/MF A01 CSCL 01C

The impact of variable sweep wing technology with relaxed static stability requirements on a supersonic-cruise executive jet with transatlantic range was assessed. The baseline vehicle utilized modified, current-technology engines and titanium structures produced with superplastic forming and diffusion bonding; this vehicle meets study requirements for both supersonic-cruise and low-speed characteristics. The baseline concept has a ramp weight of 64,500 pounds with a crew of two and eight passengers. Its Mach 2.0 cruise range is nearly 3,500 nautical miles; its Mach 0.9 cruise range is over 5,000 nautical miles. Takeoff, landing, and balanced field length requirements were calculated for a composite variant and are all less than 5,000 feet. Author

N84-23622*# National Aeronautics and Space Administration, Washington, D. C.
AERODYNAMIC CHARACTERISTICS OF THE 40- BY 80/80-BY 120-FOOT WIND TUNNEL AT NASA AMES RESEARCH CENTER
V. R. CORSIGLIA, L. E. OLSON, and M. D. FALARSKI Apr. 1984 25 p refs Previously announced in IAA as A84-25728
(NASA-TM-85946; A-9675; NAS 1.15:85946) Avail: NTIS HC A02/MF A01 CSCL 14B

The design and testing of vane sets and air-exchange inlet for the 40 x 80/80 x 120-ft wind tunnel at NASA Ames are reported. Boundary-layer analysis and 2D and 3D inviscid panel codes are employed in computer models of the system, and a 1/10-scale 2D facility and a 1/50-scale 3D model of the entire wind tunnel are used in experimental testing of the vane sets. The results are presented in graphs, photographs, drawings, and diagrams are discussed. Generally good agreement is found between the predicted and measured performance. T.K. (IAA)

N84-23623*# National Aeronautics and Space Administration, Washington, D. C.
DEVELOPMENT OF MCAERO WING DESIGN PANEL METHOD WITH INTERACTIVE GRAPHICS MODULE Final Report
J. D. HAWK and D. R. BRISTOW Washington NASA Apr. 1984 40 p refs
(Contract NAS1-17176)
(NASA-CR-3775; NAS 1.60:3775) Avail: NTIS HC A03/MF A01 CSCL 01C

A reliable and efficient iterative method has been developed for designing wing section contours corresponding to a prescribed subcritical pressure distribution. The design process is initialized by using MCAERO (MCAIR 3-D Subsonic Potential Flow Analysis Code) to analyze a baseline configuration. A second program DMCAERO is then used to calculate a matrix containing the partial derivative of potential at each control point with respect to each unknown geometry parameter by applying a first-order expansion to the baseline equations in MCAERO. This matrix is calculated only once but is used in each iteration cycle to calculate the geometry perturbation and to analyze the perturbed geometry. The potential on the new geometry is calculated by linear extrapolation from the baseline solution. This extrapolated potential is converted to velocity by numerical differentiation, and velocity is converted to pressure by using Bernoulli's equation. There is an interactive graphics option which allows the user to graphically display the results of the design process and to interactively change either the geometry or the prescribed pressure distribution. B.W.

N84-23624# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
USE OF HELICOPTERS TO DEVELOP OPERATIONAL CONCEPTS FOR V/STOL (VERTICAL AND SHORT TAKEOFF AND LANDING) AIRCRAFT IN NAVAL MISSIONS Final Report
P. S. MONTANA Aug. 1983 20 p
(AD-A139354; DTNSRDC/ASED-83/07) Avail: NTIS HC A02/MF A01 CSCL 01C

Vertical and short takeoff and landing (V/STOL) aircraft promise new operational capabilities for the Navy. In the past, new vehicle types have been slow in gaining acceptance because of the difficulty in visualizing how these new vehicles should be employed. Once built, experience gained with the vehicle evolved into an operational concept exploiting its best qualities. Now, competition for fiscal resources has reached a level from which it may be difficult to justify the development of any new vehicle without having a well-defined operational concept in hand. This report discusses the use of existing large helicopters to develop operational concepts for V/STOL in naval applications. Author (GRA)

N84-23625# BDM Corp., McLean, Va.
DARPA (DEFENSE ADVANCED RESEARCH PROJECTS AGENCY) AIR VEHICLES TECHNOLOGY OFFICE TECHNICAL TASK ORDER CONTRACT Final Technical Report
31 Aug. 1983 11 p
(Contract MDA903-83-C-0103; ARPA ORDER 4295)
(AD-A138887; BDM/W-83-319-TR) Avail: NTIS HC A02/MF A01 CSCL 15C

This task entailed assessing the applicability of third generation cruise missile technology to future Naval weapons systems and identifying the potential payoff of selected technology programs. This task investigated the technical feasibility of employing aerostats as platforms for surveillance radars to detect low-flying aircraft for AFSOUTH. This task assessed the state of ongoing programs relating to display and sensor technologies which might be applicable to close combat vehicles. This task continues work for the Critical Nodes Program, determining the appropriate munitions that are to be used against critical nodes. It emphasizes current, highest priority critical nodes. In order to fully evaluate various candidate technologies for passively detecting and tracking

low-altitude, low-radar cross-section targets using various classes of illumination, a comprehensive program plan is needed. This task involved preparing a plan to identify gaps and present alternatives for evaluating the tactical potential of the class of systems under consideration. This task encompassed identifying emerging technologies which are applicable to Army equipments to provide product improvements or enhancements with substantial payoffs in increased mission-related performance. There have been a number of major DARPA programs assessed prior to initiation to determine their worth. This task entails assessing the technical and related management risks of projected DARPA Air Vehicles programs. GRA

N84-23626# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
STATUS REPORT OF THE PROGRAMS [STATUSBEREICHT DER PROGRAMME]
1983 59 p In GERMAN
Avail: NTIS HC A04/MF A01

The status of the different MBB programs is reviewed. The programs are: transport and passenger aircraft, military aircraft, defense systems, helicopters, astronautics, marine systems, traffic, and electronic systems and special techniques. Author (ESA)

N84-23627# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
MODERN HELICOPTER DEVELOPMENT IN GERMANY [DIE MODENE HUBSCHRAUBERENTWICKLUNG IN DEUTSCHLAND]
K. PFLEIDERER 16 Nov. 1983 50 p In GERMAN Lecture presented at Essen
(MBB-UD-395-83-O) Avail: NTIS HC A03/MF A01

The status of helicopter development is presented. The evolution in Germany since 1936 is reviewed. The life cycle cost principle is explained and the means of cost reduction are presented. The technical possibilities and limits of helicopters are treated with a view to increasing their share of the market. The development trends (fuel saving, carbon fiber reinforced plastics) are described. Author (ESA)

N84-23641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUEL SYSTEM RESEARCH AND TECHNOLOGY: AN OVERVIEW OF THE NASA PROGRAM
B. R. PHILLIPS *In its* Assessment of Alternative Aircraft Fuels p 111-120 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 01C

The interactions between the design and operation of aircraft fuel systems and the properties of alternative aircraft fuels are discussed. An overview of fuels system research and technology in terms of its rationale, its progress, and future plans is given. The measurement of ambient air temperatures for a wide range of seasonal and geographic variations, design studies on the use of fuels with increased as well as conventional freezing temperatures, the evaluation of fuel heating systems, and the low temperature behavior of fuels are among the topics discussed. R.J.F.

N84-23644*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
ANALYSIS OF FUEL SYSTEM TECHNOLOGY FOR BROAD PROPERTY FUELS
G. A. COFFINBERRY *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 141-158 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 01C

An analytical study was performed in order to assess relative performance and economic factors involved with alternative advanced fuel systems for future commercial aircraft operating with broad property fuels. Significant results, with emphasis on design practicality from the engine manufacturer' standpoint, are highlighted. Several advanced fuel systems were modeled to determine as accurately as possible the relative merits of each system from the standpoint of compatibility with broad property fuel. Freezing point, thermal stability, and lubricity were key property issues. A computer model was formulated to determine the investment incentive for each system. Results are given. R.J.F.

N84-23645*# Lockheed-California Co., Burbank.
FUEL SYSTEM DESIGN CONCEPTS FOR BROAD PROPERTY FUELS
E. F. VERSAW *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 159-170 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 01C

The results of a study assessing the impact of using jet fuel with relaxed specification properties on an aircraft fuel system are given. The study objectives were to identify credible values for specific fuel properties which might be relaxed, to evolve advanced fuel system designs for airframe and engines which would permit use of the specified relaxed properties fuels, and to evaluate performance of the candidate advanced fuel systems and the relaxed property fuels in a typical transport aircraft. The study used, as a baseline, the fuel system incorporated in the Lockheed Tristar. This aircraft is powered by three RB.211-524 Rolls-Royce engines and incorporates a Pratt and Whitney ST6C-421 auxiliary power unit for engine starting and inflight emergency electrical power. The fuel property limits examined are compared with commercial Jet A kerosene and the NASA RFP fuel properties. A screening of these properties established that a higher freezing point and a lower thermal stability would impact fuel system design more significantly than any of the other property changes. Three candidate fuel systems which combine the ability to operate with fuels having both a high freeze point and a low thermal stability are described. All candidates employ bleed air to melt fuel freeze-out prior to starting the APU or an inoperable engine. The effects of incorporating these systems on aircraft weight and engine specific fuel consumption are given. R.J.F.

N84-23646*# Simmonds Precision Products, Inc., Vergennes, Vermont.
ECONOMIC IMPACT OF FUEL PROPERTIES ON TURBINE POWERED BUSINESS AIRCRAFT
F. D. POWELL *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 171-184 Apr. 1984 refs
(Contract NAS3-22827)
Avail: NTIS HC A09/MF A01 CSCL 01C

The principal objective was to estimate the economic impact on the turbine-powered business aviation fleet of potential changes in the composition and properties of aviation fuel. Secondary objectives include estimation of the sensitivity of costs to specific fuel properties, and an assessment of the directions in which further research should be directed. The study was based on the published characteristics of typical and specific modern aircraft in three classes; heavy jet, light jet, and turboprop. Missions of these aircraft were simulated by computer methods for each aircraft for several range and payload combinations, and assumed atmospheric temperatures ranging from nominal to extremely cold. Five fuels were selected for comparison with the reference fuel, nominal Jet A. An overview of the data, the mathematic models, the data reduction and analysis procedure, and the results of the study are given. The direct operating costs of the study fuels are compared with that of the reference fuel in the 1990 time-frame, and the anticipated fleet costs and fuel break-even costs are estimated. R.J.F.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A84-31309
AN ADVANCED MAINTENANCE RECORDER
C. W. ROSS (Normalair-Garrett, Ltd., Yeovil, England) Future, Winter 1983, p. 20-25.

As part of a flight data acquisition system for maintenance of the F 18 Hornet fighter aircraft, a digital recorder has been developed that is capable of operating over a temperature range of minus 50 C to 125 C, in conditions of vibration, shock and high electromagnetic fields. The recorder is housed in a small, hermetically sealed container and can record 12 million bits of data. Ferrite-ceramic-glass 4-track magnetic heads and polyimide-base magnetic tape are used to increase reliability in extreme environments. After 20,000 aircraft operating hours the system sustained has only one failure. I.H.

A84-31310
ADVANCED GEARBOX HEALTH MONITORING TECHNIQUES
D. G. ASTRIDGE (Westland Helicopters, Ltd., Yeovil, England) Future, Winter 1983, p. 26-35.

The in-service gearbox-health-monitoring capabilities of the Westland 30-series passenger helicopters introduced into service in 1982 are reviewed and illustrated. The most significant new techniques are a remote-indicating wear-particle detection system, a vibration-analysis system, and an intrascope/guide-tube system to permit visual inspection without disassembling the gearboxes. T.K.

A84-32403* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
REAL-TIME DATA DISPLAY FOR AFTI/F-16 FLIGHT TESTING
P. F. HARNEY (NASA, Flight Research Center, Edwards, CA) IN: ITC/USA/'82; Proceedings of the International Telemetering Conference, San Diego, CA, September 28-30, 1982 . Research Triangle Park, NC, Instrument Society of America, 1982, p. 13-33.

Advanced fighter technologies to improve air to air and air to surface weapon delivery and survivability is demonstrated. Real time monitoring of aircraft operation during flight testing is necessary not only for safety considerations but also for preliminary evaluation of flight test results. The complexity of the AFTI/F-16 aircraft requires an extensive capability to accomplish real time data goals; that capability and the resultant product are described. Previously announced in STAR as N83-13095 S.L.

A84-32716*# Technion - Israel Inst. of Tech., Haifa.
TUNNEL DISPLAY FOR FOUR-DIMENSIONAL FIXED-WING AIRCRAFT APPROACHES
A. J. GRUNWALD (Technion - Israel Institute of Technology, Haifa, Israel) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 369-377. refs
(Contract NASW-3302)

The present evaluation of a computer-generated perspective tunnel display for four-dimensional fixed wing aircraft landing approaches gives attention to the development and performance assessment of superimposed predictor symbology. Simulator tests indicate that a complex perspective vehicle symbol yields a decrease in bank angle activity, by comparison to a flat predictor cross, while yielding larger lateral and vertical deviations in most cases. The perspective vehicle symbol motions are successful in forward velocity control without affecting path-following performance. The perspective vehicle symbol's advantage over the flat predictor cross is nevertheless marginal. While the tunnel display used yields satisfactory response in the lateral control axis, the vertical axis lacks sensitivity to vertical path angle variations. O.C.

N84-22557*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY EXPERIENCE WITH A STEREOSCOPIC VIDEO SYSTEM IN A REMOTELY PILOTED AIRCRAFT APPLICATION
T. W. REZEK Sep. 1983 14 p refs Prepared in cooperation with NASA/Dryden Flight Research Facility, Edwards, Calif.
(NASA-TM-84909; H-1185; NAS 1.15:84909) Avail: NTIS HC A02/MF A01 CSCL 01D

Remote piloting video display development at the Dryden Flight Research Facility of NASA's Ames Research Center is summarized, and the reasons for considering stereo television are presented. Pertinent equipment is described. Limited flight experience is also discussed, along with recommendations for further study. Author

N84-22558*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FREQUENCY ENCODED AUDITORY DISPLAY OF THE CRITICAL TRACKING TASK
J. STEVENSON Apr. 1984 18 p refs
(NASA-TM-85869; A-9576; NAS 1.15:85869) Avail: NTIS HC A02/MF A01 CSCL 01D

The use of auditory displays for selected cockpit instruments was examined. In auditory, visual, and combined auditory-visual compensatory displays of a vertical axis, critical tracking task were studied. The visual display encoded vertical error as the position of a dot on a 17.78 cm, center marked CRT. The auditory display encoded vertical error as log frequency with a six octave range; the center point at 1 kHz was marked by a 20-dB amplitude notch, one-third octave wide. Asymptotic performance on the critical tracking task was significantly better when using combined displays rather than the visual only mode. At asymptote, the combined display was slightly, but significantly, better than the visual only mode. The maximum controllable bandwidth using the auditory mode was only 60% of the maximum controllable bandwidth using the visual mode. Redundant cueing increased the rate of improvement of tracking performance, and the asymptotic performance level. This enhancement increases with the amount of redundant cueing used. This effect appears most prominent when the bandwidth of the forcing function is substantially less than the upper limit of controllability frequency. E.A.K.

N84-23628# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
DIGITAL CAPABILITY FOR COCKPIT TELEVISION SENSOR INSTRUMENTATION SYSTEMS Final Report, 1 Aug. 1980 - 30 Jun. 1983
D. O. HAGUE, JR. Nov. 1983 65 p
(Contract AF PROJ. 6095)
(AD-A139432; AFWAL-TR-83-1156) Avail: NTIS HC A04/MF A01 CSCL 14C

An approach is presented for incorporating digital capability into a video instrumentation system consisting of a solid-state CCD television camera and video cassette recorder. The approach consists of passive data acquisition from a MIL STD 1553B Multiplex Serial Data Bus with the acquired data being encoded into an unused portion of the video signal. The digital data is encoded as manchester format luminance excursions in the normally blanked horizontal rasters of the video vertical blanking interval. A laboratory prototype of this device (Bus-Monitor/Video-Encoder or BM/VE) was developed along with a device (or Video Decoder) for recovery of the digital data from the video signal. The BM/VE and Video Decoder were used in laboratory testing to establish the performance parameters and design requirements needed for an actual airborne application of the BM/VE approach. A video encoding format for fault-tolerant data recovery is also developed and presented. Test results demonstrate that the primary limitation of this approach is the video cassette recorder bandwidth and that even the lower bandwidth video recorders can support application-dependent capacities of 1-3 thousand digital 16-bit words per second. GRA

07

AIRCRAFT PROPULSION AND POWER

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

A84-30116
THE STATUS OF MICROPROCESSOR BASED GENERATOR CONTROL UNIT DEVELOPMENT
S. LORENZ, B. MEHL, and G. RUFFNER (Sundstrand Corp., Sundstrand Advanced Technology Group, Rockford, IL) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 3 . New York, American Institute of Chemical Engineers, 1983, p. 1015-1020. refs

Today's advanced aircraft electrical power generating systems rely on microprocessor technology for the implementation of most control, protection, and built-in test functions. Microprocessors offer distinct advantages over discrete logic devices in system design and performance. By adapting more advanced microprocessor systems in the next generation of aircraft electric systems, additional functions can be implemented. Microprocessor closed loop control coupled with more effective built-in test capabilities will result in significant improvements in system performance.
Author

A84-30118
MULTIVOLTAGE HIGH POWER ELECTRICAL POWER SYSTEM
D. S. YORKSIE (Westinghouse Electric Corp., Pittsburgh, PA) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 3 . New York, American Institute of Chemical Engineers, 1983, p. 1039-1043.

Applications are being identified where the optimum aircraft electrical system may not be the conventional 400 Hz approach. The requirements for a multivoltage high power airborne electrical system are presented. The methodology used to define and evaluate operating parameters, system configuration and control philosophy are presented. The approach recommended for this application is described.
Author

A84-30415
THE OPTIMAL THERMAL GASDYNAMIC DESIGN OF GAS TURBINE ENGINES ON THE BASIS OF THE CHARACTERISTICS OF PART PROTOTYPES. II [OPTIMAL'NOE TERMOGAZODINAMICHESKOE PROEKTIROVANIE GTD PO KHARAKTERISTIKAM PROTOTIPOV ELEMENTOV. II]
IU. V. KOZHEVNIKOV, V. O. BOROVIK, V. S. IVANOV, V. A. TALYZIN, I. N. AGLIULLIN, and IU. V. MELUZOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 35-41. In Russian. refs

Reference is made to a study by Kozhevnikov et al. (1978), which considered the mathematical relations which determine the relationships existing between the principal engine parameters in characteristic sections for given characteristics of the fan, compressors, and turbines for lowand high-pressure stages. The results of the calculations, however, depend on the form that these characteristics take and on the method used in approximating them. Formulas are presented here which approximate graphically the specified characteristics of the engine parts. The calculations presented optimize the parameters of a two-stage, bypass engine having specified part characteristics.
C.R.

A84-30420
PREDICTING CHANGES IN THE RELIABILITY CHARACTERISTICS OF GAS TURBINE ENGINES IN USE [PROGNOZIROVANIE IZMENENII KHARAKTERISTIK NADEZHNOSTI GTD V EKSPLUATATSII]
V. P. CHEPRASOV and E. TS. VULIKH Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 68-72. In Russian.

An approach is outlined to solving the problem of diagnosing the condition of mass-produced gas turbine engines and predicting the changes that occur from use. It is pointed out that calculations at present rely on two assumptions. The first is that the law governing the distribution of times during which the engines operate without failure is exponential. The second is that all the engines are of uniform reliability. It is shown that models incorporating these assumptions can be improved by modifying the first assumption. The approach outlined involves an analysis of the conditional probabilities of failure occurrence.
C.R.

A84-30651#
AN EXAMPLE OF INNOVATION - LARGE AMERICAN JET TRANSPORTS
L. TRILLING (MIT, Cambridge, MA) American Society of Mechanical Engineers, Winter Annual Meeting, Boston, MA, Nov. 13-18, 1983. 5 p. refs
(ASME PAPER 83-WA/TS-4)

The first of the large jet-propelled passenger transports, which have become the characteristic instruments of expanded air travel since the late 1950s, were designed on the basis of engine and airframe technology developed by the U.S. Air Force to meet military needs. Subsequently, the commercial wide body jets and turbofan engines which constitute the bulk of the present major airline equipment resulted from a complex interaction between the military, the airlines, and the large airframe and engine manufacturers. This paper traces the history of the development of large jet transports and their engines, tries to analyze the motivation of the players and to show how air transport technology became distinct from military air technology, and what new sets of issues this created for the managers of U.S. airlines, airframe and engine manufacturers.
Author

A84-30808#
PROPOSED ARRANGEMENT TO IMPROVE TURBOPROP EFFICIENCY
W. S. GEARHART (Pennsylvania State University, State College, PA) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 341-345. Navy-supported research. refs

Previously cited in issue 05, p. 596, Accession no. A83-16491

A84-31288
MEASUREMENTS OF THE FLOW FROM A HIGH-SPEED COMPRESSOR ROTOR USING A DUAL PROBE DIGITAL SAMPLING (DPDS) TECHNIQUE
R. P. SHREEVE (U.S. Naval Postgraduate School, Monterey, CA) and F. NEUHOFF ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, April 1984, p. 366-375. Navy-supported research. refs
(Contract PROJECT SQUID)
(ASME PAPER 83-GT-215)

The flow from a high-speed rotor in a rotor-first arrangement has been measured using a 'dual-probe, digital sampling (DPDS)' technique. The flow field was found to be steady in rotor coordinates (periodic in machine coordinates) outside the rotor wake, and three components of velocity and the pressure field were determined in this area. The wake regions were unsteady. In these regions the measurements based on ensemble averages of multiple samples did not follow the behavior established during calibration in steady uniform free-jet flow, except near the wake center. The broadening of the wake and three-dimensional effects in the flow field were measured at reduced throttle and increased speeds. The results serve to illustrate the potential of the measurement technique, on which the emphasis of the presentation is placed.
Author

A84-31291
ON THE EVALUATION OF REYNOLDS NUMBER AND RELATIVE SURFACE ROUGHNESS EFFECTS ON CENTRIFUGAL COMPRESSOR PERFORMANCE BASED ON SYSTEMATIC EXPERIMENTAL INVESTIGATIONS
H. SIMON and A. BUELSKAEMPER (Mannesmann Demag Foerdertechnik, Duisburg, West Germany) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 106, April 1984, p. 489-498; Discussion, p. 499-501. refs
(ASME PAPER 83-GT-118)

A84-31317
SOME CONSIDERATIONS IN THE THERMAL DESIGN OF TURBINE AIRFOIL COOLING SYSTEMS
E. ELOVIC and W. K. KOFFEL (General Electric Co., Cincinnati, OH) International Journal of Turbo and Jet-Engines, vol. 1, no. 1, 1983-1984, p. 45-65. refs

Both gas and coolant side heat transfer coefficients are greatly influenced by various fluid flow effects present in gas turbine environments and by those arising in the cooling techniques used. Some of these effects and their influence on the thermal design of turbine airfoil cooling systems are reviewed. The topics discussed include: factors affecting airfoil external heat transfer coefficients; the influence of blow-off in film cooling design; cross flow effects on impingement heat transfer; and effects of rotation on heat transfer in radial passages. The need for further research and experimental data in all of these areas is emphasized. Author

A84-31670#
FATIGUE RELIABILITY OF GAS TURBINE ENGINE COMPONENTS UNDER SCHEDULED INSPECTION MAINTENANCE
J. N. YANG and S. CHEN (George Washington University, Washington, DC) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 410-420. refs
(Contract F33615-81-C-5015)
(AIAA PAPER 84-0850)

A probabilistic method is developed for the fatigue reliability analysis of gas turbine engine components under scheduled inspection maintenance in service. Various statistical uncertainties involved in the complex design system of gas turbine engine components have been taken into account, including the time to crack initiation, fatigue crack propagation, service loads, crack modeling, stress concentration factor, nondestructive evaluation (NDE) etc. It is demonstrated that the service inspection maintenance can be used to improve the reliability of fatigue-critical components significantly. Such an improvement in fatigue reliability is shown to depend on the capability of the NDE system employed. An example for the third stage turbine disk of TF-33 jet engine has been worked out to demonstrate the application of the analysis methodology developed herein. Author

A84-31778#
CALCULATION OF WALL TEMPERATURES OF AFTERBURNERS WITH CONVECTIVE AND FILM COOLING
C. ZHU Northwestern Polytechnical University, Journal, vol. 2, Jan. 1984, p. 21-28. In Chinese, with abstract in English. refs

A method is presented for calculating wall temperatures of an afterburner heat shield with convective and film cooling. The design of the cooling system is described, and the temperatures are calculated using a heat balance equation. The two computer programs employed in the calculations are described. C.D.

A84-31784#
ANALYSIS AND CALCULATION OF VIBRATION RESPONSE INDUCED BY INFLOW DISTORTION IN THE FIRST-STAGE COMPRESSOR BLADING OF TURBO-ENGINE
S. OUYANG Northwestern Polytechnical University, Journal, vol. 2, Jan. 1984, p. 115-128. In Chinese, with abstract in English. refs

The acceptability of inflow distortion patterns for engine stages is evaluated in terms of dynamical response. Rotor-blade resonance response is quantitatively evaluated using a method for calculating the excitation force acting on the blades and the vibration response due to the distortion in the resonance state. This method is based on the concept that distortion-induced blade vibration severity depends on the effectiveness of energy input to the blade. A distortion index which is directly related to blade vibration and is expressed in terms of Fourier coefficients for excitation force is discussed and improved. This index can be used to analyze the distortion characteristics and evaluate the acceptability of inflow distortion. The direct evaluation of the acceptability of inflow distortion in a turboengine by comparing the actual distortion index of the engine inlet with its allowable value is proposed. The correctness of the method is demonstrated for an actual case of inflow distortion-induced blade resonance. C.D.

A84-31902#
VIBRATION MODES OF PACKETED BLADED DISKS
D. J. EWINS and M. IMREGUN (Imperial College of Science and Technology, London, England) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, April 1984, p. 175-180. refs

This paper presents the results of investigating the vibrational behavior of turbine blades when grouped into packets. Two methods of analysis based on substructuring via receptance coupling have been developed and used with success to predict the natural frequencies of a 30-bladed disk with various packeting arrangements. A series of experiments have been conducted on a special testpiece to confirm these predictions. It is found that, unlike its continuously shrouded counterpart, the packeted bladed disk has modes which are always complex in shape, containing several nodal diameter components, a feature which can be predicted from the modal interference diagrams introduced in this work. Author

A84-31905*# Carnegie-Mellon Univ., Pittsburgh, Pa.
MODEL DEVELOPMENT AND STATISTICAL INVESTIGATION OF TURBINE BLADE MISTUNING
J. H. GRIFFIN (Carnegie-Mellon University, Pittsburgh, PA) and T. M. HOOSAC ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, April 1984, p. 204-210. refs
(Contract NAG3-231)

This paper discusses the development of an efficient algorithm which calculates the individual blade response of a bladed turbine disk, the subsequent statistical investigation to establish mistuning dependencies, and procedures which reduce the increase in blade amplitudes caused by mistuning. Author

A84-31908#
A RAPID APPROACH FOR CALCULATING THE DAMPED EIGENVALUES OF A GAS TURBINE ON A MINICOMPUTER - THEORY
E. J. GUNTER, R. R. HUMPHRIS (Virginia, University, Charlottesville, VA), and H. SPRINGER (Wien, Technische Universitaet, Vienna, Austria) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, April 1984, p. 239-249; Discussion, p. 249; Authors' Closure, p. 250. refs
(ASME PAPER 83-DET-83)

The calculation of the damped eigenvalues of a large multistation gas turbine by the complex matrix transfer procedure may encounter numerical difficulties, even on a large computer due to numerical round-off errors. In this paper, a procedure is presented in which the damped eigenvalues may be rapidly and

accurately calculated on a minicomputer with accuracy which rivals that of a mainframe computer using the matrix transfer method. The method presented in this paper is based upon the use of constrained normal modes plus the rigid body modes in order to generate the characteristic polynomial of the system. The constrained undamped modes, using the matrix transfer process with scaling, may be very accurately calculated for a multistation turbine on a minicomputer. In this paper, a five station rotor is evaluated to demonstrate the procedure. A method is presented in which the characteristic polynomial may be automatically generated by Leverrier's algorithm. The characteristic polynomial may be directly solved or the coefficients of the polynomial may be examined by the Routh criteria to determine stability. The method is accurate and easy to implement on a 16 bit minicomputer. Author

A84-32159
A STUDY OF POWER CHARACTERISTICS AND FLOW PARAMETERS IN THE CHANNEL OF MODELS WITH COMBUSTION [ISSLEDOVANIE SILOVYKH KHARAKTERISTIK I PARAMETROV POTOKA V TRAKTE MODELEI S GORENIEM]
V. K. BAEV, V. V. SHUMSKII, and M. I. IAROSLAVTSEV PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Jan.-Feb. 1984, p. 103-109. In Russian. refs

Shock wind-tunnel tests were conducted on three gasdynamic models with hydrogen combustion. One model, which had an air intake diameter of 72 mm, was tested at free-stream Mach 7.3; the other two models, with an intake diameter of 23-24 mm, were tested at Mach 4.9. The characteristics of flow of the working medium in the channel and their dependence on the temperature of the incoming air are similar for all the models tested. With hydrogen injected in the direction opposite to that of the incoming air flow and with a small recirculation zone, high combustion efficiencies (up to 0.9-0.95) have been obtained in a relatively short combustion chamber (130-180 mm), with no negative effects on the air intake. V.L.

A84-32531
F404 - FIGHTER PILOTS' ENGINE
J. MOXON Flight International (ISSN 0015-3710), vol. 125, April 14, 1984, p. 1021-1025.

After relating the development history of the YJ101 engine developed for the YF-17 prototype aircraft, and its subsequent 17-percent up-scaling to yield the current F404 engine employed by the YF-17-derived F/A-18, attention is given to the design features and performance capabilities of the F404 using the 'last-generation' J79 (which is also in its performance class), as the basis of comparisons. Major achievements of this 16,000-18,000 lb thrust engine over the J79 are a considerable simplification and a halving of engine weight. F404 pressure ratio is 25:1, its airflow 140 lb/sec, and its length 159 in. Additional aircraft which will use this engine or its growth versions are the F-20 and the Forward Swept Wing Demonstrator, as well as the Swedish JAS 39 and French ACX next-generation technology demonstrator fighters. O.C.

A84-32532
PW200 - A STEP BEYOND PT6
D. GODFREY Flight International (ISSN 0015-3710), vol. 125, April 21, 1984, p. 1075, 1076.

The design features and operational capabilities of the PW200 state-of-the-art 500 shp-class turboshaft engine are discussed. The configuration of the PW200 encompasses a single-stage 8:1 pressure ratio centrifugal compressor, and contrarotating high pressure (compressor-driving) and shaft turbine stages. The PW200 may be converted into a 300-600 shp-class turboprop powerplant for fixed wing aircraft. Its primary use is presently envisioned to be in twin-engine helicopters. The gearbox is front-mounted and employs a single reduction gear stage. O.C.

A84-32696#
BEHIND THE ALTERNATE FIGHTER ENGINE COMPETITION
J. B. NIX, JR. and R. C. SHELNUTT (USAF, Washington, DC) Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 71-73.

Experience gained in the USAF's Alternate Fighter Engine Competition to develop improved engines for the F-15 and F-16 fighter aircraft is discussed. Attention is given to the steady improvements in quality and maintainability of the F-100 engine through the Competitive Improvement Program, and to the development of two new versions of the F-100: the F-100-PW-220 and the F-100-GE-100. The F-100-PW-220 incorporates major changes to existing designs by introducing Digital Electronic Engine Control (DEEC), a new gear-type fuel pump and an Increased Life Core. The F-110-GE-100 is derived from designs of U.S. Navy F404 engines and has completed 5,000 cycles of successful accelerated mission testing. It is predicted that these new engines will have over twice the durability of today's F-100 and decrease support costs by as much as 50 percent. The program is credited with providing a greater industrial base for producing F-100 engines, as well as promoting management responsiveness, innovation, and cost reductions. I.H.

A84-32995#
COMPOSITE PROPELLER BLADES FOR COMMUTER AIRCRAFT
R. F. J. MCCARTHY (Dowty Rotol, Ltd., Gloucester, England) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 2 . Stevenage, Herts., England, British Aerospace PLC, 1983, p. 25-1 to 25-16.

Composite propeller blades have been developed and are now in production for the new generation of 20-60 seater commuter aircraft. The method of manufacture utilizes special tooling and a resin injection process specifically developed to produce composites with good fiber volume fractions and correspondingly high structural properties. Quality control and NDT methods have been developed to ensure a high quality product which involves the use of ultrasonic, radiographic and vibrational analysis. Certification of the composite propeller has necessitated rigorous structural and environmental testing of the finished blades, involving specialized rigs and techniques. The future for these blades is established, and contracts for a number of aircraft projects are now being fulfilled in a new, purpose-built composites manufacturing facility. Author

N84-22559* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REAL TIME PRESSURE SIGNAL SYSTEM FOR A ROTARY ENGINE Patent
W. J. RICE, inventor (to NASA) 31 Jan. 1984 11 p Filed 19 Feb. 1982
(NASA-CASE-LEW-13622-1; US-PATENT-4,428,226;
US-PATENT-APPL-SN-350473; US-PATENT-CLASS-73-115;
US-PATENT-CLASS-364-558) Avail: US Patent and Trademark Office CSCL 21A

A real-time IMEP signal which is a composite of those produced in any one chamber of a three-lobed rotary engine is developed by processing the signals of four transducers positioned in a Wankel engine housing such that the rotor overlaps two of the transducers for a brief period during each cycle. During the overlap period of any two transducers, their output is compared and sampled for 10 microseconds per 0.18 degree of rotation by a sampling switch and capacitive circuit. When the switch is closed, the instantaneous difference between the value of the transducer signals is provided while with the switch open the average difference is produced. This combined signal, along with the original signal of the second transducer, is fed through a multiplexer to a pressure output terminal. Timing circuits, controlled by a crank angle encoder on the engine, determine which compared transducer signals are applied to the output terminal and when, as well as the open and closed periods of the switches.

Official Gazette of the U.S. Patent and Trademark Office

N84-22560* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TIP CAP FOR A ROTOR BLADE
W. K. KOFEL (GE, Cincinnati), E. N. TULEY (GE, Cincinnati), C. H. GAY, JR. (GE, Cincinnati), R. E. TROEGER (GE, Cincinnati), and A. P. STERMAN, inventors (to NASA) (GE, Cincinnati) 25 Oct. 1983 7 p Filed 20 Mar. 1981 Sponsored by NASA
(NASA-CASE-LEW-13654-1; US-PATENT-4,411,597; US-PATENT-APPL-SN-245571; US-PATENT-CLASS-416-92; US-PATENT-CLASS-416-97R; US-PATENT-CLASS-416-224; US-PATENT-CLASS-416-233) Avail: US Patent and Trademark Office CSCL 21E

A replaceable tip cap for attachment to the end of a rotor blade is described. The tip cap includes a plurality of walls defining a compartment which, if desired, can be divided into a plurality of subcompartments. The tip cap can include inlet and outlet holes in walls thereof to permit fluid communication of a cooling fluid there through. Abrasive material can be attached with the radially outer wall of the tip cap.
Official Gazette of the U.S. Patent and Trademark Office

N84-22561# Aircraft Research Association Ltd., Bedford (England).
CIVIL TURBOFAN PROPULSION SYSTEM INTEGRATION STUDIES USING POWERED TESTING TECHNIQUES AT ARA, BEDFORD
A. E. HARRIS and K. C. PALIWAL Mar. 1984 26 p refs
(ARA-MEMO-246) Avail: NTIS HC A03/MF A01

Details are given of powered testing techniques used in civil turbofan integration studies. Tests and rigs for the study of isolated nacelle inlet and afterbody/nozzle components, isolated complete nacelle/pylon, and installed nacelle/pylon performance are described. The techniques described have placed considerable emphasis on the need to identify the many complex aerodynamic interferences involved. The main theme relates to the use of turbine powered simulator (TPS) nacelles used on both full-span and half-span models for determination of nacelle/pylon installation and interference drag levels. A detailed description of a new Mach Simulation Tank for high accuracy TPS nacelle calibrations is included. B.W.

N84-22562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DUAL CLEARANCE SQUEEZE FILM DAMPER Patent Application
D. P. FLEMING, inventor (to NASA) 5 Apr. 1984 13 p
(NASA-CASE-LEW-13506-1; US-PATENT-APPL-SN-596960)
Avail: NTIS HC A02/MF A01 CSCL 21E

A dual clearance hydrodynamic liquid squeeze film damper for a gas turbine engine is presented. Under normal operating conditions the device functions as a conventional squeeze film damper, using only one of its oil films. When an unbalance reaches abusive levels, as may occur with a blade loss or foreign object damage, a second, larger clearance film becomes active, controlling vibration amplitudes in a near optimum manner until the engine can be safety shut down and repaired. NASA

N84-22563*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OXIDIZING SEAL FOR A TURBINE TIP GAS PATH Patent Application
J. D. CAWLEY, inventor (to NASA) 19 Apr. 1984 12 p
(NASA-CASE-LEW-14053-1; US-PATENT-APPL-SN-602050)
Avail: NTIS HC A02/MF A01 CSCL 21E

The sealing of the gas path in a gas turbine engine at the blade tips is improved by maintaining a minimum clearance between the rotor blade tips and the gas path seal. This is accomplished by taking advantage of an increase in volume during controlled oxidation of certain intermetallic compounds which have high melting points. The increase in volume closes the clearance subsequent to a rub between the blades and the seal. Thus, these compounds re-form the tip seal surface to assure continued engine efficiency. NASA

N84-22564*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON BETWEEN MEASURED TURBINE STAGE PERFORMANCE AND THE PREDICTED PERFORMANCE USING QUASI-3D FLOW AND BOUNDARY LAYER ANALYSES
R. J. BOYLE, J. E. HAAS, and T. KATSANIS 1984 27 p refs Proposed for presentation at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE and ASME
(NASA-TM-83640; E-2065; NAS 1.15:83640; AVRADCOM-TR-84-C-6) Avail: NTIS HC A03/MF A01 CSCL 21E

A method for calculating turbine stage performance is described. The usefulness of the method is demonstrated by comparing measured and predicted efficiencies for nine different stages. Comparisons are made over a range of turbine pressure ratios and rotor speeds. A quasi-3D flow analysis is used to account for complex passage geometries. Boundary layer analyses are done to account for losses due to friction. Empirical loss models are used to account for incidence, secondary flow, disc windage, and clearance losses. Author

N84-22565*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY INVESTIGATION OF A TWO-ZONE SWIRL FLOW COMBUSTOR
J. A. BIAGLOW, S. M. JOHNSON, and J. M. SMITH 1984 20 p refs Proposed for presentation at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984; sponsored by AIAA, SAE, and ASME
(NASA-TM-83637; E-2029; NAS 1.15:83637) Avail: NTIS HC A02/MF A01 CSCL 21E

The effect of full-annular swirling-flow on a flow-zone combustor design is investigated. Swirl flow angles of 25, 35, and 45 degrees were investigated in a combustor design envelope typical of those used in modern engines. The two-zone combustor had 24 pilot-zone fuel injectors and 24 main-fuel injectors located in the centerbody between the pilot and swirl passage. Combustor performance was determined at idle, and two parametric 589 K inlet temperature conditions. Combustor performance was highest with the 45 degree swirl vane design; at the idle condition, combustion efficiency was 99.5 percent. The 45 degree swirl vane also produced the lowest pattern factor of the three angles and showed a combustor lean blowout limit below a 0.001 fuel-air ratio. Combustor total pressure drop varied from a low of 4.6 percent for the 25 degree swirl to a high of 4.9 percent for the 45 degree swirl. M.A.C.

N84-22566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DETERMINATION OF COMPRESSOR IN-STALL CHARACTERISTICS FROM ENGINE SURGE TRANSIENTS
C. F. LORENZO, F. P. CHIARAMONTE, and C. M. MEHALIC 1984 27 p refs Proposed for presentation at the 20th Joint Propulsion Conf., 11-13 Jun. 1983; sponsored by the AIAA, SAE and ASME
(NASA-TM-83639; E-2082; NAS 1.15:83639) Avail: NTIS HC A03/MF A01 CSCL 21E

A technique for extracting the in-stall pumping characteristics for an axial flow compressor operating in an engine system environment is developed. The technique utilizes a Hybrid computer simulation of the compressor momentum equation into which actual transient data are used to provide all terms but the desired compressor characteristic. The compressor force characteristic as a function of corrected flow and speed result from the computation. The critical problem of data filtering is addressed. Results for a compressor operating in a turbofan engine are presented and comparison is made with the conventional compressor map. The relationship of the compressor surge characteristic with its rotating stall characteristic is explored. Initial interpretation of the measured results is presented. Author

N84-22567*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL INVESTIGATION OF THE LOW NO/SUB X VORTEX AIRBLAST ANNULAR COMBUSTOR
S. M. JOHNSON, J. A. BIAGLOW, and J. M. SMITH 1984 14 p refs Presented at the 20th Joint Propulsion Conf., Cincinnati, 11-13 Jun. 1984
(NASA-TM-83615; E-2046; NAS 1.15:83615) Avail: NTIS HC A02/MF A01 CSCL 21E

A low oxides of nitrogen vortex airblast annular combustor was evaluated which has attained the goal of 1 gm NO2/kg fuel or less during operation. The experimental combustor test conditions were a nominal inlet-air temperature of 703 K, inlet total pressures between 0.52 to 0.83 MPa, and a constant inlet Mach number of 0.26. Exit temperature pattern factors for all test points were between 0.16 and 0.20 and exit swirl flow angles were 47 degrees at isothermal conditions and 23 degrees during combustion. Oxides of nitrogen did not exceed 1.05 gm NO2/kg fuel at the highest inlet pressure and exhaust temperature tested. Previous correlations have related NOx proportionally to the combustor inlet pressure raised to some exponent. In this experiment, a band of exponents between 0.5 and 1.0 resulted for fuel-air ratios from 0.023 to 0.027 and inlet pressures from 0.52 to 0.83 MPa. S.L.

N84-22568*# Teledyne CAE, Toledo, Ohio.
VARIABLE STATOR RADIAL TURBINE Final Report
C. ROGO, T. HAJEK, and A. G. CHEN May 1984 302 p refs
(Contract NAS3-23163; DA PROJ. 1L1-61102-AH-45)
(NASA-CR-174663; NAS 1.26:174663; TELEDYNE-CAE-1987)
Avail: NTIS HC A14/MF A01 CSCL 21E

A radial turbine stage with a variable area nozzle was investigated. A high work capacity turbine design with a known high performance base was modified to accept a fixed vane stagger angle moveable sidewall nozzle. The nozzle area was varied by moving the forward and rearward sidewalls. Diffusing and accelerating rotor inlet ramps were evaluated in combinations with hub and shroud rotor exit rings. Performance of contoured sidewalls and the location of the sidewall split line with respect to the rotor inlet was compared to the baseline. Performance and rotor exit survey data are presented for 31 different geometries. Detail survey data at the nozzle exit are given in contour plot format for five configurations. A data base is provided for a variable geometry concept that is a viable alternative to the more common pivoted vane variable geometry radial turbine. E.A.K.

N84-22569# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
FILM COOLING ON A GAS TURBINE BLADE NEAR THE END WALL Interim Report
R. J. GOLDSTEIN and H. P. CHEN May 1983 10 p
(Contract F49620-83-C-0062; AF PROJ. 2307)
(AD-A138794; AFOSR-84-0109TR) Avail: NTIS HC A02/MF A01 CSCL 21E

Local film cooling effectiveness on a gas turbine blade with a row of discrete cooling jets was measured using a mass transfer technique. Emphasis is placed on phenomena near the end wall of the blade. This region contains a horseshoe vortex system modified by a passage vortex. On the concave (pressure) surface the film cooling performance is not greatly altered by the presence of the end wall. On the convex surface of the blade the film cooling is essentially absent in a triangular region extending from near the region of peak curvature on the blade to its trailing edge. This unprotected region closely corresponds to location of the passage vortex as indicated by flow visualization. The passage vortex sweeps away the injected coolant flow from the surface. Upstream of the unprotected area the injected flow is skewed toward the middle span of the blade. End wall influence extends about one-half cord length up from the end wall in the present experiments. GRA

N84-22570# Rolls-Royce Ltd., Derby (England).
ENGINE RELIABILITY THROUGH BEARING CONDITION MONITORING
P. A. MUCKLOW 19 Apr. 1983 9 p Presented at South African Airways Symp. on Engine Monitoring, 19-21 Apr. 1983
(PNR-90168; REPRINT-871) Avail: NTIS HC A02/MF A01

The use of magnetic chip detectors to detect bearing fatigue deterioration in RB 211 aircraft engines is described. A detector is located in each of five oil scavenge lines, with a sixth detector in the combined scavenge line. Inspection using magnetic detectors gives an increase from 25 % to 75 % of location of bearing failures, with almost no in-flight shutdown. Author (ESA)

N84-22571# Rolls-Royce Ltd., Derby (England).
ACOUSTIC EMISSION: A BRIEF INTRODUCTION TO SOME OF ITS USES IN THE AERO ENGINE INDUSTRY
T. J. HOLROYD 1 Oct. 1983 14 p refs
(PNR-90172; REPRINT-875) Avail: NTIS HC A02/MF A01

Acoustic emission (AE) processes which involve the cooperation of aircraft engine material in an irreversable manner, such as crack extension, plastic deformation and phase transformations; and processes which result in no permanent material change but are associated with rapid localized elastic events such as particle impacts, fretting, cavitation and turbulence are discussed. The use of AE for single cycle tests, fatigue tests, honeycomb integrity assessment, monitoring machining processes, and bearing monitoring is described. Author (ESA)

N84-22572# Rolls-Royce Ltd., Derby (England). Advanced Research Lab.
OPTICAL GAS TEMPERATURE MEASUREMENT IN GAS TURBINES
J. D. BLACK 16 Jun. 1983 13 p refs
(PNR-90174; REPRINT-877) Avail: NTIS HC A02/MF A01

The requirements for temperature measurements in the various sections of a gas turbine are discussed. Nonintrusive optical measurement techniques are outlined and their applicability to the engine is discussed. Absorption, incoherent scattering, and Raman techniques are described. Because of the requirement for optical access, gas temperature measurements are more likely to be applied on component test rigs rather than full scale engines, and those measurements which are made on engines are in the exhaust section. Author (ESA)

N84-22573# Rolls-Royce Ltd., Derby (England).
EMISSIONS VARIABILITY AND TRAVERSING ON PRODUCTION RB211 ENGINES
J. K. BHANGU, H. L. HAWKINS, C. H. PRIDDEN, and P. H. WALKER 1 Oct. 1983 9 p refs Sponsored by FAA
(PNR-90176; REPRINT-879) Avail: NTIS HC A02/MF A01

Emissions of RB211 production engines were surveyed in order to determine engine-to-engine variability, and demonstrate that a specific probe design provides a representative sample. Emissions characteristics of six production RB211-524B-02 engines were measured using a fixed cruciform rake to give engine to engine variability in terms of standard deviation/mean for each pollutant. A rotatable cruciform rake was used to traverse the exhaust plane of another RB211-524B4-02 engine for various emissions and total pressure at three power settings. The effects of rake design and positioning, and variations between meaned and individual sample collection methods were evaluated. Results confirm the utility of the method. Emissions legislation is considered. Author (ESA)

N84-22574# Rolls-Royce Ltd., Derby (England).
ENGINE AFFORDABILITY
R. M. HEATHCOTE 1 Jun. 1983 25 p Presented at Royal Aeron. Soc. Management Studies Group Colloq. on Who Can Afford Aerospace Products, Jun. 1983
(PNR-90178; MISC-804) Avail: NTIS HC A02/MF A01

Factors which effect the cost of developing and operating aircraft engines, particularly of civil aircraft, are discussed. Fuel efficiency, reliability, maintenance, weight reduction, safety, and specifications are considered. Author (ESA)

N84-22575# Rolls-Royce Ltd., Derby (England).
THE DEVELOPMENT OF ADVANCED SPECIMEN TESTING AND ANALYSIS TECHNIQUES APPLIED TO FRACTURE MECHANICS LIFING OF GAS TURBINE COMPONENTS
A. C. PICKARD, C. W. BROWN, and M. A. HICKS 1983 7 p refs
(PNR-90179; REPRINT-892) Avail: NTIS HC A02/MF A01

Fracture mechanics analyses of the fatigue lives of components were derived from a corner cracked specimen geometry which closely simulates the cracks observed in rig tested gas turbine components. Using the results, good agreement is obtained between fracture mechanics predictions and observed behavior of rig tested nickel and titanium alloy components containing fatigue induced or artificially generated cracks. However, results show that caution must be exercised in the application of long crack data to situations where the crack size is of the order of or less than the microstructural unit size. Author (ESA)

N84-22576# Rolls-Royce Ltd., Derby (England).
TURBOPROP ENGINE DESIGN CONCEPTS
H. W. BENNETT Jun. 1983 8 p
(PNR-90181; REPRINT-894) Avail: NTIS HC A02/MF A01

Three major categories of aircraft for the future application of turboprop engines are identified: 30 to 70 seat commuter, cruise speed 250 to 300 kts, design range 600 to 700 nm; 70 to 100 seat super commuter, cruise speed up to 0.7 MN, design range up to 1000 nm; and 100 to 150 seat mainliner, cruise speed 0.7 to 0.8 MN, design range 1000 to 2000 nm. Commercial market potential is discussed. Engine configurations, covering power requirements over the range of 2000 SHP to 12000 SHP are reviewed. Integration and tailoring of the total power plant with the airframe is seen to be a necessity for the ultimate success in this class of turboprop aircraft. Problems encountered in high power gearbox design and engine concepts are reviewed.
Author (ESA)

N84-22577# Rolls-Royce Ltd., Derby (England).
THE ACCELERATING PACE OF ADVANCING AERO ENGINE TECHNOLOGY
J. F. COPLIN 5 May 1983 92 p In ENGLISH and GERMAN Presented at 8th European Pioneer's Day, Bonn, 5 May 1983 Sponsored by Procurement Executive of Ministry of Defence
(PNR-90191; REPRINT-891) Avail: NTIS HC A05/MF A01

Improvements in jet engine fuel efficiency are discussed. Fan aerodynamics; multistage compressors; high, intermediate and low pressure turbines; advanced turbine materials; and propeller design are discussed. Author (ESA)

N84-22578# Rolls-Royce Ltd., Derby (England).
HELICOPTER ENGINE TECHNOLOGY WITH PARTICULAR REFERENCE TO THE ROLLS-ROYCE GEM ENGINE
D. LEWIS Mar. 1981 10 p Presented at Brit. Aviation Seminar and Exhibition 1981, Delhi, 17-19 Mar. 1981 and Bangalore, India, 25-27 Mar. 1981
(PNR-90193; REPRINT-751) Avail: NTIS HC A02/MF A01

The Gem gas turbine helicopter engine structure power ratings, control systems, intake protection and surge free handling are discussed. Sensitivity to intake pressure disturbances, and the ability to accept contaminated air in the intake are considered.
Author (ESA)

N84-22579# Rolls-Royce Ltd., Derby (England).
SOME THEMES ON ROLLS-ROYCE MILITARY ENGINE TECHNOLOGY. PART 1: OLD AND NEW ENGINES FOR COMBAT AIRCRAFT. PART 2: AFTER-BURNING TECHNOLOGY
P. H. YOUNG Mar. 1981 12 p refs Presented at Brit. Aviation Seminar and Exhibition 1981, Delhi, 17-19 Mar. 1981 and Bangalore, 25-27 Mar. 1981
(PNR-90195; REPRINT-919) Avail: NTIS HC A02/MF A01

Engine specifications for a light combat aircraft (LCA) are discussed. Interactions between power plant characteristics and LCA size and capability are considered. The effect of bypass ratio on afterburning technology; reheat design rules; combustion instabilities; jet pipe cooling; control problems; and plenum chamber burning are treated. Author (ESA)

N84-22580# Rolls-Royce Ltd., Derby (England).
FUEL EFFICIENT ENGINES FOR LARGE TRANSPORT
A. G. NEWTON Mar. 1981 14 p Presented at Brit. Aviation Seminar and Exhibition 1981, Delhi, 17-19 Mar. 1981 and Bangalore, 25-27 Mar. 1981
(PNR-90196; REPRINT-913) Avail: NTIS HC A02/MF A01

The impact of deteriorating quality and availability of aviation fuel on large transport aircraft engine fuel distribution and control systems and combustion systems is discussed. The advantages of liquid hydrogen as a replacement for fossil fuels are outlined, and the effects on engine design are considered. Long term low specific thrust developments are indicated. Author (ESA)

N84-22581# Rolls-Royce Ltd., Derby (England).
INDUSTRIAL AND MARINE ENGINE DERIVATIVES: A SPIN-OFF FROM AVIATION
W. J. R. THOMAS Mar. 1981 10 p Presented at Brit. Aviation Seminar and Exhibition 1981, Delhi, 17-19 Mar. 1981 and Bangalore, 25-27 Mar. 1981
(PNR-90197; REPRINT-914) Avail: NTIS HC A02/MF A01

Aviation derived gas turbine engine utilization for electric power generation, oil and gas pumping and compression, and the propulsion of ships, hydrofoils and hovercraft is illustrated.
Author (ESA)

N84-22582# Rolls-Royce Ltd., Derby (England). Combustion Technology Div.
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 Oct. 1983 18 p refs Sponsored by Procurement Executive of Ministry of Defence
(PNR-90198; REPRINT-916) Avail: NTIS HC A02/MF A01

A low emissions tubo-annular combustor was developed for the Spey aero gas turbine engine. Ten combustors form the tubo-annular combustion system. Use of Transply pseudotranspiration cooling material enables a significant saving to be made in the utilization of 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 emission levels. Durability problems are overcome. Development constraints imposed by an existing engine design are described. The rig and engine test program leading to a full definition of the aerothermodynamics of the combustor is summarized.
Author (ESA)

N84-22627# Aeronautical Research Associates of Princeton, Inc., N. J.
AIRCRAFT EXHAUST PLUME SIGNATURE PREDICTIONS FOR NON-AXISYMMETRIC MULTIPLE ENGINE INSTALLATIONS
B. E. PEARCE, R. W. MCCULLOUGH, and R. D. THORPE *In* APL The 14th JANNAF Plume Technol. Meeting, Vol. 1 p 87-95 Nov. 1983 refs
Avail: NTIS HC A07/MF A01 CSCL 21E

The exhaust plume flowfields and infrared radiation in a mid-IR bandpass are calculated for a single axisymmetric jet, a 5:1 aspect ratio rectangular nozzle, and two side-by-side axisymmetric nozzles with plume exit conditions typical of an aircraft in subsonic flight at non-afterburning thrust. The emphasis is on illustrating the different spatial distributions of the radiance from these non-axisymmetric flows. A unique combination of a three dimensional flowfield code and a radiative transfer code were used for the predictions. Plume and nozzle hot parts radiance distributions, spectra, and intensities are compared. The objective is to suggest that it is currently practical to make predictions of spatially resolved signatures for non-axisymmetric plumes of this class. Author

N84-22787# Joint Publications Research Service, Arlington, Va.
EFFECT OF ROTATION ON THERMAL STATE OF RUNNER BLADE THROUGH EFFECT ON HEAT TRANSFER ON COOLANT SIDE Abstract Only
V. Y. MITYAKOV and V. V. RIS *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 12 17 Apr. 1984 Transl. into ENGLISH from Teploenerg. (Moscow), no. 1, Jan. 1983 p 51-52
Avail: NTIS HC A03/MF A01

An experimental study and subsequent analysis established that rotation of the runner blades in high-temperature gas turbines, throught action of the Coriolis force, produces secondary flow in the passages and thus affects the heat transfer from blades to coolant. This is indicated by the profile of local heat transfer coefficients, which changes with a tendency to flatten along and around the blade as the Rossby number increases. This conclusion was verified on a GTZ-150 gas turbine running at 3000 rpm and operating at an inlet temperature of 1000 K, with 0.16 kg/s of cooling air at 473 K and 1.02 MPa for each blade. The heat transfer on the coolant side can be described either by the relation Nu = 0.021Re0.8Pr0.43 disregarding the effect of rotation of rotation or by the relation Nu sub w/Nu sub O = 1 - 1.55 cost Ro-0.56 (Re = idem approximately equals 10,000, Ro approximately 20) including the effect of rotation. R.J.F.

N84-22793# Joint Publications Research Service, Arlington, Va.
CALCULATION OF APPARENT MASSES IN BLADE RING Abstract Only
L. A. TKACHEVA *In its* USSR Rept.: Eng. and Equipment (JPRS-UEQ-84-004) p 15-16 17 Apr. 1984 Trans. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Novosibirsk, USSR), no. 5, Sep. - Oct. 1983 p 56-62 Previously announced in IAA as A84-21115
Avail: NTIS HC A03/MF A01

For the case of irrotational fluid flow along a three-dimensional annular cascade of thin blades, the plane theory of lattices is used to calculate the coefficient of apparent additional masses. The blades undergo small harmonic oscillations with constant phase shift in an incompressible fluid. The average law of oscillations is used in the case of small blade aspect ratio, and the hypothesis of cylindrical sections is used in the case of large blade aspect ratio. Author

N84-23586# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
FLUID DYNAMIC ASPECTS OF TURBINE ENGINE TESTING
J. G. MITCHELL *In* AGARD Wind Tunnels and Testing Tech. 19 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

Turbine engine testing in ground test facilities cannot rely upon the simulation parameters that are common to aerodynamic testing in wind tunnels. The interfaces between the internal fluid dynamics of the engine and the external aerodynamics of the flight vehicle are sometimes simulated in wind tunnels and sometimes duplicated in engine test facilities. The choice is primarily dictated by test facility capability and finances available for test models. This paper will discuss some of the testing techniques which have been used and denote research efforts which are directed toward extension of test procedures and facility capability. In particular, applicable material from the recent AGARD Propulsion and Energetics Panel Symposium on Turbine Engine Testing will be summarized and amplified. Some emphasis will be placed upon airframe-inlet-engine testing and the development of testing capabilities for this purpose. Author

N84-23600# Dornier-Werke G.m.b.H., Munich (West Germany).
EXPERIENCE IN ENGINE FACE, NON-STEADY, FLOW MEASUREMENTS THROUGH A SIDE AND BOTTOM ENGINE AIR INLET DUCT
D. RITCHIE and R. FRIEDRICHS (DFVLR, Brunswick) *In* AGARD Wind Tunnels and Testing Tech. 18 p Feb. 1984 Sponsored by German Ministry of Defense
Avail: NTIS HC A22/MF A01

Two types of turbine engine air inlets are described. Models of these inlets are instrumented with high frequency pressure sensors and turbulence levels are measured in the wind tunnel for various mass flow ratios, angles of attack and sideslip angles. The instrumentation and methods of data reduction and analysis are described. Some results are shown to support the merit of high frequency, non stationary instrumentation. Non stationary data are compared with stationary measurements taken at the same time. M.A.C.

N84-23629*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
V/STOL MODEL FAN STAGE RIG DESIGN REPORT
J. G. CHEATHAM and T. L. CREASON Aug. 1983 280 p refs
(Contract NAS3-22779)
(NASA-CR-174688; NAS 1.26:174688; PWA/GPD-FR-17826)
Avail: NTIS HC A13/MF A01 CSCL 21E

A model single-stage fan with variable inlet guide vanes (VIGV) was designed to demonstrate efficient point operation while providing flow and pressure ratio modulation capability required for a V/STOL propulsion system. The fan stage incorporates a split-flap VIGV with an independently actuated ID flap to permit independent modulation of fan and core engine airstreams, a flow splitter integrally designed into the blade and vanes to completely segregate fan and core airstreams in order to maximize core stream supercharging for V/STOL operation, and an EGV with a variable leading edge fan flap for rig performance optimization. The stage was designed for a maximum flow size of 37.4 kg/s (82.3 lb/s) for compatibility with LeRC test facility requirements. Design values at maximum flow for blade tip velocity and stage pressure ratio are 472 m/s (1550 ft/s) and 1.68, respectively. Author

N84-23630*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ASSESSMENT OF ALTERNATIVE AIRCRAFT FUELS
Washington Apr. 1984 188 p refs Conf. held in Cleveland, 2-3 Nov. 1983
(NASA-CP-2307; E-1878; NAS 1.55:2307) Avail: NTIS HC A09/MF A01 CSCL 21D

The purpose of this symposium is to provide representatives from industry, government, and academia concerned with the availability and quality of future aviation turbine fuels with recent technical results and a status review of DOD and NASA sponsored fuels research projects. The symposium has included presentations on the potential crude sources, refining methods, and characteristics of future fuels; the effects of changing fuel characteristics on the performance and durability of jet aircraft components and systems; and the prospects for evolving suitable technology to produce and use future fuels.

N84-23634*# United Technologies Research Center, East Hartford, Conn.
INFLUENCE OF FUEL CHEMICAL PROPERTIES ON GAS TURBINE COMBUSTORS
T. J. ROSFJORD *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 31-46 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 21E

In an attempt to rigorously study the fuel chemical property influence, UTRC (United Technologies Research Center) (under contract to NASA Lewis Research Center) has conducted an experimental program using 25 test fuels. The burner was a 12.7 cm dia cylindrical device consisting of six sheet metal louvers. A single pressure atomizing injector and air swirler were centrally mounted with the conical dome. Fuel physical properties were

de-emphasized by using fuel injectors which produced highly atomized, and hence rapidly vaporizing sprays. A substantial fuel spray characterization effort was conducted to allow selection of nozzles which assured that such sprays were achieved for all fuels. The fuels were specified to cover the following wide ranges of chemical properties: hydrogen, 9.1 to 15 (wt) pct; total aromatics, 0 to 100 (vol) pct; and naphthalene, 0 to 30 (vol) pct. They included standard fuel (e.g., Jet A, JP4), specialty products (e.g., decalin, xylene tower bottoms) and special fuel blends. Included in this latter group were six, 4-component blends prepared to achieve parametric variations in fuel hydrogen, total aromatics and naphthalene contents. Author

N84-23635*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

FUEL PROPERTY EFFECTS ON USAF GAS TURBINE ENGINE COMBUSTORS AND AFTERBURNERS

C. M. REEVES *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 47-62 Apr. 1984 refs

Avail: NTIS HC A09/MF A01 CSCL 21E

Since the early 1970s, the cost and availability of aircraft fuel have changed drastically. These problems prompted a program to evaluate the effects of broadened specification fuels on current and future aircraft engine combustors employed by the USAF. Phase 1 of this program was to test a set of fuels having a broad range of chemical and physical properties in a select group of gas turbine engine combustors currently in use by the USAF. The fuels ranged from JP4 to Diesel Fuel number two (DF2) with hydrogen content ranging from 14.5 percent down to 12 percent by weight, density ranging from 752 kg/sq m to 837 kg/sq m, and viscosity ranging from 0.830 sq mm/s to 3.245 sq mm/s. In addition, there was a broad range of aromatic content and physical properties attained by using Gulf Mineral Seal Oil, Xylene Bottoms, and 2040 Solvent as blending agents in JP4, JP5, JP8, and DF2. The objective of Phase 2 was to develop simple correlations and models of fuel effects on combustor performance and durability. The major variables of concern were fuel chemical and physical properties, combustor design factors, and combustor operating conditions. B.W.

N84-23636*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla.

FUEL PROPERTY EFFECTS ON USN GAS TURBINE COMBUSTORS

A. I. MASTERS, S. A. MOSIER, and C. J. NOWACK (Naval Air Propulsion Center) *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 63-72 Apr. 1984

Avail: NTIS HC A09/MF A01 CSCL 21E

For several years the Department of Defense has been sponsoring fuel accommodation investigations with gas turbine engine manufacturers and supporting organizations to quantify the effect of changes in fuel properties and characteristics on the operation and performance of military engine components and systems. Inasmuch as there are many differences in hardware between the operational engines in the military inventories, due to differences in design philosophy and requirements, efforts were initially expended to acquire fuel effects data from rigs simulating the hot sections of these different engines. Correlations were then sought using the data acquired to produce more general, generic relationships that could be applied to all military gas turbine engines regardless of their origin. Finally, models could be developed from these correlations that could predict the effect of fuel property changes on current and future engines. This presentation describes some of the work performed by Pratt and Whitney Aircraft, under Naval Air Propulsion Center sponsorship, to determine the effect of fuel properties on the hot section and fuel system of the Navy's TF30-P-414 gas turbine engine. Author

N84-23639*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.

ANALYTICAL FUEL PROPERTY EFFECTS: SMALL COMBUSTORS

J. D. COHEN *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 89-98 Apr. 1984

Avail: NTIS HC A09/MF A01 CSCL 21E

The study performed in Phase 1 of this program applies only to a T700/CT7 engine family type combustor functioning in the engine as defined and does not necessarily apply to other cycles or combustors of differing stoichiometry. The study was not extended to any of the fuel delivery accessories such as pumps or control systems, nor was there any investigation of potential systems problems which might arise as a consequence of abnormal properties such as density which might affect delivery schedules or aromatics content which might affect fuel system seals. The T700/CT7 engine is a front drive turboshaft or turboprop engine in the 1500-1800 shp (1120-1340 kW) class as currently configured with highpower core flows of about 10 lb/sec (4.5 kg/sec). It employs a straight-through annular combustion system less than 5 in. (12.5 cm) in length utilizing a machined ring film cooled construction and twelve low-pressure air blast fuel injectors. Commercial and Naval versions employ two 0.5 Joule capacitive discharge surface gap ignitors. B.W.

N84-23648*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONTINGENCY POWER CONCEPTS FOR HELICOPTER TURBOSHAFT ENGINE

R. HIRSCHKRON (General Electric Co., Lynn, Mass.), R. H. DAVIS (General Electric Co., Lynn, Mass.), D. N. GOLDSTEIN (General Electric Co., Lynn, Mass.), J. F. HAYNES (General Electric Co., Lynn, Mass.), and J. W. GAUNTNER 1984 14 p refs Presented at the 40th Ann. Forum of the American Helicopter Society, Arlington, Va., 16-18 May 1984

(NASA-TM-83679; E-2128; NAS 1.15:83679; A-83-40-66-7000)

Avail: NTIS HC A02/MF A01 CSCL 21E

Twin helicopter engines are often sized by power requirement of 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 minute Contingency Power rating, permitting an engine size reduction. The merits of water injection, cooling flow modulation, throttle push and an auxiliary power plant were evaluated using military life cycle cost (LCC) and commercial helicopter direct operating cost (DOC) merit factors in a rubber engine/rubber aircraft scenario. Author

N84-23649*# Rensselaer Polytechnic Inst., Troy, N. Y. Gas Dynamics Lab.

INVESTIGATION OF THE EFFECTS OF PRESSURE GRADIENT, TEMPERATURE AND WALL TEMPERATURE RATIO ON THE STAGNATION POINT HEAT TRANSFER FOR CIRCULAR CYLINDERS AND GAS TURBINE VANES Final Report

H. T. NAGAMATSU and R. E. DUFFY Apr. 1984 43 p refs Sponsored in part by National Science Foundation

(Contract NAG3-292)

(NASA-CR-174667; NAS 1.26:174667) Avail: NTIS HC A03/MF A01 CSCL 21E

Low and high pressure shock tubes were designed and constructed for the purpose of obtaining heat transfer data over a temperature range of 390 to 2500 K, pressures of 0.3 to 42 atm, and Mach numbers of 0.15 to 1.5 with and without pressure gradient. A square test section with adjustable top and bottom walls was constructed to produce the favorable and adverse pressure gradient over the flat plate with heat gages. A water cooled gas turbine nozzle cascade which is attached to the high pressure shock tube was obtained to measuse the heat flux over pressure and suction surfaces. Thin-film platinum heat gages with a response time of a few microseconds were developed and used to measure the heat flux for laminar, transition, and turbulent boundary layers. The laminar boundary heat flux on the shock tube wall agreed with Mirel's flat plate theory. Stagnation point

heat transfer for circular cylinders at low temperature compared with the theoretical prediction, but for a gas temperature of 922 K the heat fluxes were higher than the predicted values. Preliminary flat plate heat transfer data were measured for laminar, transition, and turbulent boundary layers with and without pressure gradients for free-stream temperatures of 350 to 2575 K and flow Mach numbers of 0.11 to 1.9. The experimental heat flux data were correlated with the laminar and turbulent theories and the agreement was good at low temperatures which was not the case for higher temperatures. Author

N84-23650*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A MODEL FOR REACTION RATES IN TURBULENT REACTING FLOWS
W. CHINITZ (Cooper Union, New York) and J. S. EVANS May 1984 45 p refs
(NASA-TM-85746; L-15679; NAS 1.15:85746) Avail: NTIS HC A03/MF A01 CSCL 21E

To account for the turbulent temperature and species-concentration fluctuations, a model is presented on the effects of chemical reaction rates in computer analyses of turbulent reacting flows. The model results in two parameters which multiply the terms in the reaction-rate equations. For these two parameters, graphs are presented as functions of the mean values and intensity of the turbulent fluctuations of the temperature and species concentrations. These graphs will facilitate incorporation of the model into existing computer programs which describe turbulent reacting flows. When the model was used in a two-dimensional parabolic-flow computer code to predict the behavior of an experimental, supersonic hydrogen jet burning in air, some improvement in agreement with the experimental data was obtained in the far field in the region near the jet centerline. Recommendations are included for further improvement of the model and for additional comparisons with experimental data. Author

N84-23651# Rolls-Royce Ltd., Derby (England).
FUTURE ENGINE TECHNOLOGIES AND THEIR EFFECT ON MAINTENANCE
P. CURLEY 1983 41 p
(PNR-90190; REPRINT-903) Avail: NTIS HC A03/MF A01

The effects on maintenance of changes in turbofan engines to decrease fuel consumption, improve reliability and environmental acceptability, and reduce overall cost of ownership are discussed. Increased mechanization of maintenance tasks, and adoption of operationally oriented engine management policy are predicted. With nondestructive test techniques and the introduction of retirement for cause, more economic use of major rotating components is possible. The introduction of electronic control systems with associated test facilities speeds up troubleshooting with gains in despatch reliability. Author (ESA)

08

AIRCRAFT STABILITY AND CONTROL

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

A84-30274
ROBUSTNESS AGAINST SENSOR FAILURES
J. ACKERMANN (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wessling, West Germany) Automatica (ISSN 0005-1098), vol. 20, March 1984, p. 211-215. refs

Parameter space design of control systems is extended to accommodate requirements for robustness against sensor failures. The relation with failure detection is discussed. A fixed gain controller is designed for the stabilization of an unstable aircraft such that the pole region requirements are met in four typical flight conditions. This is achieved only with two parallel gyros. The pole region properties are made robust against failure of one gyro. Author

A84-30801#
TWENTY-FIVE YEARS OF HANDLING QUALITIES RESEARCH
I. L. ASHKENAS (Systems Technology, Inc., Hawthorne, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 289-301. refs
(AIAA PAPER 82-1353)

Handling qualities are briefly defined as those dynamic and static properties of a vehicle which permit the pilot to fully exploit its performance and other potential in a variety of missions and roles. Three recognized facets to handling are related to trim and unattended operation, large amplitude maneuvers, and regulation and precision flying. Attention is given to some past applications of pilot-vehicle-display system analyses to a design, flight encountered problems, and simulation. Good path regulation properties are examined, taking into account inner loop control integrity and equalization potential, adequacy and ordering of path control loop bandwidths, uncoupled or complementary control responses, the minimum depletion of safety margins, control economy, and control harmony. Aspects of attitude control and path control are also explored. G.R.

A84-31225
HORIZONTAL VARIABLE-SPEED INTERCEPTION GAME SOLVED BY FORCED SINGULAR PERTURBATION TECHNIQUE
J. SHINAR and N. FARBER (Technion - Israel Institute of Technology, Haifa, Israel) Journal of Optimization Theory and Applications (ISSN 0022-3239), vol. 42, April 1984, p. 603-636. refs
(Contract F49620-79-C-0135)

The time-optimal pursuit-evasion game in the horizontal plane between two airplanes is analyzed by applying the technique of forced singular perturbations (FSPT). Based on the assumption of multiple time scale separation, a zeroth-order closed-form solultion is obtained, enabling one to use realistic aerodydnamic and propulsion data. Control strategies are approximated by explicit feeback expresions of the state variables and the aircraft performance parameters. The zeroth-order feedback approximation is compared to the optimal open-loop solution of the game. This comparison confirms the validity of the FSPT approximation for sufficiently large initial distances of separation. Author

A84-31712*# California Univ., Los Angeles.
AEROMECHANICAL STABILITY ANALYSIS OF A MULTIROTOR VEHICLE MODEL REPRESENTING A HYBRID HEAVY LIFT AIRSHIP (HHLA)
C. VENKATESAN and P. P. FRIEDMANN (California, University, Los Angeles, CA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 251-265. refs
(Contract NAG2-116)
(AIAA PAPER 84-0987)

Hybrid Heavy Lift Airship (HHLA) is a proposed candidate vehicle aimed at providing heavy lift capability at low cost. This vehicle consists of a buoyant envelope attached to a supporting structure to which four rotor systems, taken from existing helicopters are attached. Nonlinear equations of motion capable of modelling the dynamics of this coupled multi-rotor/support frame/vehicle system have been developed. Using these equations of motion the aeroelastic and aeromechanical stability analysis is performed aimed at identifying potential instabilities which could occur for this type of vehicle. The coupling between various blade, supporting structure and rigid body modes is identified. Furthermore, the effects of changes in buoyancy ratio (Buoyant lift/total weight) on the dynamic characteristics of the vehicle are studied. The dynamic effects found are of considerable importance for the design of such vehicles. The analytical model developed is also useful for

studying the aeromechanical stability of single rotor and tandem rotor coupled rotor/fuselage systems. Author

A84-31748*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC CALCULATION OF AIRFOIL STABILITY AND RESPONSE WITH ACTIVE CONTROLS
J. T. BATINA (NASA, Langley Research Center, Unsteady Aerodynamics Branch, Hampton, VA) and T. Y. YANG (Purdue University, West Lafayette, IN) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 578-588. refs
(AIAA PAPER 84-0873)

Transonic aeroelastic stability and response analyses are performed for the MBB A-3 supercritical airfoil. Three degrees of freedom are considered: plunge, pitch, and aileron pitch. The objective of this study is to gain insight into the control of airfoil stability and response in transonic flow. Stability analyses are performed using a Padeaeroelastic model based on the use of the LTRAN2-NLR transonic small-disturbance finite-difference computer code. Response analyses are performed by coupling the structural equations of motion to the unsteady aerodynamic forces of LTRAN2-NLR. The focus of the present effort is on transonic time-marching transient response solutions using modal identification to determine stability. Frequency and damping of these modes are directly compared in the complex s-plane with Pademodel eigenvalues. Transonic stability and response characteristics of two-dimensional airfoils are discussed and comparisons are made. Application of the Padeaeroelastic model and time-marching analyses to flutter suppression using active controls is demonstrated. Author

A84-32291
VTOL AIRCRAFT CONTROL OUTPUT TRACKING SENSITIVITY DESIGN
J. D. DE MELO (Santa Catarina, Universidade Federal, Florianopolis, Brazil) and S. N. SINGH (Vigyan Research Associates, Inc., Hampton, VA) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-20, March 1984, p. 82-93. refs

A method is presented for reducing trajectory sensitivity and achieving robust asymptotic tracking for linear feedback systems when there are parameter perturbations and disturbance inputs. The controller consists of a servocompensator containing the modes of the reference signals and disturbance inputs, a stabilizing feedback loop, and a feedforward compensator. Application of the method to the design of a vertical takeoff and landing (VTOL) aircraft flight control system is discussed. The use of a precompensator allows performance maneuvers such that the aircraft tracks desired trajectories and the feedforward and feedback signals aid in reducing the trajectory sensitivity to variations of parameters due to change in airspeed and to wind gust. Simulation results are presented to show the robust tracking, disturbance rejection, and sensitivity reduction capabilities of the flight control system. Author

A84-32472#
LATERAL-DIRECTIONAL STABILITY - THEORETICAL ANALYSIS AND FLIGHT TEST EXPERIENCE
A. FAULKNER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) and M. KLOSTER (Muenchen, Fachhochschule, Munich, West Germany) Associazione Industrie Aerospaziali and Associazione Italiana di Aeronautica ed Astronautica, European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983. 18 p. refs
(MBB-UD-402-83-OE)

The coupled lateral-directional dynamic stability (Dutch roll) for the helicopter is analysed theoretically using the technique of linearized stability derivatives. Sensitivity studies are used to highlight the most important derivatives for this mode and the model reduction to approximate formulae for the frequency and damping ratio is validated. Data based on parameter identification and a theoretical model are used. The composition of the derivatives is discussed, showing the most important moment and force sources from the rotor, fin and tail rotor. Practical experience from the BK 117 and BO 105 family of helicopters is presented and intepreted. It is shown that nonlinear aerodynamic effects caused by the fuselage and rotor wakes play an important role in the dynamic response and must be considered during the design stage. A balanced tail configuration is suggested. Author

A84-32698#
FIGHTER MANEUVERABILITY
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 22, May 1984, p. 80-83.

Current research for NASA's Aeronautical Systems Division on improving the maneuverability of fighter aircraft is discussed. The goal of the research is to develop aircraft designs which permit quicker maneuvers through the use of more efficient wing configurations, canards, digital control inflight thrust reversal, and VTOL and STOL technology. In a study of adapting an Augmented Defector Exhaust Nozzle (ADEN) to the forward swept wing X-29 fighter aircraft, it was found that the X-29 wing already converts centerline thrust to lift and turning force, and instantaneous turn rate was improved by only 4 percent. Thrust reversers are shown to increase the speed at which an aircraft decelerates, allowing the pilot to reach optimal turning speed more rapidly, thereby making a tighter turn. Future research will focus on VTOL and STOL capabilities, and competing designs of modified VTOL/STOL testbed aircraft are described. The aircraft chosen must have a two-dimensional nozzle with thrust vectoring and reversing, integrated control, and features to facilitate all-weather landings and takeoffs from damaged runways. I.H.

A84-32711#
ANALYTICAL DESIGN AND ASSURANCE OF DIGITAL FLIGHT CONTROL SYSTEM STRUCTURE
D. B. MULCARE, W. G. NESS, and R.M. DAVIS (Lockheed-Georgia Co., Marietta, GA) Journal of Guidance, Control and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 329-337. refs

Previously cited in issue 20, p. 3155, Accession no. A82-40434

A84-32713#
OPTIMAL CONTROL APPLIED TO AIRCRAFT FLUTTER SUPPRESSION
C. HWANG and W. S. PI (Northrop Corp., Aircraft Div., Hawthorne, CA) (Structures, Structural Dynamics and Materials Conference, 23rd, New Orleans, LA, May 10-12, 1982, Collection of Technical Papers. Part 2, p. 427-438) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 347-354. refs
(Contract F33615-80-C-3217)

Previously cited in issue 13, p. 2023, Accession no. A82-30173

A84-32715#
DESIGN AND FLIGHT TEST OF A LATERAL-DIRECTIONAL COMMAND AUGMENTATION SYSTEM
D. ATZHORN (USAF, Washington, DC) and R. G. STENGEL (Princeton University, Princeton, NJ) (Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers, p. 580-592) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, May-June 1984, p. 361-368. refs
(Contract N00014-78-C-0257)

Previously cited in issue 03, p. 332, Accession no. A82-13527

A84-32788
AN INVESTIGATION OF LARGE AMPLITUDE WING-ROCK
C. EVANS (Bristol, University, Bristol, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, March 1984, p. 51-57. Research supported by the Science and Engineering Research Council. refs

The large amplitude wing-rock of a ground attack aircraft was investigated by the use of a small perturbation, linear stability analysis and a nonlinear simulation of the aircraft dynamics. The linear stability analysis compared the results from a complete six degrees-of-freedom (DOF) coupled equation set with the results obtained using a six-DOF dynamic stability axis set. The results showed an oscillatory instability that was caused by frequency coalescence of the primary pitch and yaw modes. The simulation produced a rolling motion similar in nature to wing-rocks experienced in flight. The large amplitude oscillation was generated by the nonlinear variations of the aerodynamic loads rather than by the instability predicted by the linearized dynamics. Specifically, the appearance of nonzero lateral moments at zero sideslip as well as shock-induced jumps in the rolling moment against sideslip curves were major contributors to the motion. These features of the static aerodynamic data are thus considered better warnings of the possibility of large amplitude wing-rock than is the negatively damped Dutch-roll oscillation predicted by the linearized analysis. Author

A84-33136*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INVESTIGATION OF CONTROL LAW RECONFIGURATIONS TO ACCOMMODATE A CONTROL ELEMENT FAILURE ON A COMMERCIAL AIRPLANE
A. J. OSTROFF and R. M. HUESCHEN (NASA, Langley Research Center, Hampton, VA) American Automatic Control Council, American Control Conference, San Diego, CA, June 6-8, 1984, Paper. 10 p. refs

The ability of a pilot to reconfigure the control surfaces on an airplane after a failure, allowing the airplane to recover to a safe condition, becomes more difficult with increasing airplane complexity. Techniques are needed to stabilize and control the airplane immediately after a failure, allowing the pilot more time to make longer range decisions. This paper presents a baseline design of a discrete multivariable control law using four controls for the longitudinal channel of a B-737. Non-reconfigured and reconfigured control laws are then evaluated, both analytically and by means of a digital airplane simulation, for three individual control element failures (stabilizer, elevator, spoilers). The simulation results are used to evaluate the effectiveness of the control reconfiguration on tracking ability during the approach and landing phase of flight with severe windshear and turbulence disturbing the airplane dynamics. Author

N84-22583*# Textron, Inc., Irvine, Calif. Systems Engineering Div.
TECHNOLOGY REVIEW OF FLIGHT CRUCIAL FLIGHT CONTROLS
H. A. REDIESS and E. C. BUCKLEY Apr. 1984 93 p refs (Contract NAS1-17403)
(NASA-CR-172332; NAS 1.26:172332; HR-78500037) Avail: NTIS HC A05/MF A01 CSCL 01C

The results of a technology survey in flight crucial flight controls conducted as a data base for planning future research and technology programs are provided. Free world countries were surveyed with primary emphasis on the United States and Western Europe because that is where the most advanced technology resides. The survey includes major contemporary systems on operational aircraft, R&D flight programs, advanced aircraft developments, and major research and technology programs. The survey was not intended to be an in-depth treatment of the technology elements, but rather a study of major trends in systems level technology. The information was collected from open literature, personal communications and a tour of several companies, government organizations and research laboratories in the United States, United Kingdom, France, and the Federal Republic of Germany. Author

N84-22584*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL MANEUVERABILITY AND CONTROL
J. A. FRANKLIN and S. B. ANDERSON Apr. 1984 50 p refs (NASA-TM-85939; A-9697; NAS 1.15:85939) Avail: NTIS HC A03/MF A01 CSCL 01C

Maneuverability and control of V/STOL aircraft in powered-lift 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 ontrol 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. S.L.

N84-22585*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FORMULATION AND ANALYSIS OF COMBAT GAMES
M. HEYMANN (Technion - Israel Inst. of Tech.), M. D. ARDEMA, and N. RAJAN (Stanford Univ., Calif.) Apr. 1984 40 p refs (NASA-TM-85927; A-9678; NAS 1.15:85927) Avail: NTIS HC A03/MF A01 CSCL 12B

Combat which is formulated as a dynamical encounter between two opponents, each of whom has offensive capabilities and objectives is outlined. A target set is associated with each opponent in the event space in which he endeavors to terminate the combat, thereby winning. If the combat terminates in both target sets simultaneously, or in neither, a joint capture or a draw, respectively, occurs. Resolution of the encounter is formulated as a combat game; as a pair of competing event constrained differential games. If exactly one of the players can win, the optimal strategies are determined from a resulting constrained zero sum differential game. Otherwise the optimal strategies are computed from a resulting nonzero sum game. Since optimal combat strategies may frequently not exist, approximate or delta combat games are also formulated leading to approximate or delta optimal strategies. The turret game is used to illustrate combat games. This game is sufficiently complex to exhibit a rich variety of combat behavior, much of which is not found in pursuit evasion games. E.A.K.

N84-23653*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MATHEMATICAL MODEL OF THE UH-60 HELICOPTER
K. B. HILBERT Apr. 1984 44 p refs
(NASA-TM-85890; A-9646; NAS 1.15:85890; USAAVSCOM-TM-84-A-2) Avail: NTIS HC A03/MF A01 CSCL 01C

This report documents the revisions made to a ten-degree-of-freedom, full-flight envelope, generic helicopter mathematical model to represent the UH-60 helicopter accurately. The major modifications to the model include fuselage aerodynamic force and moment equations specific to the UH-60, a canted tail rotor, a horizontal stabilator with variable incidence, and a pitch bias actuator (PBA). In addition, this report presents a full set of parameters and numerical values which describe the helicopter configuration and physical characteristics. Model validation was accomplished by comparison of trim and stability derivative data generated from the UH-60 math model with data generated from a similar total force and moment math model. Author

N84-23654*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOW-SPEED WIND-TUNNEL STUDY OF THE HIGH-ANGLE-OF-ATTACK STABILITY AND CONTROL CHARACTERISTICS OF A CRANKED-ARROW-WING FIGHTER CONFIGURATION
S. B. GRAFTON May 1984 39 p refs
(NASA-TM-85776; L-15762; NAS 1.15:85776) Avail: NTIS HC A03/MF A01 CSCL 01C

The low-speed, high-angle-of-attack stability and control characteristics of a fighter configuration incorporating a cranked arrow wing were investigated in the Langley 30- by 60-foot tunnel as part of a NASA/General Dynamics cooperative research program to investigate the application of advanced wing designs to combat aircraft. Tests were conducted on a baseline configuration and on several modified configurations. The results show that the baseline configuration exhibited a high level of maximum lift but displayed undesirable longitudinal and lateral-directional stability characteristics at high angles of attack. Various wing modifications were made which improved the longitudinal and lateral-directional stability characteristics of the configuration at high angles of attack. However, most of the modifications were detrimental to maximum lift. Author

N84-23655*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF HELICOPTER GUST RESPONSE ALLEVIATION BY AUTOMATIC CONTROL
S. SAITO Dec. 1983 103 p refs
(NASA-TM-85870; A-9578; NAS 1.15:85870) Avail: NTIS HC A06/MF A01 CSCL 01C

Two control schemes designed to alleviate gust-induced vibration are analytically investigated for a helicopter with four articulated blades. One is an individual blade pitch control scheme. The other is an adaptive blade pitch control algorithm based on linear optimal control theory. In both controllers, control inputs to alleviate gust response are superimposed on the conventional control inputs required to maintain the trim condition. A sinusoidal vertical gust model and a step gust model are used. The individual blade pitch control, in this research, is composed of sensors and a pitch control actuator for each blade. Each sensor can detect flapwise (or lead-lag or torsionwise) deflection of the respective blade. The acturator controls the blade pitch angle for gust alleviation. Theoretical calculations to predict the performance of this feedback system have been conducted by means of the harmonic method. The adaptive blade pitch control system is composed of a set of measurements (oscillatory hub forces and moments), an identification system using a Kalman filter, and a control system based on the minimization of the quadratic performance function. B.W.

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.

A84-31331
A SUCCESSFUL EXPERIMENT - THE THERMAL REPAVING OF THE RUNWAY AT CAZAUX AIR BASE [UNE EXPERIENCE REUSSIE - LA THERMOREGENERATION DE LA PISTE BASE AERIENNE DE CAZAUX]
M. VIVIER (Entreprise Jean Lefebvre, Neuilly-sur-Seine, Hauts-de-Seine, France) Revue Generale des Routes et des Aerodromes (ISSN 0035-3191), vol. 58, Jan. 1984, p. 53, 54. In French.

A84-31332
COMPOPAVE THERMAL REPAVING IN BELGIUM - RENEWAL OF THE RUNWAY OF THE MILITARY AIRFIELD AT GOETSENHOVEN [LA THERMOREGENERATION COMPOPAVE EN BELGIQUE - RENOVATION DE LA PISTE DE L'AERODROME MILITAIRE DE GOETSENHOVEN]
J. DOUALIN (SocieteGravibel, Namur, Belgium) and P. MICHAUD (SocieteChimique, Routiere et d'Entreprise Generale, S.A., Puteaux, Hauts-de-Seine, France) Revue Generale des Routes et des Aerodromes (ISSN 0035-3191), vol. 58, Jan. 1984, p. 56, 57. In French.

The repaving of the 45,000-sq m runway surface at Goetsenhoven military air base in Belgium with 50 kg/sq m of asphaltic concrete containing 6.4 percent asphalt is described. The operation of the preheating, paving, and compacting machines is explained, the components of the coating applied are listed in a table, and the coverage of the runway area (in 3.75-m bands of final thickness 2 cm) is characterized. The work was delayed somewhat by significant heat losses associated with strong winds, low temperatures, and rain. T.K.

A84-31333
THE RECONSTRUCTION OF THE INTERNATIONAL AIRPORT AT PRAGUE-RUZYNE [RECONSTRUCTION DE L'AEROPORT INTERNATIONAL DE PRAGUE-RUZYNE]
L. ZADNIK, J. SUCHY, and V. CHUPIK (Dopravni Stavby, Olomouc, Czechoslovakia) Revue Generale des Routes et des Aerodromes (ISSN 0035-3191), vol. 58, Feb. 1984, p. 35-39. In French.

The construction techniques employed in resurfacing the runways and taxiways at Prague-Ruzyne International Airport are characterized, with a focus on the 437,000 sq m of concrete surface slabs for the runways (one 2900 x 52.5 m and one 3850 x 60 m). The composition and preparation of the concrete, its application (using a sliding-form finisher) in 7.5-m-wide strips, the sawing of the expansion joints, and the results of various testing procedures are discussed. It is found that the shrinkage of the concrete slabs can be controlled by decreasing the amount of the alite in the SC-70 cement by 50-60 percent, increasing the amount of belite by 20-30 percent, and decreasing the specific surface (as measured by a Blaine permeameter) to 3000 sq cm/g. Photographs of the equipment, diagrams and maps of the project, and tables of materials specifications and test results are included. T.K.

A84-32024
DEVELOPMENT OF A MODULAR ELECTROMAGNETIC LAUNCHER SYSTEM FOR THE AIR FORCE ARMAMENT LABORATORY
J. DAOUST, R. CREEDON, L. FRANKLIN, P. MILLER, A. PEURON (GA Technologies, Inc., San Diego, CA), K. COBB, and B. LUCAS (GA Technologies, Inc., San Diego, CA; USAF, Armament Laboratory, Eglin AFB, FL) (Institute of Electrical and Electronics Engineers, Symposium on Electromagnetic Launch Technology, 2nd, Boston, MA, Oct. 10-13, 1983) IEEE Transactions on Magnetics (ISSN 0018-9464), vol. MAG-20, March 1984, p. 294-297. refs
(Contract F08635-82-C-0402)

An evaluation is being conducted of the potential of electromagnetic launchers (EML) to fire small projectiles at high velocities from aircraft against air or ground targets, or in fixed or mobile defense against attacking aircraft. As part of the evaluation program, a modular EML was designed, fabricated, and delivered for study of a broad range of technology issues. Preliminary tests verified that the EML system met performance specifications. The launcher is currently undergoing tests to demonstrate its full capabilities. Aspects of system design and analysis are discussed, taking into account the accelerator rails, the pulse-forming networks, parallel-plate feedlines, and the helium-driven preaccelerator. Attention is given to the barrel structure, the power source for accelerating a 10 g projectile to 3.0 km/s over over the 4 m rail length, instrumentation and controls, the Air Force use of the EML, and a computer simulation to accommodate considered power source configurations. G.R.

A84-32443
AUTOMATED DATA SYSTEM FOR HELICOPTER STRUCTURAL FATIGUE TESTING
A. S. CARNICKE (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN: ITC/USA/'82; Proceedings of the International Telemetering Conference, San Diego, CA, September 28-30, 1982 . Research Triangle Park, NC, Instrument Society of America, 1982, p. 687-695. refs

A description is given of an automated data acquisition and control system which satisfies the specific requirements of full-scale helicopter airframe structural fatigue testing. The system is used to test the airframe of the Navy's SH-60B Seahawk helicopter. It was estimated by test personnel that the total program test time was half of what it would have been without the level of automation provided by the shaker controller and the data system. It is noted that the Seahawk test engineers were fully competent in the operation with as little as four hours of orientation. Shakers controlled by microprocessors apply dynamic loads to the test article and simulate a typical flight profile, that is, take-off, climb, cruise, descent, hover and landing. The automated data system, based on minicomputers, acquires as many as 128 measurement channels consisting of outputs from accelerometers and strain gages with an overall data system throughput rate of 50,000 samples per second. C.R.

A84-32479
CRYOGENIC METHODS IN WIND TUNNELS [METHODES CRYOGENIQUES EN SOUFFLERIE]
A. MIGNOSI (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 31 p. In French.
(AAAF PAPER NT 83-08)

Current progress in the application of low-temperature techniques to achieve flightlike Reynolds numbers in wind tunnels is surveyed. The basic principles of cryogenic-wind-tunnel operation and the associated boundary-layer, transition, flow-quality, and condensation-limit problems are reviewed; and the technology and instrumentation employed in the various facilities (NTF, ETW, KKK, T2, PETW) are discussed and illustrated with diagrams. T.K.

A84-32481
MODERNIZATION OF THE BREGUET LOW-SPEED WIND TUNNEL AT VELIZY [MODERNISATION DE LA SOUFFLERIE BASSE VITESSE BREGUET DE VELIZY]
A. SAMBLAT (Avions Marcel Dasault-Breguet Aviation, Vaucresson, Hauts-de-Seine, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 20 p. In French.
(AAAF PAPER NT 83-11)

The modifications introduced in the data-processing system of the Breguet wind tunnel are examined, and some typical results are shown. The limitations of the previous system are reviewed, and need for real-time analysis is indicated. A multiprogramming executive system is combined with a SOLAR 16-40 architecture to provide increased computing power in both time-sharing-interactive and batch modes, with active memory capacity 128 K 16-bit words, easily expandable to 256 K. The microprocessor hardware implementation is described, and illustrated with block diagrams, and results for an air-intake experiment are presented graphically. The modernized system permits more efficient use of the facility; e.g., an increase from 2000 to 4000 tests/year. T.K.

A84-32491
GROUND-EFFECT MEASUREMENTS AT THE CEAT AEROHYDRODYNAMIC TUNNEL [MESURES D'EFFET DE SOL AU TUNNEL AEROHYDRODYNAMIQUE DU C.E.A.T.]
M. HUMBERTCLAUDE (Toulouse, Centre d'Essais Aeronautique, Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 20th, Toulouse, France, Nov. 8-10, 1983. 55 p. In French.
(AAAF PAPER NT 83-24)

The design of the wind-tunnel facility at the Centre d'Essais Aeronautique de Toulouse (CEAT) and its application to ground-effect studies are discussed and illustrated with drawings and graphs of typical results. The CEAT tunnel employs a streamlined moving platform to carry the model at velocities up to 40 m/sec over a 1200-m-long water surface of variable height. Results of tests on ACT, Falcon 900, and A310 models are compared with those obtained in conventional wind tunnels (using fixed or moving floors), demonstrating the advantages of the moving-platform technique. T.K.

A84-32792
DESIGN AND PERFORMANCE OF A NEW LOW TURBULENCE WIND TUNNEL AT BRISTOL UNIVERSITY
R. V. BARRETT (Bristol, University, Bristol, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, March 1984, p. 86-90. refs

Attention is given to the design features and performance characteristics of a low speed, low turbulence wind tunnel of conventional design and modest scale, which follows the guidelines of Bradshaw and Pankhurst (1964). The goal of this wind tunnel design and construction effort was to achieve a turbulence intensity lower than 0.1 percent with negligible spatial variation of velocity. To offset the small size of the tunnel, a high top speed was chosen as the means of achieving the greatest possible Reynolds numbers. The maximum wind speed measured in the empty working section was 104.7 m/s at 30 C, equivalent to Mach 0.3. The flow in the tunnel's working section has exhibited a high degree of spatial uniformity. O.C.

N84-22586 British Aerospace Dynamics Group, Bristol (England).
ELECTRO-MAGNETIC COMPATABILITY TEST FACILITY, BRISTOL
May 1982 67 p
(BAE-BT-10658) Avail: Issuing Activity

A computerized electromagnetic compatability data acquisition and plotting facility for conducted and radiated emissions up to 18GHz is described. Aerial correction factors, current probe transfer functions, cable losses and bandwidth factors are stored in the computer and removed from raw spectral data automatically. The emissions are plotted out directly in engineering units against the appropriate specification limits. For data presentation, graphical - specification; graphical with above specification emissions only; and tabular listing of emissions are possible. Continuous RF swept signal (CW or modulated) at very high electric field levels (200V/m typical) up to 18GHz are created. The facility can analyze problems at component or system level, and meets British Ministry of Defense, and NATLAS standards. Author (ESA)

N84-22587# ICON, Inc., San Diego, Calif.
DEVICE 2E6 (ACMS) AIR COMBAT MANEUVERING SIMULATOR INSTRUCTOR CONSOLE REVIEW Final Report
J. P. CHARLES Dec. 1983 132 p
(Contract N61339-82-M-0767)
(AD-A138972; NAVTRAEQUIPC-82-M-0767-1) Avail: NTIS HC A07/MF A01 CSCL 05I

This report covers a survey of the IOS of a part-mission trainer, Training Device 2E6, an Air Combat Maneuvering Simulator. The device is significantly different from the WSTs surveyed previously (Device 2F119 and Device 2F112) in terms of the training objectives and in the characteristics of the trainer. The training objectives are concerned exclusively with the visual attack phase of air-to-air combat. Thus the environment and vehicle simulation requirements are limited and the training events consist of multiple relatively

short duration flights. Training Device 2E6 consists of two domes inside which is projected the simulated visual world and which house the training mockups. Two IOSs are provided so that the two training mockups can be operated as independent trainers. The two trainers can also be tied together and operated as a single training device. The survey of the IOSs included reviewing technical documentation for the device, observing training operations and interviewing instructors, mission operators and technical personnel supporting the trainer. In addition, operating procedures were analyzed. The goal was to identify console design deficiencies and develop feasible solutions, for both short and long term. GRA

N84-22588# European Space Agency, Paris (France).
A UNIVERSAL 3-DIMENSIONAL WALL PRESSURE CORRECTION METHOD FOR CLOSED RECTANGULAR SUBSONIC WIND TUNNEL TEST SECTIONS (DISPLACEMENT, DOWNWASH, STREAMLINE CURVATURE)
G. SCHULZ Jun. 1983 74 p refs Transl. into ENGLISH of "Ein Universelles Dreidimensionales Wanddruck Korrekturverfahren fuer Geschlossene Rechteckige Unterschallwindkanalmessstrecken (Verdraengung, Abwind, Kruemmung)" rept. no. DFVLR-FB-82-19 DFVLR (West Germany), Oberpfaffenhofen
(ESA-TT-800; DFVLR-FB-82-19) Avail: NTIS HC A04/MF A01; original German version available from DVFLR, Cologne DM 28,10

A wall pressure correction method for closed rectangular subsonic test sections, which corrects displacement, downwash, and streamline curvature for models of arbitrary size, shape, position and bulkiness is presented. The number of wall measuring points required is kept small so that the test duration need not be increased because of the correction. This is achieved by the selection of special wall pressure locations. The method can be extended to tunnels of any cross section. Experimental results are good for high lift measurements, and especially so for blockage correction in the presence of large wake regions behind the model. Author (ESA)

N84-22589# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1983-4, 215/JULY-AUGUST
C. SEVESTRE, ed. Paris ESA Jan. 1984 117 p refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimensuel (Paris), No. 1983-4, 215/Jul.-Aug.
(ESA-TT-823) Avail: NTIS HC A06/MF A01; print copy in ENGLISH available at ONERA, Paris FF 60; original report in FRENCH available at ONERA, Paris FF 60

Wind tunnel adaptive walls design and construction; error estimates for spectral approximation of Stokes equations; a Eulerian-Lagrangian model for turbulent combustion; splitting schemes for solving hyperbolic and parabolic nonlinear problems (applications to Euler and Navier-Stokes equations); indirect measurement of the thermal-acoustic efficiency spectrum of a long turbulent burner; and numerical simulation of turbulence on minisystems with attached processors (in mono or multiprocessor configuration) are discussed. Author (ESA)

N84-23565*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL EXPERIENCE WITH THE NATIONAL TRANSONIC FACILITY
L. W. MCKINNEY *In* Agard Wind Tunnels and Testing Tech. 8 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01 CSCL 01B

Construction of the National Transonic Facility was completed in September 1982. The checkout of all systems required about one year. The facility operated to the design point of 120 million Reynolds number based on a 0.25 meter chord at a Mach number of 1.0. Performance of all systems was basically as expected. Setup for the detailed aerodynamic calibration begins late in 1983, and the calibration is expected to be complete by the last quarter of 1984. Author

N84-23566# National Aerospace Lab., Amsterdam (Netherlands).
THE EUROPEAN TRANSONIC WINDTUNNEL (ETW) Status Report
R. J. NORTH, F. MAURER, J. PRIEUR, J. A. SCHIMANSKI, and J. A. TIZARD *In* Agard Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The status of the preliminary design phase of the European Transonic Windtunnel project is described. The latest version of the proposed tunnel is given together with some details of its estimated performance. Some features of the tunnel which were revised following the first preliminary design proposals are discussed and the results of an investigation into the expected future use of the tunnel are summarized. An aerodynamic circuit test-rig is described along with some of the results obtained. Information on the pilot tunnel is included as well as reference to the supporting program on cryogenic technology. Author

N84-23567# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Aerothermodynamique.
THE T2 CRYOGENIC WIND TUNNEL WITH SELF-ADAPTABLE WALLS AT ONERA/CERT [LA SOUFFLERIE CRYOGENIQUE A PAROIS AUTO-ADAPTABLES T2 DE LONERA/CERT]
A. MIGNOSI and J. B. DOR *In* Agard Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

The transonic induction driven wind-tunnel T2 at the ONERA Toulouse Research Center is equipped with a 0.4 x 0.4 sq m test section, and is a pressurized closed circuit wind-tunnel, operating at ambient temperature with runs of 30 to 60 seconds. The wind-tunnel was adapted for cryogenic operation using liquid nitrogen as a coolant and an internal thermal insulation. The main characteristics of the wind-tunnel at low temperature and of the constituents used to perform airfoil tests with adaptive walls are described. The flow qualities are analyzed through an evaluation of the thermal gradients, pressure and thermal fluctuations studies, and the operating limit at very low temperature. The effects of various parameters able to influence test results are examined, such as boundary layer transition and differences between wall temperature and adiabatic wall recovery temperature. A.R.H.

N84-23568# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
THE CRYOGENIC WIND TUNNEL COLOGNE
G. VIEHWEGER *In* Agard Wind Tunnels and Testing Tech. 8 p Feb. 1984
Avail: NTIS HC A22/MF A01

The modification of a low-speed wind tunnel to cryogenic operation is discussed. The tunnel with a test section of 2.4 m x 2.4 m should be operational in the middle of 1984. The technical concept of the tunnel is examined and some of the most important components are described. Author

N84-23569# Institut Aerotechnique de Saint-Cyr, Saint-Cyr-l'Ecole (France).
PRODUCING A CRYOGENIC GUST IN AN EIFFEL TYPE ATMOSPHERIC WIND TUNNEL WITH SHORT GUST [PRODUCTION DUNE RAFALE CRYOGENIQUE DANS UNE SOUFFLERIE DE TYPE EIFFEL ATMOSPHERIQUE A RAFALE COURTE]
D. CHAUVET and C. DUJARRIC (Serice Technique des Programmes Aeronautiques, Paris) *In* Agard Wind Tunnels and Testing Tech. 17 p Feb. 1984 refs In FRENCH
Avail: NTIS HC A22/MF A01

Demonstrations of the feasibility of an Eiffel-type cryogenic atmospheric wind tunnel with short gusts and of the economy of operation of such a concept requires prior resolution of certain specific technical problems found in this type wind tunnel. The technique for generating cryogenic gaseous flow by atomizing liquid

nitrogen in air at the level of the plenum chamber is described as well as the chronological feeding out of a cryogenic gust. Theoretical and experimental studies are developed for optimizing the evaporation of liquid nitrogen in the plenum chamber of a wind tunnel. The results of measuring the grain size of drops of liquid nitrogen are compared with a computation model which correctly represents the real behavior of the aerosol.
Transl. by A.R.H.

N84-23585# Aeronautica Macchi S. p. A., Varese (Italy).
USE OF A SMALL SCALE WIND TUNNEL AND MODEL SHOP AT AERONAUTICA MACCHI AS AN INDUSTRIAL TOOL
R. MARAZZI, D. MALARA, M. LUCCHESINI, S. COMORETTO, and F. PACORI *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The paper describes some facilities and capabilities which are currently available at the Aerodynamic Test Department of Aeronautica Macchi. Special wind tunnel testing techniques allow the use of a small scale wind tunnel to obtain useful data for the development of aircraft configurations; model work-shop capabilities permit the manufacture of specialized wind tunnel models for detailed analysis of problem areas. The topics covered are: (1) updating of the rotary balance facility for the measurement of dynamic derivatives due to roll in the full range of model attitudes; (2) assessment of Reynolds number effects on high lift devices of modern design; (3) design and manufacture of an afterbody model; and (4) manufacture and testing of flutter models. B.W.

N84-23593# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Hauptabt. Windkanaele.
THE NEW CALIBRATION TANK FOR ENGINE SIMULATORS AT DFVLR GOETTINGEN
B. BINDER, E. MELZER, and R. WULF *In* AGARD Wind Tunnels and Testing Tech. 9 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

Interference effects between engine and airframe in wind tunnel tests the knowledge of the characteristics of model engines is necessary, especially if Turbine Powered Simulators (TPS) are used. The calibration tank which was built for the determination of TPS characteristics is described. Results of calibration measurements are presented for the six component balance and for the sonic nozzles to determine the mass flow. E.A.K.

N84-23594# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NEW TPS CALIBRATION BENCH, AND EJECTOR TESTS
J. P. BECLE, J. COSTE, and J. LEYNAERT *In* AGARD Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

The new calibration bench for large turbopowered simulator (TPS), adapted to the airplane models in wind tunnels, is described. This bench uses an existing wind tunnel wall balance equipped with two compressed air supply devices, which is installed in a depressurized tank. The depressurization is obtained by the jet effect of the TPS acting as an ejector. Various types of ejectors were tested. The influence of the geometrical parameters is analyzed, and the problem of stable or instable conditions is presented. E.A.K.

N84-23596# Fluidyne Engineering Corp., Minneapolis, Minn.
A SELF-CONTAINED CAPTIVE TRAJECTORY SYSTEM FOR A BLOWDOWN WIND TUNNEL
C. D. CHRISTOPHERSON, D. N. KAMIS, D. M. NELSON, and R. D. WEEK *In* AGARD Wind Tunnels and Testing Tech. 9 p Feb. 1984
Avail: NTIS HC A22/MF A01

The trajectory of a store which is released from an aircraft can be determined by model tests using a six component sting balance to measure the aerodynamic forces and moments on the shell. A completely self contained captive trajectory system is described which is configured to provide maximum efficiency in the use of wind tunnel test time. There are three primary factors which contribute to achieving this goal: the self contained nature of the system, the use of high performance electrohydraulic servo positioning systems for all motions, the use of a modern high speed minicomputer and appropriately matched amplifier/multiplexer I/O equipment to acquire information, perform the mathematical manipulations required, and provide appropriate inputs to the servo systems. The system described is separated into four subsystems: the structural/mechanical system, the electrohydraulic positioning systems, the minicomputer based analyzer/programmer system, the software system. An overview of the wind tunnel circuit, a 4 ft by 4 ft (1.2 m x 1.2 m) trisonic blowdown configured to provide high quality by the use of a perforated sleeve valve flow control, perforated flow diffusers, acoustic baffles, a honeycomb, and screens, is given. M.A.C.

N84-23656# Science Applications, Inc., Orlando, Fla.
SYNTHETIC FLIGHT TRAINING SYSTEM STUDY Final Report, Sep. - Dec. 1983
23 Dec. 1983 269 p
(Contract N61339-82-D-0006)
(AD-A139392) Avail: NTIS HC A12/MF A01 CSCL 05H

The primary purpose of this report was to investigate flight simulator commonality. Visual system commonality was investigated using an advanced development program called the Visual System Component Development Program (VSCDP) as a baseline. In addition, the study investigated commonality issues of such subsystems as motion platforms, instructional features, computer hardware and software, student stations, etc. Author (GRA)

N84-23657# Dayton Univ., Ohio.
NOZZLE TESTS FOR SIMULATING HEAVY RAIN IN A WIND TUNNEL Final Report, Feb. 1983 - Feb. 1984
J. K. LUERS and I. B. FISCUS Wright-Patterson AFB, Ohio AFWAL Jan. 1984 32 p
(Contract F33615-83-K-3008; AF PROJ. 2404)
(AD-A139566; AFWAL-TR-83-3131) Avail: NTIS HC A03/MF A01 CSCL 14B

Tests were conducted with a vibrating tube nozzle system to assess the ability of the system to realistically simulate the natural heavy rain environment at wind tunnel airspeeds of 65 to 125 mph. The nozzle system was specifically designed to achieve the large droplet sizes (-2mm) that are characteristic of the heavy rain environment. The nozzle system also produced the appropriate total water volume to simulate rain rates from 25 mm/hr to over 500 mm/hr. The test results established the allowable velocity differential between the airstream and water velocity that resulted in large droplet formation. Velocity differentials exceeding the allowable or critical value resulted in the shattering of large drops into a spectrum of much smaller drops. Author (GRA)

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ASTRONAUTICS

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

A84-30146
SOLAR ARRAY POWER TO WEIGHT PERFORMANCE OF 1- TO 10-KILOWATT, FLAT-FOLDED FLEXIBLE WINGS
P. A. DILLARD and M. L. CAMPELL (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 3 . New York, American Institute of Chemical Engineers, 1983, p. 1232-1236.

Flexible solar array technology developed for 25-100 kW power levels has been applied to wings with nominal output of 1, 4, and 10 kW, enough to meet the power requirements of most near-term missions. The wing design model is described, and information is presented on blanket size, blanket densities and relative electrical performance, wing weight versus aspect ratio, frequency versus aspect ratio, electrical performance, radiation equivalence, and GEO performance. C.D.

A84-30574* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL AWARENESS IN FUTURE SPACE TRANSPORTATION SYSTEM CONCEPTS AND TECHNOLOGY SELECTIONS
D. G. EIDE and W. D. MORRIS (NASA, Langley Research Center, Space Systems Div., Hampton, VA) IN: Astrodynamics 1983; Proceedings of the Conference, Lake Placid, NY, August 22-25, 1983. Part 2 . San Diego, CA, Univelt, Inc., 1984, p. 831-852. refs
(AAS PAPER 83-382)

An analysis of operations for a two-stage, fully reusable future space transportation system has been performed, and the results are discussed. The value of conducting an analysis of operations in the conceptual design phase to produce a highly productive system was demonstrated by obtaining estimated reductions in resources and ground turnaround time and comparing them with estimated mature Shuttle program requirements. Cooperative efforts by users, future vehicle designers, and operations analysts during the conceptual design phase are shown to produce an efficient vehicle design with broad market potential. The synergistic effects of vehicle design configuration, subsystems, and procedures can enhance productivity of the transportation system as measured by flexibility, availability, and viability. Advanced technologies and subsystems beneficial to such a system are identified. C.D.

A84-30593
BALLISTIC ORBITAL MOTION IN A ROTATING ATMOSPHERE
M. E. HOUGH (Analytic Sciences Corp., Reading, MA) IN: Astrodynamics 1983; Proceedings of the Conference, Lake Placid, NY, August 22-25, 1983. Part 2 . San Diego, CA, Univelt, Inc., 1984, p. 1211-1236. refs
(AAS PAPER 83-416)

The present approximate, semianalytic solution to the two-body problem (with drag) describes nonlifting orbital motion in a rotating atmosphere, where spherical earth gravity is modeled as a central, inverse-square field. It is shown that orbital motion occurs in an earth-fixed, invariable plane that is defined by the radius and relative velocity vectors, and that equations of motion that are simplified by ignoring aerodynamic lift, gravitational perturbations, and kinematic accelerations, are autonomous and independent of the central angle measured in the invariable plane. O.C.

A84-31751#
GEOMETRIC METHODS FOR MULTIBODY DYNAMICS
M. EL-BARAKA and P. S. KRISHNAPRASAD (Maryland, University, College Park, MD) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 607-615. refs
(Contract NSF ECS-81-18138; NSF ECS-82-19123; DE-AC01-80RA-50420-A001)
(AIAA PAPER 84-1022)

Differential geometric methods are developed to treat dynamic-control problems of multibody systems. A basic stability theorem is obtained for the dual-spin maneuver of a rigid spacecraft with rotors, and disturbance torques are decoupled from attitude variables. T.K.

A84-31791
DEVELOPMENTAL TENDENCIES IN AIRCRAFT CONTROL SYSTEMS [ENTWICKLUNGSTENDENZEN BEI FLUGKOERPER-LENKSYSTEMEN]
U. SCHWELLINGER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Armada International, July-Aug. 1983, p. 97, 98, 100. In German.
(MBB-UA-754-83-OE)

Technological developments in the area of fighter aircraft control systems to meet future combat threats are discussed. The points emphasized include control in the face of highly maneuverable targets and multiple targets and improvements in reaction time, all-weather capability, and insensitivity to disturbances. C.D.

N84-22634# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
PARTICLE SIZING IN A FUEL RICH AIRBREATHING ENGINE COMBUSTOR
R. TURNER and R. E. LEE *In* APL The 20th JANNAF Combust. Meeting, Vol. 1 p 17-26 Oct. 1983 refs
(Contract N00024-83-C-5301)
Avail: NTIS HC A99/MF A01 CSCL 20H

A laser Doppler anemometer (LDA), configured to measure the size and speed of individual particles, 3 to approximately 100 micrometers in diameter moving at speeds of 528 to 1400 m/s, was used to study the exhaust jet of a fuel-rich ramjet combustor. The LDA appeared suitable for measuring solid particles or small drops. When particle distortion or break-up is a possibility, which is the case in the present application, care in interpreting the results is necessary. The jet flow contained a small number of large particles moving at high speed. The average size of these large particles derived from the visibility and intensity of the LDA signal was approximately 50 micrometers; while their size derived from the particle velocity-lag was approximately 5 microns. The difference between the two measurements is attributed to the clustering of small drops, resulting from the break-up of the large fuel drops, whole size was not resolved by the LDA as instrumented. Author

N84-23825# OAO Corp., Greenbelt, Md.
DYNAMIC SPACECRAFT SIMULATORS IN MILITARY SPACE GROUND SYSTEMS
R. S. SMITH, III, P. DAVID, and D. A. GOODWIN *In* AF Academy Proc. of the 1983 Symp. on Mil. Space Commun. and Operations p 119-126 1983
(AD-P002159) Avail: NTIS HC A07/MF A01 CSCL 14B

Simulators have long been used in training situations to provide hands-on experience without risking expensive real systems. The most common example is in aircraft flight training. It has been OAO Corporation's experience that the same principles can be applied on a much more modest scale to expedite spacecraft ground system integration and operation training. The purpose of this paper is to outline some of the uses of simulators in the military space ground system environment, present some indicators which aid in determining when a simulator design. The authors validate these points by drawing on six years experience in

providing space vehicles and operational simulation aids to NASA, USAF and commercial satellite control centers. Author

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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.

A84-30658
IN SITU INDICATIONS OF DUCTILITY EVOLUTION DURING HIGH-TEMPERATURE FATIGUE TESTING WITH AND WITHOUT HOLD TIMES
K. RAHKA (Technical Research Centre of Finland, Espoo, Finland) and C. LAIRD (Pennsylvania, University, Philadelphia, PA) IN: Fatigue mechanisms: Advances in quantitative measurement of physical damage; Proceedings of the International Conference on Quantitative Measurement of Fatigue Damage, Dearborn, MI, May 10, 11, 1982 . Philadelphia, PA, American Society for Testing and Materials, 1983, p. 151-175. Research supported by the Technical Research Centre of Finland, Walter Ahlstroem Foundation, and Emil Aaltonen Foundation. refs
(Contract DE-AC02-80ER-105170; NSF DMR-79-23647)

Research on the characterization of creep-fatigue damage in a *1Cr-1Mo-0.25V rotor steel is discussed, focusing on damage in* the early stages of life. Interrelationships of literature results are developed along with results from a new experimental approach based on transverse strain range response in strain-controlled testing with the total axial strain amplitude held constant. Observations of the damaged microstructure are presented. It is cocluded that early high-temperature fatigue and creep-fatigue damage rate is uniquely characterized by the diametral strain range response in a manner which resembles literature data on postfatigue creep ductility and fatigue data with superimposed monotonic strain. In the tested rotor steel, a hold time of 0.5 h at the tensile maximum strain leads to a ductility exhaustion damage rate based on secondary strain response that is roughly twice as fast per cycle as in continuous cycling. C.D.

A84-30807#
FEASIBILITY OF A FULL-SCALE DEGRADER FOR ANTIMISTING KEROSENE
R. J. MANNHEIMER (Southwest Research Institute, San Antonio, TX) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 335-340. Sponsorship: U.S. Department of Transportation. refs
(Contract DOT-FA79WA-4310)

Previously cited in issue 16, p. 2339, Accession no. A83-36240

A84-31123
CLASSIFICATION OF FUELS AND LUBRICATING MATERIALS FOR AVIATION EQUIPMENT [KLASSIFIKATSIIA TOPLIV I SMAZOCHNYKH MATERIALOV DLIA AVIATSIONNOI TEKHNIKI]
B. G. BEDRIK Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 3, 1984, p. 23-25. In Russian.

Fuels and lubricants which successfully completed service testing and are used in aviation equipment are classified according to group, class, grade, and brand. The groups consist of lubricants; protective materials (anticorrosives); multipurpose materials to decrease friction, wear, and corrosion; and special fluids for cooling, *landing gear shock-absorbers, etc. The classes represent areas* of application within each group such as piston engines, jet engines, and antiicing. The determining characteristics for the grades within each class include such factors as octane level for piston engines; thermal stability for jet engines; and operating temperature for oils, greases, and hydraulic fluids. A number of presently used fuel and lubrication brands are listed according to class (area of application), and a superior alternative brand is proposed for each. J.N.

A84-31200
EVALUATION AND PROGNOSIS OF THE TOXICITY OF AERONAUTICAL MATERIALS AT THE TIME OF FIRES [EVALUATION ET PREVISION DE LA TOXICITEDES MATERIAUX AERONAUTIQUES LORS D'INCENDIES]
J. P. BOGAERT, L. CARETTE, M. DUCLOUX, and M. LAOUISSET (Rhone-Poulenc Industries, France) Medecine Aeronautique et Spatiale, vol. 23, 1st Quarter, 1984, p. 71-81. In French.

Laboratory tests were conducted which compared the behavior of various burning aircraft seat materials, and a fire was produced underneath a seat in a simulated aircraft cabin in order to evaluate the combined diverse effects of burning cabin materials. A mathematical model was developed that characterizes the temperatures, fluxes, and gas concentrations of a fire, as well as the interaction of a fire with its environment. Topics given consideration include the effects on rats of carbon monoxide at high temperatures. C.M.

A84-31654#
VISCOPLASTIC FATIGUE IN A SUPERALLOY AT ELEVATED TEMPERATURES CONSIDERING A ZERO MEAN STRESS
A. N. PALAZOTTO (USAF, Institute of Technology, Wright-Patterson AFB, OH) and R. E. WILSON IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 264-274. refs

This study involves the analysis of the stress field and plastic zone ahead of a crack tip in a compact tension specimen acting under a reverse loading considering IN-100, a superalloy. An inhouse finite element computer program named VISCO was used for this study. The Bodner-Partom viscoplastic constitutive equations for describing the material behavior were utilized. Load spectra included various frequencies with an R-ratio of -1.0 (zero mean load). Author

A84-31678#
STRUCTURAL POTENTIAL OF SUPERPLASTIC FORMED ALUMINUM
R. L. WILKINSON and R. K. CANNON (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, *Technical Papers. Part 1 . New York, American* Institute of Aeronautics and Astronautics, 1984, p. 498-502. refs
(AIAA PAPER 84-0935)

This paper describes the first phase of a three part program to evaluate the potential of superplastic formed (SPF) aluminum for load-bearing structural applications. The alloy evaluated in Phase 1 was Supral 220 - the British alloy roughly comparable to the US 7075. Components for the T-46 (Next Generation Trainer) Aircraft were formed, treated to the T6 condition, and cut into test coupons. Tensile yield and ultimate strengths, and fatigue crack growth rates all fell between the values expected for 6061-T6 and 7075-T6. Fatigue initiation times were shorter than expected, but most initiation sites were at the specimen surfaces, indicating that surface finish and cladding may be more of a factor than cavitation. The overall first impression is that SPF aluminum alloys have definite potential for load-bearing applications, provided that an 'initial flaw' concept is used during design. Author

A84-32612*# Cornell Univ., Ithaca, N.Y.
TIME-RESOLVED DENSITY MEASUREMENTS IN PREMIXED TURBULENT FLAMES
F. C. GOULDIN (Cornell University, Ithaca, NY) and K. V. DANDEKAR (Illinois, University, Chicago, IL) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 655-663. Research supported by the General Motors Corp. and U.S. Navy. refs
(Contract NSG-3019)

Previously cited in issue 08, p. 1196, Accession no. A83-22033

A84-32676
SUPERPLASTIC FORMING OF STRUCTURAL ALLOYS; PROCEEDINGS OF THE SYMPOSIUM, SAN DIEGO, CA, JUNE 21-24, 1982
N. E. PATON, ED. (Rockwell International Corp., Pittsburgh, PA) and C. H. HAMILTON, ED. (Rockwell International Science Center, Thousand Oaks, CA) Symposium sponsored by the Metallurgical Society of AIME and American Society for Metals. Warrendale, PA, Metallurgical Society of AIME, 1982, 424 p.

Research on superplasticity as a low-cost production method for the manufacture of complex components is presented in terms of basic mechanisms, superplastic materials, superplastic forming processes and applications, and cavitation in superplastic alloys. Specific areas of study include the superplastic behavior of metals; superplasticity in titanium-base alloys, high-strength aluminum alloys, and nickel-base alloys; and superplastic forming of sheet metal. Attention is also given to aerospace applications of SPF and SPF/DB and commercial applications of superplastic sheet forming. J.N.

A84-32684
CONCURRENT SUPERPLASTIC FORMING/DIFFUSION BONDING OF TITANIUM
E. D. WEISERT and G. W. STACHER (Rockwell International Corp., Los Angeles, CA) IN: Superplastic forming of structural alloys; Proceedings of the Symposium, San Diego, CA, June 21-24, 1982 Warrendale, PA, Metallurgical Society of AIME, 1982, p. 273-289. refs

The concurrent superplastic forming/diffusion bonding (SPF/DB) titanium fabrication process for application to advanced structures is now approaching the stage of production practice after years of development and demonstration. The process takes advantage of two unusual properties of titanium alloys, superplasticity and diffusion bondability, and results in significant cost and weight savings when compared to conventional titanium manufacturing methods. Superplasticity in conjunction with diffusion bonding permits the fabrication of titanium parts that could not otherwise be produced. Typical applications include parts formed and bonded into hollow sections starting with two or more flat titanium sheets resulting in complex sandwich structures and sheets formed with preplaced bonded details replacing multiple piece assemblies and machined parts. Estimated cost reductions and weight savings have averaged between 30 and 50 percent when compared to previous construction. The nature of the SPF/DB process is reviewed with attention to the status of production readiness. Author

A84-32851
1982 NATIONAL POWDER METALLURGY CONFERENCE, MONTREAL, CANADA, MAY 24-27, 1982, PROCEEDINGS
Conference sponsored by the Metal Powder Industries Federation and American Powder Metallurgy Institute. Princeton, NJ, Metal Powder Industries Federation (Progress in Powder Metallurgy. Volume 38), 1983, 639 p.

The papers presented in this volume provide an overview of recent developments in powder metallurgy and efforts to define the future of P/M technology and its attainment. Some of the most advanced developments presented cover details of rapid solidification technology, P/M superconductors, and the development of manufacturing in outer space. Other topics discussed include current P/M parts applications, parts production, quality control and properties evaluation, fully dense materials, and advances in titanium P/M materials. V.L.

A84-32855
PRODUCTION OF NEAR NET SHAPES BY HOT ISOSTATIC PRESSING OF SUPERALLOY POWDER
D. R. MALLEY (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT), J. E. STULGA (Crucible Research Center, Pittsburgh, PA), and R. J. ONDERCIN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: 1982 National Powder Metallurgy Conference, Montreal, Canada, May 24-27, 1982, Proceedings . Princeton, NJ, Metal Powder Industries Federation, 1983, p. 229-246.

A program was conducted to demonstrate the technology necessary for the near net shape direct-HIP processing of gas turbine engine components. F100 turbine and compressor disks were manufactured from improved IN100 (MERL 76) superalloy powder using three different processes. These were a ceramic mold process, the Fluid Die container system, and a welded sheet metal container process. A detailed technical and economic evaluation of the three processes showed that sheet metal containers provided the best overall approach to near net shape disk production. JT90 turbine disks were then produced using the selected container method. All the disks adequately protected the sonic inspection shape and showed excellent dimensional reproducibility. V.L.

A84-32858
AGE HARDENING BEHAVIOR OF AL-LI-(CU)-(MG)-ZR P/M ALLOYS
D. J. CHELLMAN and G. G. WALD (Lockheed-California Co., Burbank, CA) IN: 1982 National Powder Metallurgy Conference, Montreal, Canada, May 24-27, 1982, Proceedings . Princeton, NJ, Metal Powder Industries Federation, 1983, p. 361-381. refs

An evaluation was made of the mechanical properties of a series of P/M Al-Li alloy extrusions produced from rapidly solidified powders in order to identify high-strength, corrosion-resistant candidate alloys for the fabrication of aircraft structures. Moderate to high levels of strength were obtained for all extrusion products, but ductility values remained below target objectives. A study of the effect of heat treatment schedules on the properties of the alloys shows that the use of underaged tempers and thermomechanical treatment procedures offers considerable potential for improving the combination of strength, ductility, and toughness properties. Ternary and quarternary alloy compositions based on Al-Li-(Cu)-(Mg)-Zr systems exhibit higher tensile strengths than the binary Al-Li alloy for the same tensile ductility levels. V.L.

A84-32859
THE MECHANICAL PROPERTIES OF TITANIUM P/M PARTS PRODUCED FROM SUPERCLEAN POWDERS
E. J. KOSINSKI (Nuclear Metals, Inc., Concord, MA) IN: 1982 National Powder Metallurgy Conference, Montreal, Canada, May 24-27, 1982, Proceedings . Princeton, NJ, Metal Powder Industries Federation, 1983, p. 491-501.

The design criteria for aircraft structures produced from P/M titanium alloys are based on static and dynamic mechanical properties equivalent to those of forged titanium alloys. While the static properties of forgings have been met by P/M titanium alloy parts produced by various powder making and consolidation techniques, the dynamic properties, particularly low-cycle fatigue, have been difficult to achieve. Results of low-cycle fatigue tests are reported here for the Ti-6Al-4V powders made and consolidated by processes recognized as optimum from previous efforts. It is shown that the low-cycle fatigue life of the properly processed Ti-6Al-4V powder compacts is equivalent to that of wrought plate. V.L.

A84-32977#
COMPOSITES OR METALS (TOMORROW'S AIRCRAFT - BLACK OR SILVER)
J. FRAY (British Aerospace PLC, Manchester, England) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 1 . Stevenage, Herts., England, British Aerospace PLC, 1983, p. 1-1 to 1-16.

A comparative study is conducted of the relative advantages offered by carbon-reinforced plastic composites over aluminum alloys currently used by the aircraft industry, and an attempt is made to project the prospective changes in the performance superiority margins established for carbon-reinforced composites which may result from the successful development of advanced aluminum-lithium, magnesium, and titanium alloys. The unique properties of the aramid-reinforced aluminum laminate composite system designated 'Arall' are noted, as well as the prospects for superplastically formable aluminum alloys, metal-matrix composites, and powder metallurgy-produced alloys. Attention is given to the relative merit of the various candidate materials' application to the major primary structure elements of civilian and military aircraft. O.C.

A84-32980#
SUPERSONIC RADOMES IN COMPOSITE MATERIALS
T. COOK and M. C. CRAY (British Aerospace PLC, Stevenage, Herts., England) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 1 . Stevenage, Herts., England, British Aerospace PLC, 1983, p. 4-1 to 4-14. refs

Materials for the nose radomes of high speed missiles and aircraft necessitate a combination of suitable dielectric properties with the ability to withstand severe structural and environmental stresses. These properties are provided by certain glass fiber reinforced composites. Matrix resins capable of meeting the increasingly stringent demands of supersonic flight are often intractable materials requiring special processing technology for the manufacture of composites of satisfactory quality. The paper discusses the examination of various candidate resin systems for this purpose and the fabrication of radomes from them. It concludes that the only proven types satisfying the demanding requirements are certain epoxide and polyimide resins. Author

A84-33146
COMPARATIVE INVESTIGATIONS INVOLVING AIRCRAFT STRUCTURAL COMPONENTS PRODUCED BY DIFFERENT PROCEDURES FROM HIGH-STRENGTH ALUMINUM MATERIALS [VERGLEICHENDE UNTERSUCHUNGEN AN FLUGZEUBAUTEILEN UNTERSCHIEDLICHER HERSTELLVERFAHREN AUS HOCHFESTEN ALUMINIUMWERKSTOFFEN]
D. MIETRACH and K. BLOMEIER (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) Aluminium (ISSN 0002-6689), vol. 59, no. 3, 1983, p. 216-222. In German. refs
(MBB-VFW-42-83-OE)

The manufacture of structural components in the aviation industry is currently in many cases relatively expensive. The high costs are essentially a result of expensive processing operations and the material lost in metal removal. Investigations are, therefore, conducted with the aim to reduce manufacturing costs on the basis of a utilization of more cost-effective processing operations and the development of materials which can be processed by such operations. In this connection, three different processing operations were compared with respect to cost, constructive design, and material strength, taking into account an application of these techniques in the manufacture of a representative structural component of the MRCA Tornado aircraft. The operations compared include milling, accurate forging, and an advanced casting procedure. The employment of a forging operation was found to make it possible to achieve savings in the range from 30 to 74 percent compared to milling costs (100 percent). Savings provided by advanced casting are similar. G.R.

N84-22703# Naval Surface Weapons Center, White Oak, Md.
MOISTURE TRANSPORT IN COMPOSITES DURING REPAIR WORK
J. M. AUGL Sep. 1983 33 p
(Contract WR0-2204; F41-422)
(AD-A138658; NSWC/TR-83-374) Avail: NTIS HC A03/MF A01 CSCL 15E

The increased use of composites for structural materials in modern Naval aircraft (wing skins) requires reliable repair techniques for damaged areas (holes or delaminations). It is desirable to carry out these repairs under field or depot conditions by adhesively bonding a metal or composite patch over the damaged area. The problem is to prevent excessive void formation in the adhesive bond caused by evaporation of water during the curing process. Moisture that had been sorbed into the composite may diffuse into the adhesive. If the partial pressure of water dissolved in the still liquid adhesive exceeds the environmental (applied) pressure voids may form rapidly and reduce the load carrying strength of the bonded patch. An interactive desk top computer program was written for predicting the moisture profiles in the composite and the adhesive during the whole course of predrying and patch bonding. Thus it should be possible to get a better understanding of the problem and to obtain guidance for an experimental approach to optimize repair procedures. The underlying principles for the modeling are discussed and a specific example of moisture transport using a metal patch is given.
Author (GRA)

N84-22737# American Univ., Washington, D. C.
CLARIFICATION OF ENVIRONMENTAL EFFECTS IN STRESS CORROSION CRACKING Final Report, 1 Jun. 1975 - 31 Dec. 1983
R. T. FOLEY Jan. 1984 26 p
(Contract N00014-75-C-0799)
(AD-A138581) Avail: NTIS HC A03/MF A01 CSCL 11F

The objective of this project was to clarify the role of the environment in the stress corrosion cracking and the localized corrosion of aluminum alloys. Specifically, the project addressed the manner in which different chemical species, such as various anions, are involved in the corrosion process. Author (GRA)

N84-22742# Rolls-Royce Ltd., Derby (England).
THE FUTURE FOR TITANIUM AND SUPERALLOYS
G. W. MEETHAM 1 Oct. 1983 15 p refs
(PNR-90175; REPRINT-878) Avail: NTIS HC A02/MF A01

The state of the art in titanium and nickel superalloys in aircraft engines, and future property requirements are discussed. Titanium alloys are used for compressor disks and blades with nickel superalloys being used in the hotter turbine and reheat components. Until recently the uses of titanium and nickel superalloys were distinct and complementary but they are now becoming interactive, with titanium alloys replacing lower temperature nickel superalloys in certain components. Despite developments which improve engine performance, titanium and superalloys meet increasing competition from other material systems, tending to limit any increase in their total use in gas turbine engines. Author (ESA)

N84-22743# Rolls-Royce Ltd., Derby (England).
THE CYCLIC BEHAVIOUR OF A POWDER NI-BASE SUPERALLOY
M. A. HICKS, R. A. NEWLEY, and B. P. TOWILL 1983 21 p refs
(PNR-90182; REPRINT-895) Avail: NTIS HC A02/MF A01

The influence of the inherent defect population in Astroloy derived superalloys on cyclic properties was tested. The role of defects in fatigue, and the interaction of microstructure crack size, temperature and stress conditions on the mode and rate of crack growth were studied. The selection and interpretation of test piece data for the prediction of safe lives for components in fatigue is discussed. Results show that defects should not prevent application in gas turbine components provided their presence is recognized and a total disk lifing system which involves modifications of existing fatigue life and fracture mechanics methods is applied. This can

result in a significant improvement in operating stresses and cyclic life over conventionally produced nickel base materials.
Author (ESA)

N84-22767# Rolls-Royce Ltd., Derby (England).
HIGH TEMPERATURE ADHESIVES FOR STRUCTURAL APPLICATIONS: A REVIEW
J. R. FOWLER 1 Dec. 1982 15 p refs Presented at Ind. Appl. of Adhesives Seminar, 10 Nov. 1982; sponsored by Institution of Production Engineers and Design Council
(PNR-90171; REPRINT-873) Avail: NTIS HC A02/MF A01

The requirement for high temperature adhesives in the aero engine industry is assessed and the reasons for the choice of polyimide adhesives as prime candidates are outlined. Cure chemistry of these resins is described and the development of polyimides that cure by addition mechanisms is reviewed. Adhesives are listed and two typical formulations (FM34 and A7F) are discussed, giving as-cured and thermally aged properties. The necessity for the provision of special accessory materials and curing facilities to process these adhesives at the required temperatures is explained. Author (ESA)

N84-23559# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
ADDITIONALLY COMPRESSED TITANIUM FINE CAST COMPONENTS [NACHVERDICHTETE TITAN FEINGUSSSTELLE]
K. BLOMEIER *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 81-83 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

The effect of hot isostatic compression on the vibratory fatigue limit behavior of titanium fine cast components was investigated. Results show that the use of titanium casts in aircraft construction is required for fatigue limit and cost reduction reasons.
Author (ESA)

N84-23631*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRENDS OF JET FUEL DEMAND AND PROPERTIES
R. FRIEDMAN *In its* Assessment of Alternative Aircraft Fuels p 1-10 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 21D

Petroleum industry forecasts predict an increasing demand for jet fuels, a decrease in the gasoline-to-distillate (heavier fuel) demand ratio, and a greater influx of poorer quality petroleum in the next two to three decades. These projections are important for refinery product analyses. The forecasts have not been accurate, however, in predicting the recent, short term fluctuations in jet fuel and competing product demand. Changes in petroleum quality can be assessed, in part, by a review of jet fuel property inspections. Surveys covering the last 10 years show that average jet fuel freezing points, aromatic contents, and smoke points have trends toward their specification limits. Author

N84-23632*# Exxon Research and Engineering Co., Linden, N.J.
THE EFFECT OF PROPERTY CHANGES ON JET FUEL PRODUCIBILITY AND COST
G. M. VARGA, JR., A. R. CUNNINGHAM, J. F. GORGOL, A. J. GRAF, and G. A. OLIVER *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 11-22 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 21D

An investigation of the effect of property relaxation on jet A producibility and cost in the U.S. has been completed under NASA sponsorship by Exxon Research and Engineering Company. This presentation reviews the results obtained. Linear programming optimization models have been used. Model input included petroleum product demand and property data, estimates of crude qualities, and information on refinery processes. The time period considered was 1978 to 2010. Author

N84-23637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA BROAD-SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM
J. S. FEAR *In its* Assessment of Alternative Aircraft Fuels p 75-78 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 21B

The NASA Broad-Specification Fuels Combustion Technology Program was initiated in response to concerns that the supply of high-quality petroleum middle distillates for jet fuel, abundant in the past, would diminish in availability toward the end of the century. The specific program objective is to evolve the combustion system technology required to use fuels with moderate ranges of broadened properties in the engines used on commercial jet aircraft. The first phase of the program, in which effects of the use of broadened-properties fuels were identified and technology with the potential to offset these effects was also identified, has been completed. The second phase, in which the technology identified in Phase 1 is being refined, will be completed within the next three months. B.W.

N84-23638*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
NASA/GENERAL ELECTRIC BROAD-SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM
W. J. DODDS *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 79-88 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 21B

The NASA/General Electric Broad Specification Fuels Combustion Technology Program is being conducted to evolve and demonstrate the technology required to use broadened-properties fuels in current and next generation commercial aircraft engines. The first phase of this program, completed in 1982, involved the design and test evaluation of three different combustor concepts. All combustors were designed for the General Electric CF6-80A engine envelope and operating conditions, using Experimental Referee Broad Specification (ERBS) fuel having a fuel hydrogen content of 12.8% by weight. Several different configurations of each combustor concept were evaluated in a series of high pressure sector combustor component tests. A total of 25 sector tests were conducted during phase 1. Combustor metal temperatures, emissions, exit temperature profiles, and radiant heat flux were measured over the full range of steady-state operating conditions using four fuels having nominal hydrogen contents between 11.8 and 14%. During the current phase 2 program, the two most promising concepts from phase 1 are being further refined and evaluated. For phase 2 testing, two additional fuels representing a wider range of fluidity and volatility are also being used in combustion system tests. Author

N84-23640*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla.
THE NASA BROAD SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM AT PRATT AND WHITNEY
R. P. LOHMANN *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 99-110 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 21B

The technology required to accommodate the use of broadened properties fuels in commercial aircraft engine combustors with minimum impact on the emissions, performance, durability and engine operational characteristics is discussed. Emphasis was placed on defining the potential for reducing the fuel sensitivity of the reference combustion system through design refinements and the introduction of more advanced technology combustors. To this end the tests conducted included the evaluation of variations of three different combustor concepts representing progressively more advanced technology levels. It was demonstrated that reduced fuel hydrogen content has adverse impacts on current single stage combustors; the best opportunities for reducing the fuel sensitivity of these combustors are through improved fuel injectors and advanced liner cooling and structural concepts and that the advanced technology staged and variable geometry combustor concepts have inherent operational flexibility that can

be exploited to accommodate changes in fuel composition. Also, advanced technology combustor concepts were evaluated. A variable geometry combustor capable of airflow modulation during operation and a new concept which is a further evolution of the Vorbix combustor are discussed. R.J.F.

N84-23642*# 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 its* Assessment of Alternative Aircraft Fuels p 121-130 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 21D

The problems associated with aircraft fuel instability are discussed. What is currently known about the problem is reviewed and a research program to identify those areas where more research is needed is discussed. The term fuel instability generally refers to the gums, sediments, or deposits which can form as a result of a set of complex chemical reactions when a fuel is stored for a long period at ambient conditions or when the fuel is thermally stressed inside the fuel system of an aircraft. R.J.F.

N84-23643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IN-FLIGHT ATMOSPHERIC AND FUEL TANK TEMPERATURE MEASUREMENTS
R. SVEHLA *In its* Assessment of Alternative Aircraft Fuels p 131-140 Apr. 1984 refs
Avail: NTIS HC A09/MF A01 CSCL 21D

In order to maintain an adequate supply of aviation turbine fuels in the future, fuels may have properties different from those now currently produced. One possible change is an increase in the freezing point temperature. If this should occur, it will be necessary to know the low temperature flow characteristics of these fuels. Studies to date involved both the use of computer models and subscale fuel tank simulators. They indicate that steep temperature gradients occur near the upper and lower surfaces which can result in freezing at the bottom, even though the bulk fuel temperature is above the freezing point. In order to obtain flight data to verify computer model and simulator results, a Lockheed L1011 research aircraft at Palmdale, California was instrumented with a vertical thermocouple rake in an inboard tank and an outboard tank. The tests were conducted with one of the two instrumented tanks maintained full for either two or five hours at altitudes of at least 10668 meters (35000 ft). Other flight parameters such as Mach number, air temperature, fuel quantity, and heading were also recorded. R.J.F.

N84-23647*# Southwest Research Inst., San Antonio, Tex.
FUEL PROPERTY EFFECTS ON NAVY AIRCRAFT FUEL SYSTEMS
C. A. MOSES *In* NASA. Lewis Research Center Assessment of Alternative Aircraft Fuels p 185-190 Apr. 1984
Avail: NTIS HC A09/MF A01 CSCL 21D

Problems of ensuring compatibility of Navy aircraft with fuels that may be different than the fuels for which the equipment was designed and qualified are discussed. To avoid expensive requalification of all the engines and airframe fuel systems, methodologies to qualify future fuels by using bench-scale and component testing are being sought. Fuel blends with increasing JP5-type aromatic concentration were seen to produce less volume swell than an equivalent aromatic concentration in the reference fuel. Futhermore, blends with naphthenes, decalin, tetralin, and naphthalenes do not deviate significantly from the correlation line of aromatic blends, Similar results are found with tensile strenth and elongation. Other elastomers, sealants, and adhesives are also being tested. R.J.F.

N84-23702# Naval Research Lab., Washington, D. C.
HIGH PERFORMANCE COMPOSITES AND ADHESIVES FOR V/STOL AIRCRAFT Final Report
C. F. PORANSKI, JR. 22 Feb. 1984 103 p
(Contract F54-502)
(AD-A139168; NRL-MR-5231) Avail: NTIS HC A06/MF A01 CSCL 11D

This is the final report a NAVAIR sponsored program addressing aspects of the composite and adhesive materials requirements of V/STOL aircraft. The primary tasks were to develop and characterize high modulus, high toughness resins with use temperatures of 350 F to 450 F or higher; to develop graphite fiber reinforced composite fabrication technology for newly developed resin matrices; to develop failure criteria for composite design optimization; and to establish appropriate quality control parameters. During the course of the program a variety of matrix materials and adhesives were studied in the various tasks. Three matrix materials were picked for a detailed study on the basis of performance and processing characteristics. They are NRL C10-diamide, Narmco 5208 epoxy and Hexcel F-178 bis-maleimide. Composites made from T-300 graphite fiber formed the key test set in the Failure Analysis Task. Detailed chemical and thermochemical characterization was carried out on these resins to provide a data base for developing quality assurance procedures. This report covers the final phase of the program. GRA

N84-23750*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FRACTURE TEMPERATURE AND FLAW GROWTH IN NITRONIC 40 AT CRYOGENIC TEMPERATURES
M. S. DOMACK May 1984 46 p refs
(NASA-TP-2312; L-15722; NAS 1.60:2312) Avail: NTIS HC A03/MF A01 CSCL 11F

The fracture resistance and fatigue response of Armco Nitronic 40 austenitic stainless steel were evaluated under cryogenic conditions. Tensile, fracture toughness and fatigue crack growth properties were measured at -275 F. The tensile yield strength was approximately 120 ksi and the fracture toughness was estimated to be 350 ksi-in /2 on the basis of fracture toughness measurements. Testing was conducted to evaluate the behavior of a simulated section of the wing of the Pathfinder 1 model subject to a load and temperature history typical of that for testing in the National Transonic Facility. The wing section model incorporated a proposed brazing technique for pressure-transducer attachment. The simulated wing section performed satisfactorily at stress levels of nearly 60 percent of the material yield strength. The brazing technique proved to be an effective method of transducer attachment under conditions of high stress levels and large temperature excursions. 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.

A84-30055
TWIN AIRFOIL BLADE IN DOUBLE CIRCULATING GAS TURBINE PROCESSES
M. MAJCEN, N. SARUNAC (Zagreb, Sveuciliste, Zagreb, Yugoslavia), and A. MAJCEN (Jugoturbina, Karlovac, Yugoslavia) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 1 . New York, American Institute of Chemical Engineers, 1983, p. 398-403. refs

A double circulating process with a twin flow gas turbine using a thermosiphon or a heat-pipe-cooled twin airfoil blade is described, and calculations for cycle efficiencies and specific work vs. firing temperature and cycle pressure ratio are presented for two cycles. In the older first cycle, air discharged from the compressor is divided into two flows. The first flow passes through a high pressure heat exchanger, and the second flow is expanded in the cold flow of the high pressure turbine. In the improved second cycle, the twin airfoil blade is applied only in the high pressure turbine. The maximum cycle efficiency is reached at a higher cycle pressure ratio than in the first cycle, which results in the reduction of the engine size. A variation of the second cycle using a counter-rotating turbine is proposed in which the upper airfoil of the twin airfoil design is in the hot flow and the lower airfoil is in the cold flow. The hot cycle operates on high firing temperature, and the blade temperature is expected to be near the average of the hot flow and cold flow temperatures. J.N.

A84-30064
TEST RESULTS OF A STEAM INJECTED GAS TURBINE TO INCREASE POWER AND THERMAL EFFICIENCY
R. L. MESSERLIE (General Motors Corp., Detroit Diesel Allison Div., Detroit, MI) and A. O. TISCHLER (International Power Technology, Inc., Sunnyvale, CA) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 2 . New York, American Institute of Chemical Engineers, 1983, p. 615-625.

The output power and thermal efficiency gains derivable from regeneration, intercooling, reheat and combustor steam injection gas turbine augmented cycles are compared. The last of these alternatives, designated the Cheng dual-fluid cycle (Cheng-DFC), incorporates the generation of steam using heat from the engine exhaust, and its injection into the combustion chamber through an annular manifold. A series of performance tests have demonstrated a 30-percent thermal efficiency gain for the Cheng-DFC engine, together with a 60-percent increase in output power, without increase in turbine inlet temperature. Attention is given to the effects of steam rate feed, steam injection location, turbine temperature, and Cheng-DFC engine operational characteristics. O.C.

A84-30074
INSTANTANEOUS HEAT TRANSFER DURING COMPRESSION AND EXPANSION IN RECIPROCATING GAS HANDLING MACHINERY
H. B. FAULKNER and J. L. SMITH, JR. (MIT, Cambridge, MA) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 2 . New York, American Institute of Chemical Engineers, 1983, p. 724-730. refs

In reciprocating gas handling machinery, there is both a net or average heat transfer over many cycles between the gas and the environment, and a cyclic heat exchange back and forth between the gas and the cylinder wall within each cycle. The latter phenomenon occurs both in open cylinder processes, and in closed cylinder processes, where it is sometimes referred to as 'gas spring loss'. This paper addresses the cyclic heat transfer as it occurs in a closed cylinder without combustion. A considerable number of experiments with a closed cylinder are discussed. For a given gas, work lost per cycle is correlated with an average Reynolds number for the cycle and the specific heat ratio of the gas. The T-S diagram of the cylinder contents is shown to be a sensitive indicator of the magnitude and timing of the heat transfer. Author

A84-30410
A STRENGTH ANALYSIS OF AIRCRAFT DESIGNS BY MEANS OF AN INCREMENTAL TECHNIQUE THAT USES THE FINITE ELEMENT METHOD [K RASCHETU NA PROCHNOST' AVIATSIONNYKH KONSTRUKTSII SHAGOVYM METODOM S PRIMENENIEM METODA KONECHNYKH ELEMENTOV]
S. M. BASTRAKOV, IU. A. DENISOV, and IU. G. POPOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 9-14. In Russian. refs

Attention is given to the problem of more rapidly obtaining exact solutions to systems of linear equations describing a design in a nonlinear formulation. Also considered is an extension of the incremental technique. A characteristic feature of the incremental technique is that a transition of the design from one state to another (and, consequently, from one computational state to the next) can be described using the change in the rigidity characteristics of a single load-bearing element; this element is the first for which the regular breakpoint on the deformation diagram has been reached. The incremental approach is extended here from the beam computational scheme to the finite-element method. The calculation of an altered design is reduced to a problem of matrix conversion by the augmentation method (Faddeev and Faddeeva, 1963); this is shown to considerably reduce the computation time. C.R.

A84-30416
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE BENDING-ROLLING PROCESS APPLIED TO SHEETS TO FORM CONICAL AIRCRAFT PARTS [TEORETICHESKOE I EKSPERIMENTAL'NOE ISSLEDOVANIE PROTSESSA GIBKI-PROKATKI LISTOVYKH KONICHESKIKH DETALEI LETATEL'NYKH APPARATOV]
M. I. LYSOV and N. V. SOSOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 41-47. In Russian.

The limits of applicability of existing methods for calculating the spring of conical parts manufactured from sheets are determined experimentally. It is found that the hypothesis of independent springing is valid in the region of small included angles in the parts and that the hypothesis of the cone-to-cone transition is valid in the region of large angles. Two variations are proposed for calculating the spring; these can be used over the entire range of changes in the included angle, that is, for small, intermediate, and large angles. C.R.

A84-30418
THE CALCULATION OF THIN-WALLED AIRCRAFT DESIGNS IN A GEOMETRICALLY NONLINEAR FORMULATION [RASCHET AVIATSIONNYKH TONKOSTENNYKH KONSTRUKTSII V GEOMETRICHESKI NELINEINOI POSTANOVKE]
V. A. PAVLOV and A. S. SAFONOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 52-56. In Russian. refs

Odinokov's (1948) theory is used to develop a method for calculating thin-walled reinforced designs. The method makes it possible to determine the stress-strain state in a way that allows for the effect of displacements of the axis. Nonlinear integro-differential equations are obtained. The principal relations of Odinokov's theory are generalized so that they can be used in investigating geometrically nonlinear problems. C.R.

A84-30517#
PERFORMANCE EVALUATION OF THE ADAPTIVE MTI CANCELLER FOR EXTENDED CLUTTER, ACEC
G. GALATI (Selenia S.p.A., Rome; Calabria, Universita, Cosenza, Italy) IETE, IEEE, SEE, and Institution of Engineers of India, International Radar Symposium, Bangalore, India, Oct. 9-12, 1983, Paper. 9 p. refs

The ACEC is an open-loop adaptive MTI for the cancellation of a moveable, extended-in-range clutter, such as rain or chaff. Its simple structure is well suited for a digital implementation; its performance, much superior to other systems that use the phase information only, has been evaluated for different clutter spectra and clutter-to-noise ratios. The problems due to a fixed MTI upstream and/or to a pulse compressor downstream are analyzed and the pertaining solutions are presented, both from the theoretical and the experimental point of view. Author

A84-30519#
SURVEY ON DATA PROCESSING SYSTEMS IN NETTED RADAR
A. FARINA (Selenia S.p.A., Rome, Italy) IETE, IEEE, SEE, and Institution of Engineers of India, International Radar Symposium, Bangalore, India, Oct. 9-12, 1983, Paper. 9 p. refs

This survey paper deals with the problem of netted radar systems which arises when the search and tracking functions are performed by using plots obtained from two or more, spatially separated, radar having overlapping coverages. Monostatic as well as bistatic radar can be netted in a system. Advantages and drawbacks of the netted systems will be listed; a description of the different architectures of the netted radar and of the technical problems involved will be given. A relevant application of the netted radar concept to the air-traffic-control (ATC) system will be also considered. Author

A84-30797
SHIP SATELLITE-NAVIGATION SYSTEMS (2ND REVISED AND ENLARGED EDITION) [SUDOVYE KOMPLEKSY SPUTNIKOVOI NAVIGATSII /2ND REVISED AND ENLARGED EDITION/]
P. S. VOLOSOV, IU. S. DUBINKO, B. G. MORDVINOV, and V. D. SHINKOV Leningrad, Izdatel'stvo Sudostroenie, 1983, 272 p. In Russian. refs

Principles for the construction of automated satellite-based navigation systems for ships are reviewed. Topics covered include satellite navigation principles; the apparent motion of navigation satellites; the analysis of ephemeris observational errors; and the optimization of both equipment solutions and algorithms for navigation information processing. The present theoretical analysis is supported by results of mathematical modeling, by geometric interpretation of separate positions, and by examples of applications in the Transit and Navstar GPS systems. J.N.

A84-30850
CIRCUITS AND DEVICES IN AIRCRAFT ELECTRICAL EQUIPMENT SYSTEMS [TSEPI I USTROISTVA SISTEM ELEKTROOBORUDOVANIIA LETATEL'NYKH APPARATOV]
V. N. ISTRATOV Moscow, Izdatel'stvo Mashinostroenie, 1983, 232 p. In Russian. refs

Basic properties of electrical circuits and their application in aircraft electrical equipment are studied. Topics of investigation include linear ac circuits, three-phase circuits, transient processes in linear first- and second-order circuits, nonlinear ac and dc circuits, thermoelectric and photoelectric sources of electric energy and electrical transformers, synchronous generators, generators for automated systems, and electric motors and servomechanisms. J.N.

A84-30997
COOLED BLADES OF GAS TURBINES /THERMAL DESIGN AND PROFILING/ [OKHLAZHDAEMYE LOPATKI GAZOVYKH TURBIN /TEPLOVOI RASCHET I PROFILIROVANIE/]
S. Z. KOPELEV Moscow, Izdatel'stvo Nauka, 1983, 145 p. In Russian. refs

The efficiency of the air-cooling of gas turbine blades is analyzed, and various approaches to the design of air-cooled gas turbine blades are discussed. In particular, attention is given to the analysis of heat transfer in blades with an internal deflector, blades with radial air flow, and blades with convective-barrier cooling. Methods for calculating the temperature of blades with transverse flow of the cooling air are discussed, as are methods for calculating losses in an air-cooled turbine. V.L.

A84-31119
FLOW AND HEAT TRANSFER AROUND A HEATED CIRCULAR CYLINDER IN A RAREFIED GAS
K. YAMAMOTO (Okayama University, Okayama, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 53, Jan. 1984, p. 167-177. refs

This paper deals with the flow of rarefied gas past a circular cylinder at low Mach numbers and the heat transfer from the cylinder on the basis of the BGK equation. The solution is obtained in the form of Oseen-Stokes solutions (describing slips at the cylinder surface) and correction terms in the kinetic region. The simultaneous integral equations for the velocity, density and temperature are derived. Numerical calculations for the thermal field are carried out over a wide range of the Knudsen number covering the slip to the nearly-free molecular flow. The variation of the Nusselt number with the Knudsen number is obtained and is favorably compared with a previous formula valid for small Knudsen numbers. Author

A84-31315
ANALYTICAL STUDY OF THE THERMAL AND FLUID MECHANICAL EVOLUTION OF A COOLING FILM INJECTED FROM A SINGLE LINE OF INCLINED ROUND HOLES
J. F. LOUIS (MIT, Cambridge, MA) and P. H. RAMETTE International Journal of Turbo and Jet-Engines, vol. 1, no. 1, 1983-1984, p. 7-28. refs

Attention is given to the effectiveness of a cooling film which issues from an infinite row of inclined and equally spaced holes, in an analytical study of the mixing which occurs between a primary flow and the jets which issue from the discrete holes. A pair of contrarotating vortices is created inside each jet, so that the entrainment of the primary flow by the jets is due to both the vortices and turbulent mixing. At a distance from the point of injection, which is dependent on the jets' lateral spacing, the jets become contiguous; this condition, together with reattachment to the wall at relaltively low momentum, results in the formation of a mixed layer which grows by turbulent diffusion and vortex entrainment. A self-contained analytical formulation is used to determine the path of the jets, the growth of the layer, the trajectory of the vortices, and both the velocity and the temperature profiles. Satisfactory agreement is found in comparisons of analysis results with available experimental data. O.C.

A84-31626
STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 25TH, PALM SPRINGS, CA, MAY 14-16, 1984, TECHNICAL PAPERS. PART 1
Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1984, 548 p.

Papers are presented on topics including optimum reliability-based design of plastic structures; shape optimization; expert systems and computer-aided engineering; stochastic differential equations for structural dynamics; and noise transmission through aircraft panels. Other topics include bolted joints in laminated composites; vacuum degassing behavior of beryllium; the role of ply buckling in the compressive failure of

graphite/epoxy tubes; and Langrange shell elements with spurious mode control. J.N.

A84-31628#
DAMAGE TOLERANT DESIGN DEMONSTRATION
J. M. HOPPER, G. MILIZIANO (Boeing Commercial Airplane Co., Seattle, WA), and E. DEMUTS (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 15-20. USAF, sponsored research. refs
(AIAA PAPER 84-0847)

Damage tolerance characterization testing was conducted on 5 in x 10 in specimens of the enhanced-toughness Hercules AS6/2220-3 according to the NASA-developed test specification NRP 1092. The static failure strengths are presented for various environments and room temperature/dry fatigue thresholds of the delaminated and impact-damaged graphite/epoxy coupons and stringer-stiffened wing skin panels. Damage due to external low velocity impact is found to be more critical than single-ply internal delaminations. A growth threshold for the impact-damaged components subjected to constant amplitude compression-compression cyclic load (R = 10) exists at about 60 percent of the damaged static strength. J.N.

A84-31646*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN INVESTIGATION INTO THE PROBABILISTIC COMBINATION OF QUASI-STATIC AND RANDOM ACCELERATIONS
R. W. SCHOCK and L. P. TUELL (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 193-199.
(AIAA PAPER 84-0908)

The development of design load factors for aerospace and aircraft components and experiment support structures, which are subject to a simultaneous vehicle dynamic vibration (quasi-static) and acoustically generated random vibration, require the selection of a combination methodology. Typically, the procedure is to define the quasi-static and the random generated response separately, and arithmetically add or root sum square to get combined accelerations. Since the combination of a probabilistic and a deterministic function yield a probabilistic function, a viable alternate approach would be to determine the characteristics of the combined acceleration probability density function and select an appropriate percentile level for the combined acceleration. The following paper develops this mechanism and provides graphical data to select combined accelerations for most popular percentile levels.
Author

A84-31660*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
RESPONSE OF LONG SHALLOW CYLINDRICAL PANELS TO RADIAL LINE LOADS
E. R. JOHNSON, M. W. HYER (Virginia Polytechnic Institute and State University, Blacksburg, VA), and D. M. CARPER (Pratt and Whitney Aircraft, Middletown, CT) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 310-321. refs
(Contract NCC1-15)
(AIAA PAPER 84-0954)

The large displacement static response of shallow orthotropic panels subjected to lateral loading is examined both theoretically and experimentally. The panels are circular cylindrical open shells which are also thin and long. The straight edges are simply supported at a fixed distance apart, and the curved edges are free. The lateral load is a spatially uniform line load acting along the generator direction of the cylinder, and is directed radially inward toward the center of curvature. The load induces a circumferential thrust, and the panel can, and does, snap-through to an inverted configuration at the buckling load. The effect of load position on the response is also examined. The test panels discussed in the paper are /(90/0)3/S graphite-epoxy laminates. Nominal dimensions are a radius of 60 in., a thickness of 0.060 in., and an arc length of 12 in. Very good agreement between theory and experiment is achieved. Author

A84-31675#
INDICIAL AND GUST RESPONSE OF AN UNSTAGGERED THIN-AIRFOIL CASCADE
V. G. MENGLE and S.-F. SHEN (Cornell University, Ithaca, NY) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 464-477. refs
(AIAA PAPER 84-0912)

The key to transient loading on a cascade system due to arbitrary in-phase perturbation and uniform qust is the indicial and the step-gust response. These are found here for an unstaggered cascade subjected specifically to a sudden unit-change of quasi-steady circulation for each airfoil and to a transverse gust with its front parallel to the cascade axis. The indicial lift is found by solving the linearized integral equation for vorticity using transform methods in the complex-frequency domain; whereas, the step-gust response is obtained from its harmonic counter-part by applying the reciprocal Fourier Transform pair relationship and analytic continuation. The small time asymptotic solutions are first found for the transient responses. Next Pade Approximants to the transformed responses are found from their Maclaurin series representations. The inverses for the transformed functions using these Pade Approximants give asymptotically stable transient responses with finite exponential series representations which are tabulated for various values of the gap-to-chord ratios. The meromorphic structure of the transformed response functions reveals that (1) both transient responses must have the same time constants and (2) dense cascades must respond faster than ones with low solidity or isolated airfoil. It also furnishes the proof for convergence-in-measure of the Pade Approximants used.
Author

A84-31680*# Army Air Mobility Research and Development Lab., Hampton, Va.
NONLINEAR RESPONSE AND FAILURE CHARACTERISTICS OF CLAMPED INTERNALLY PRESSURIZED GRAPHITE-EPOXY CYLINDRICAL PANELS
R. L. BOITNOTT (U.S. Army, Structures Laboratory, Hampton, VA), J. H. STARNES, JR. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, VA), and E. R. JOHNSON (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 514-525. refs
(Contract NCC1-15)
(AIAA PAPER 84-0955)

The nonlinear response and failure characteristics of internally pressurized 4- to 16-ply cylindrical panels of graphite/epoxy are experimentally and analytically studied. Tests simulated the skin of a typical transport aircraft fuselage under loading to eventual failure. Aluminum test specimens were similarly tested and compared. All graphite/epoxy panels are found to withstand the internal pressures applied, which are well above the proof pressure loading expected for transport fuselage structures. O.C.

A84-31681#
STRAIN-ENERGY-RELEASE RATE ANALYSIS OF DELAMINATION AROUND AN OPEN HOLE IN COMPOSITE LAMINATES
T. K. OBRIEN (U.S. Army, Structures Laboratory, Hampton, VA) and I. S. RAJU (U.S. Army, Structures Laboratory, Vigyan Research Associates, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 526-536. refs
(AIAA PAPER 84-0961)

The strain energy release rate G for delamination around an open hole in a laminate is presently calculated by means of a simple technique in which discrete locations around the hole boundary are modeled as straight edges, with the ply orientations rotated by an appropriate angle. The circumferential strain which had been calculated from an elasticity solution was substituted into a simple equation derived from the rule of mixtures and from laminated plate theory, to yield G distributions around the hole boundary. O.C.

A84-31684
STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 25TH, PALM SPRINGS, CA, MAY 14-16, 1984, AND AIAA DYNAMICS SPECIALISTS CONFERENCE, PALM SPRINGS, CA, MAY 17, 18, 1984, TECHNICAL PAPERS. PART 2
Conferences sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1984, 665 p.

Analytical and experimental investigations of structural-dynamics problems are reported, with emphasis on aircraft and spacecraft applications. Topics discussed include separated-flow unsteady aerodynamics for propfans, design-oriented identification of critical times in transient response, unified flutter analysis for composite aircraft wings, Shuttle-payload transient-load analysis, flexible-beam modal-control experiments, decoupled control of large space structures, a photogrammetric method for obtaining frequency-response functions, the Galileo spacecraft modal survey, the aeroelastic behavior of straight and forward-swept graphite/epoxy wings, and geometric methods for multibody dynamics. T.K.

A84-31692#
A UNIFIED FLUTTER ANALYSIS FOR COMPOSITE AIRCRAFT WINGS
G. A. OYIBO (Fairchild Republic Co., Farmingdale, NY) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 73-80. refs
(AIAA PAPER 84-0906)

A generalized theory capable of predicting aeroelastic flutter speeds for all composite and isotropic aircraft wings is presented. The existence of an affine space in which the flutter analysis of composite and isotropic wings can be effected in a unified and efficient manner is established. The wing is idealized as a cantilevered flat plate-like lifting surface subjected to an incompressible flow in the physical space. The analysis assumes that the wing's construction permits the negligence of the elastic constant, D(26), in the Virtual Work Theorem. Using the well known bending-torsion displacement assumptions in the affine space and the variational principles, the aeroelastic equations of motion are derived. Employing the affine space unsteady aerodynamics and the uncoupled bending and torsional frequencies generated in separate analyses the flutter studies are carried out. The advantages of the present approach over the existing one include a significant reduction in the number of physical space quantities (whose relative importance and bounds are unknown), a better exposure of the interactions between the aerodynamic and elastic forces and the fact that the flutter characteristics can be efficiently compared for all materials in a preliminary design process. The results agree with previous investigations for isotropic wings. Author

A84-31711#
EQUATIONS OF MOTION OF AN ELASTIC FLIGHT VEHICLE UTILIZING STATIC AEROELASTIC CHARACTERISTICS OF THE RESTRAINED VEHICLE
W. P. RODDEN and J. R. LOVE (Northrop Corp., Pico Rivera, CA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 236-250. refs
(AIAA PAPER 84-0986)

The equations of motion of an elastic flight vehicle are presented, giving the structural flexibility in terms of the flexibility matrix of the vehicle restrained in a statically determinate manner. The rotations of the principal axes relative to the structural axes caused by aerodynamic and inertial loading are included in the equations of motion; and the correctness of the formulation is demonstrated by identical numerical results from four case studies of longitudinal maneuvering in a forward-swept aircraft using the principal axis formulation and three significantly different structural axis formulations. Errors due to disregard of the requirements for the principal axis are evaluated on the sample aircraft. C.D.

A84-31715#
ANALYTICAL DETERMINATION OF REAL NORMAL MODES FROM MEASURED COMPLEX RESPONSES
N. NIEDBAL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Aeroelastik, Goettingen, West Germany) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 292-295. refs
(AIAA PAPER 84-0995)

Normal mode parameters are required in order to solve dynamic problems. These parameters can be determined either analytically by means of a Finite Element Method (FEM) or experimentally by means of a Ground Vibration Test or Modal Survey Test. The classical Phase Resonance Method determines directly the undamped normal mode parameters. To overcome the problem of structures with limited accessibility, phase separation methods have to be taken into account. In order to ensure comparability between the results of the FEM analysis and the proposed experimental method, a matrix transformation is presented to transform the damped (complex) normal mode parameters into undamped (real) normal mode parameters. Author

A84-31749#
AEROELASTIC BEHAVIOR OF STRAIGHT AND FORWARD SWEPT GRAPHITE/EPOXY WINGS
B. J. LANDSBERGER (USAF, Edwards AFB, CA) and J. DUGUNDJI (MIT, Cambridge, MA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 589-598. refs
(Contract AF-AFOSR-82-0071)
(AIAA PAPER 84-0903)

An analytical and experimental investigation was made of the aeroelastic deflection, divergence, and flutter behavior of both straight and 30-deg-forward-swept rectangular graphite/epoxy cantilevered-plate-type wings with various amounts of bending-torsion stiffness coupling. The analytical investigation used a Rayleigh-Ritz formulation together with incompressible three-dimensional Weissinger L-Method aerodynamics for the divergence and incompressible two-dimensional unsteady strip theory for the flutter. Rough attempts were also made to obtain the steady airload deflections of the wing, including the nonlinear stall behavior. Experiments on 13 wing configurations showed divergence and bending-torsion flutter at low angles of attack,

and torsion stall flutter and bending stall flutter at higher angles of attack. Good agreement with theory was found for the divergence and bending-torsion flutter cases at low angles of attack, and for the nonlinear steady wing deflections at high angles of attack. The +15-deg ply configuration was efficient in relieving the adverse divergence effect of the forward-swept wing. Author

A84-31783#
OPTIMIZATION OF STIFFENED PANELS UNDER COMPRESSION
W. LI Northwestern Polytechnical University, Journal, vol. 2, Jan. 1984, p. 107-114. In Chinese, with abstract in English. refs

The optimization of the angle-stiffened panel under compression using the feasible direction method is studied in this paper. For each iteration of the feasible direction method only the most critical constraint is considered; therefore, the process of calculation is greatly simplified. To avoid the occurrence of some unexpected buckling and to enhance the efficiency of the structure, the design variables are modified once in each iteration by some empirical formulas. The modification of the design variables is beneficial to the stability and the convergence of the design process. A uniform-scaling design is adopted in each iteration to ensure the feasibility of the results. The comparison of the numerical results of the illustrative examples in this paper with the data given by Gallagher (1973) indicates the effectiveness and the efficiency of this method. Author

A84-31856
THE EFFECT OF HEATING ON THE STABILITY OF FLOW OVER CONCAVE WALLS
V. K. GARG and R. C. DIPRIMA (Rensselaer Polytechnic Institute, Troy, NY) Physics of Fluids (ISSN 0031-9171), vol. 27, April 1984, p. 812-820. Navy-Army-supported research. refs
(Contract NSF MCS-82-01340; NSF MCS-81-20839)

The effect of heating or cooling on the linear Goertler instability of the boundary layer flow over a concave wall is described using an asymptotic analysis for shortwavelength disturbances. Nonparallel flow effects are included in the analysis and the quasiparallel flow approximation is not made. The basic flow and the linearized perturbation equations are derived. While the perturbation density is assumed to vary linearly with the perturbation temperature, the fluid viscosity is held constant. A rational asymptotic analysis of the disturbance equations for stationary streamwise vortices of short wavelength is given, followed by an analysis for travelling-wave disturbances. It is found that the critical disturbances are concentrated in thin viscous layers near the middle of the boundary layer, the precise location depending on the basic velocity and temperature profiles. Heating the boundary layer destabilizes the short-wavelength disturbances and cooling does the reverse. C.D.

A84-31901#
VIBRATIONS OF BLADED-DISK ASSEMBLIES - A SELECTED SURVEY
A. V. SRINIVASAN (United Technologies Research Center, East Hartford, CT) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, April 1984, p. 165-168. refs

The progress made in the decade 1973-1983 in the area of vibration of jet engine blades is surveyed. The purpose of the survey is to provide a general review of recent progress and the limited number of references cited can be used to reach the many other important publications in this area. Both structural and aerodynamic aspects of blade vibration are discussed, although the emphasis is on the former. The areas of future analytical and experimental research needed to continue to influence the design of these components are outlined. Author

A84-31907#
MAXIMUM RESONANT RESPONSE OF MISTUNED BLADED DISKS
J. C. MACBAIN (USAF, AeroPropulsion Laboratory, Wright-Patterson AFB, OH) and P. W. WHALEY (Nebraska, University, Lincoln, NE) ASME, Transactions, Journal of Vibration, Acoustics, Stress and Reliability in Design (ISSN 0739-3717), vol. 106, April 1984, p. 218-223. refs

The prediction of the maximum resonant response of a mistuned bladed disk having closely spaced dual modes as a function of mode mistuning and modal damping is investigated. Equations describing the dual-mode response of the disk are rigorously analyzed to investigate the individual mode behavior in terms of response level and nodal line position. The value of the mistune parameter, S/zeta, yielding a maximum resonant response was analytically determined to be 0.414. This response is 20 percent higher than the response of a tuned bladed disk having coincident dual modes. It is proposed that mistuning always produces a maximum resonant response greater than or equal to that of the tuned system. J.N.

A84-32346#
HIGH-AVERAGE-POWER EXCIPLEX LASER SYSTEM [DESCRIPTION D'UN SYSTEME LASER AEXCIPLEXES AVOCATION DE GRANDE PUISSANCE MOYENNE]
M. SENTIS (Aix-Marseille II, Universite, Marseille, France) Entropie (ISSN 0013-9084), vol. 20, no. 115, 1984, p. 3-12. In French. Research supported by the Direction des Recherches, Etudes et Techniques and Commissariat al'Energie Atomique. refs

The LUX high-average-power high-PRF exciplex laser (EL) system being developed at the Institut de Mecanique des Fluides de Marseille is characterized, and some preliminary results are presented. The fundamental principles and design criteria of ELs are reviewed, and the LUX components are described and illustrated, including a closed-circuit subsonic wind tunnel and a 100-kW-average power 1-kHz-PRF power pulser providing avalanche-discharge preionization by either an electron beam or an X-ray beam. Laser energy of 50 mJ has been obtained at wavelength 308 nm in the electron-beam mode (14.5 kV) using a 5300/190/10 mixture of Ne/Xe/HCl at pressure 1 bar. T.K.

A84-32600
A CONDITIONAL-SAMPLING STUDY OF THE INTERACTION OF TWO TURBULENT WAKES
G. FABRIS (Illinois Institute of Technology, Chicago, IL) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 140, March 1984, p. 355-372. refs

The merging of two simple two-dimensional far-turbulent wakes formed by equal cylinders is studied. The conditional-sampling technique was able to be used due to the slight heating of one of the wakes, which traced its fluid by an elevated temperature. A special four-wire probe was used for simultaneous and precise measurements of uncontaminated instantaneous u, v, w, and theta, and the single-wake data of Fabris (1979) served as a reference. The interaction of the turbulent wakes resulted in a marked enhancement of the lateral heat transfer. Mean velocities and fluctuating fields rapidly developing in the interacting region at $x/D = 200$ and 400 are associated with diminishing turbulent energy. Levels of all three components of the kinetic energy of turbulence attain their highest relative maxima in the heated zones as they cross the upper cold wake. J.N.

A84-32614#
OPTIMALITY CRITERION TECHNIQUES APPLIED TO FRAMES HAVING GENERAL CROSS-SECTIONAL RELATIONSHIPS
M. R. KHAN (Clarkson College of Technology, Potsdam, NY) (Structures, Structural Dynamics and Materials Conference, 22nd, Atlanta, GA, April 6-8, 1981, Technical Papers. Part 1, p. 233-241) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 669-676. refs

Previously cited in issue 12, p. 2018, Accession no. A81-29402

A84-32617#
BUFFETING OF A SLENDER CIRCULAR BEAM IN AXIAL TURBULENT FLOWS
W. H. LIN (Argonne National Laboratory, Argonne, IL) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 443-447) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 690-695. refs

Previously cited in issue 12, p. 1744, Accession no. A83-29854

A84-32624#
SINGULAR PROPAGATION BEHAVIOR OF CRACKS IN STIFFENED CYLINDRICAL SHELLS
C. SHANGCHOW (Northwestern Polytechnical University, Xian, People's Republic of China) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 721-723.

Crack propagation in a 300-mm-long 200-mm-diameter circular cylindrical shells of 1-mm-thick Al alloy, both unstiffened and stiffened with one or two circumferential 22-mm-wide riveted bands of the same material, is investigated experimentally and analytically. Stiffeners are found to have an adverse effect on the fracture strength and burst pressure of the shells, a phenomenon attributed to increased stress-intensity factors associated with the interaction of crack and stiffener. Implications for the design of shell-like structures such as aircraft pressure cabins are indicated. T.K.

A84-32764#
VIBRATION OF IMPELLERS. V - MEASUREMENT OF RESONANT VIBRATORY STRESSES OF AN IMPELLER AND PRESSURE DISTRIBUTION DUE TO AERODYNAMIC EXCITATION
S. MICHIMURA, A. NAGAMATSU (Tokyo Institute of Technology, Tokyo, Japan), H. YAMAGUCHI (Komatsu, Ltd., Oyama, Tochigi, Japan), and T. ISHIKAWA JSME, Bulletin (ISSN 0021-3764), vol. 27, March 1984, p. 534-539.

Impellers rotate at high speeds, and therefore in order to improve the efficiency of turbomachines it is necessary to take into account not only the static strength to withstand centrifugal force but also the dynamic strength to withstand vibration. In this investigation, a screen with slots around its periphery is positioned in front of the impeller and the impeller is excited aerodynamically through this screen. The resonant vibratory stresses and the pressure distribution are measured simultaneously in resonant condition, when the impeller is rotating at high speeds. The relationship between the resonant vibratory stresses and the pressure distribution is discussed in detail by analyzing the frequency variation of the two components. Author

A84-32765#
STABILITY OF A RIGID ROTOR SUPPORTED BY EXTERNALLY PRESSURIZED GAS JOURNAL BEARINGS WITH A CIRCULAR SLOT RESTRICTOR
S. YOSHIMOTO and Y. NAKANO (Tokyo Science University, Tokyo, Japan) JSME, Bulletin (ISSN 0021-3764), vol. 27, March 1984, p. 561-568. refs

In this paper, the stability of a rigid rotor supported by externally pressurized gas journal bearings with a circular slot restrictor is theoretically determined by the small-perturbation method with respect to whirling amplitude. The influences of the inertia forces of the gas film on the dynamic properties of the bearing are investigated, and the theoretical results are compared with experimental data: good agreement is obtained. Author

A84-32791
THE FLOW FROM NOTCHED NOZZLES IN THE PRESENCE OF A FREE STREAM
D. J. SMITH and T. HUGHES (Manchester, Victoria University, Manchester, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, March 1984, p. 77-85.

Experimental results obtained in jets from notched nozzles in a co-flowing free stream are presented. It is confirmed that even at low jet speeds the notches produce trailing vortices and it is found that the effect on the free stream on the vortices is surprisingly small. Author

A84-32993#
SURVEY OF QUALITY RESULTS OBTAINED IN SERIAL PRODUCTION OF AEROSPACE COMPOSITE STRUCTURES
F. CIPRI (Aeritalia S.p.A., Gruppo Velivoli da Combattimento, Turin, Italy) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 2 . Stevenage, Herts., England, 1983, p. 23-1 to 23-13.

A significant number of mechanical tests has been performed on advanced composites and adhesives for acceptance of incoming material and process control. The test results have been statistically analyzed to establish their scatter pattern against the nominal mechanical properties and some decay in behavior caused by the time elapsed between incoming and actual use of material. The resulting scatter has to be confined to a narrow band, and the general tendency of mechanical performances is to improve as production progresses. The results obtained permit one to envisage some reduction on the present number of tests required for acceptance of both material and process, with the objective of decreasing the overall costs of activities to verify quality. Author

A84-32997#
THE MECHANISED LAYING OF COMPOSITE MATERIALS INTO CURVED MOULD TOOLS
K. FAWCETT and C. BREAKSPEAR (Westland Helicopters, Ltd., Yeovil, Somerset, England) IN: Engineering with composites; Proceedings of the Third Technology Conference, London, England, March 14-16, 1983. Volume 2 . Stevenage, Herts., England, British Aerospace PLC, 1983, p. 27-1 to 27-6.

Composite materials are used extensively throughout the aerospace industry. A range of resin-impregnated materials are used in the development and production of composite helicopter rotor blades. Current composite material-laying machines use a roller to lay the materials onto a flat bedway. Laminates are produced by laying successive layers. These then have to be removed from the flat bedway, carried, and laid manually into the curved blade mould tools. A method of laying composite materials directly into the curved mould tools has been developed which uses a system of bristle brushes to lay and consolidate the materials. This method has reduced the manual labor content of blade production and has overcome the problems associated with handling 9-m lengths of uncured, resin-impregnated materials, as used in blade manufacture. Author

A84-33144
CRACK PROPAGATION BEHAVIOR IN PLATED SHEET METAL CONSISTING OF ALCUMG(2) AND ALZNMGCU(1.5) IN THE CASE OF DYNAMIC STRESSES [RISSAUSBREITUNGSVERHALTEN IN PLATTIERTEN BLECHEN AUS ALCUMG2 UND ALZNMGCU1,5 BEI SCHWINGBEANSPRUCHUNGEN]
L. SCHWARMANN (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) Aluminium (ISSN 0002-6689), vol. 59, no. 6, 1983, p. 443-445. In German. refs
(MBB-VFW-44-83-OE)

Calculations regarding crack propagation are often performed to assist the designer in component design operations. The calculations have the objective to provide information regarding the damage tolerance properties of the components. One of the computational procedures employed in the aircraft industry is the approximate method described by Forman (1967). The present investigation has the objective to provide material parameters needed for the utilization of Forman's method, taking into account values for plated aluminum alloy sheet involving AlCuMg(2) and AlZnMgCu(1.5). The influence of alloy composition and heat treatment conditions on the crack propagation characteristics is studied. G.R.

N84-22771*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERONAUTICS AND SPACE ENGINEERING BOARD: AERONAUTICS ASSESSMENT COMMITTEE
1977 263 p refs Meeting held 16-17 Mar. 1977
(NASA-TM-85594; NAS 1.15:85594) Avail: NTIS HC A12/MF A01 CSCL 13B

High temperature engine materials, fatigue and fracture life prediction, composite materials, propulsion noise pollution, propulsion components, full-scale engine research, V/STOL propulsion, advanced engine concepts, and advanced general aviation propulsion research were discussed. B.G.

N84-22813# Rolls-Royce Ltd., Derby (England).
MULTI-SMALL HOLE DRILLING BY EDM
D. F. TOLLER Apr. 1983 11 p
(PNR-90184; REPRINT-897) Avail: NTIS HC A02/MF A01

Electrodischarge machining processes were developed so that large numbers of small cooling holes can be drilled at economic production rates in gas turbine components. Developments in electrode contact and refeed systems, multidirectional electrode guides and machine tools are described. Trends in small hole drilling technology are indicated. Author (ESA)

N84-22814# Rolls-Royce Ltd., Derby (England).
MANUFACTURING INFLUENCE OF DESIGN AND ITS IMPORTANCE TO SUCCESSFUL AUTOMATION
F. TURNER 1983 9 p
(PNR-90189; REPRINT-902) Avail: NTIS HC A02/MF A01

Cooperation between designers and manufacturers of aircraft engines and engine parts is discussed. The contributions of computer aided design and manufacture, and standardization of cutting tools are summarized. Automated inspection is described. Author (ESA)

N84-22815# Rolls-Royce Ltd., Derby (England).
A REVIEW OF ADVANCED MANUFACTURING TECHNOLOGY
T. BROUGHTON Mar. 1981 16 p Presented at Brit. Aviation Seminar and Exhibition 1981, Delhi, 17-19 Mar. 1981 and Bangalore, 25-27 Mar. 1981
(PNR-90194; REPRINT-758) Avail: NTIS HC A02/MF A01

Joining techniques, hot forming technology, forging technology, investment casting, small cooling hole manufacturing, combustor technology, quality assurance, and chip forming machining of gas turbine engine components are discussed. Electron and laser beam welding; laser hard facing techniques; automatic TIG and plasma welding; diffusion brazing of titanium and nickel alloys; heated die forming: blow forming; superplastic forming; fan and compressor blade forging; and wheel and disk forging from powder superalloys are described. Author (ESA)

N84-22904 British Aerospace Dynamics Group, Bristol (England). Aerodynamics Research Dept.
VISUALISATION OF THE VORTEX DOMINATED FLOW AROUND A DELTA WING-BODY COMBINATION USING A WATER TUNNEL
H. P. SWABY 27 Nov. 1980 41 p refs
(BAE-821/RES/6631) Avail: Issuing Activity

Interaction of the body vortex system and the wing panels in vortex dominated flow around a cruciform wing/body combination at angles of incidence up to 35 deg was studied using dye lines in a water tunnel with flow speed = 5 to 10 cm/sec, Reynolds number based on body diameter = 1700. Photographs show anticipated differences in the flow field for a delta, as opposed to a cropped delta wing-body configuration. A strong wing leading edge vortex is present with the delta wing combination. The vortex does not break up when the body attitude is such that there is a low effective angle of attack on the upper wing panel, but when the body is at low incidence with zero roll angle, or at higher incidence with the wings rolled to the leeside. The flow remains rotational. Author (ESA)

N84-22906*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ANALYSIS OF SHOCK COALESCENCE INCLUDING THREE-DIMENSIONAL EFFECTS WITH APPLICATION TO SONIC BOOM EXTRAPOLATION Ph.D. Thesis - George Washington Univ.
C. M. DARDEN Jan. 1984 77 p refs
(NASA-TP-2214; L-15660; NAS 1.60:2214) Avail: NTIS HC A05/MF A01 CSCL 20D

A method for analyzing shock coalescence which includes three dimensional effects was developed. The method is based on an extension of the axisymmetric solution, with asymmetric effects introduced through an additional set of governing equations, derived by taking the second circumferential derivative of the standard shock equations in the plane of symmetry. The coalescence method is consistent with and has been combined with a nonlinear sonic boom extrapolation program which is based on the method of characteristics. The extrapolation program, is able to extrapolate pressure signatures which include embedded shocks from an initial data line in the plane of symmetry at approximately one body length from the axis of the aircraft to the ground. The axisymmetric shock coalescence solution, the asymmetric shock coalescence solution, the method of incorporating these solutions into the extrapolation program, and the methods used to determine spatial derivatives needed in the coalescence solution are described. Results of the method are shown for a body of revolution at a small, positive angle of attack. E.A.K.

N84-22909*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VORTEX GENERATING FLOW PASSAGE DESIGN FOR INCREASED FILM-COOLING EFFECTIVENESS AND SURFACE COVERAGE
S. S. PAPELL 1984 21 p refs Presented at the 22nd Natl. Heat Transfer Conf., Niagara Falls, N.Y., 5-8 Aug. 1984; sponsored by ASME and the American Inst. for Chemical Engineering.
(NASA-TM-83617; E-2048; NAS 1.15:83617) Avail: NTIS HC A02/MF A01 CSCL 20D

The fluid mechanics of the basic discrete hole film cooling process is described as an inclined jet in crossflow and a cusp shaped coolant flow channel contour that increases the efficiency of the film cooling process is hypothesized. The design concept requires the channel to generate a counter rotating vortex pair secondary flow within the jet stream by virture of flow passage geometry. The interaction of the vortex structures generated by both geometry and crossflow was examined in terms of film cooling effectiveness and surface coverage. Comparative data obtained with this vortex generating coolant passage showed up to factors of four increases in both effectiveness and surface coverage over that obtained with a standard round cross section flow passage. A streakline flow visualization technique was used to support the concept of the counter rotating vortex pair generating capability of the flow passage design. M.G.

N84-22915# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
MIXING OF SWIRLING FLOWS AND BEHAVIOR OF WET FLOWS Annual Report, 1 May 1982 - 30 Apr. 1983
G. C. OATES 22 Nov. 1983 7 p
(Contract AF-AFOSR-0186-80; AF PROJ. 2307)
(AD-A138697; AFOSR-84-0108TR) Avail: NTIS HC A02/MF A01 CSCL 20D

This report describes progress into research on the interaction of droplets with shock waves, the mixing of co-axial jets in the near region, the influence of nearby solid boundaries on multihole probes, and the behavior of shock trains in ramjet inlets. The study of the mixing of coaxial jets has been completed with the submission of a Ph.D. dissertation. Appropriate software for laser velocimetry data reduction has been prepared for use with the droplet-shock wave study, and a computer program for the description of droplet shock wave interaction has been generated. Preliminary measurements of solid boundary influence on five hole probe readings have been taken, and optical data for shock trains

in ramjet inlets have been obtained from both a water analogy rig and a supersonic wind tunnel. GRA

N84-22956# Rolls-Royce Ltd., Derby (England).
LASER DRILLING OF AERO ENGINE COMPONENTS
D. F. TOLLER Nov. 1982 9 p
(PNR-90185; REPRINT-898) Avail: NTIS HC A02/MF A01

Cost advantages of the solid state YAG laser over other machining techniques used for production of holes in aero engine parts are discussed. While ruby and glass based systems are useful, the rapid pulse rates offered by the YAG system and the ability to use a trepanning technique for small hole drilling make it the first choice. Cost comparison with other methods show 30% to 40% savings in consummables and floor to floor times. This together with the advent of reliable CNC machines means a faster growth in applications for laser drilling than before. Author (ESA)

N84-22959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED COMPLIANT HYDRODYNAMIC FLUID JOURNAL BEARING Patent Application
E. L. WARREN, inventor (to NASA) 2 Apr. 1984 11 p
(NASA-CASE-LEW-13670-1; US-PATENT-APPL-SN-603374)
Avail: NTIS HC A02/MF A01 CSCL 13I

An arc heating structure is described that prevents destructive bending moments within the top foil. Welds are eliminated by mounting the top bearing foil in the bearing cartridge sleeve without using a space block. Tabs or pins at the end of the top bearing foil are restrained by slots or stops formed in the cartridge sleeve. These structural members are free to move in a direction normal to the shaft while being restrained from movement in the direction of shaft rotation. NASA

N84-22971# Rolls-Royce Ltd., Derby (England).
COST EFFECTIVENESS OF RELIABILITY IN THE AEROSPACE INDUSTRY
F. H. THOMAS 1983 29 p
(PNR-90187; REPRINT-900) Avail: NTIS HC A03/MF A01

A computer based reliability analysis data system was developed for jet engine assessment. The system comprises data bases for aircraft flying times and engine removals; modification embodiment at engine and module level; engine module event file with three basic formats to facilitate analysis based on sort order, and all serialized parts tracked through life and location. Problems can be placed in the context of the total exposure, giving a true measure of the risk of failure or rejection over a predetermined period of time. Failure modes on new parts are differentiated from those on worn parts, and the nature of shop related failure in a subset of the population is rapidly determined. The system is expensive to create, but its capabilities and rapidity outweigh cost disadvantages. Author (ESA)

N84-22972# Rolls-Royce Ltd., Derby (England).
SIRE: AN INTEGRATED RELIABILITY AND COST MODEL FOR THE AEROSPACE INDUSTRY
F. H. THOMAS and M. I. LITTLEWOOD 1983 17 p refs
(PNR-90192; REPRINT-904) Avail: NTIS HC A02/MF A01

A Weibull based analytical model to describe the effects of design, maintenance, and operational actions in terms of changes in reliability and maintenance costs for the main aerospace propulsion plant is proposed. All reasonable behavioral subsets are recognized, e.g., inspection, rejection, replacement, repair and failure. Combination of these behavioral modes to produce overall system modes of cost and reliability at differing levels of complexity is outlined. Author (ESA)

N84-22973# Rolls-Royce Ltd., Derby (England).
PROVEN DESIGN + NEW TECHNOLOGY = RELIABILITY + ECONOMY
R. G. JACKSON 2 Nov. 1983 22 p Presented at Air Transport Assoc. of Canada Tech. Forum, 2 Nov. 1983
(PNR-90199; REPRINT-917) Avail: NTIS HC A02/MF A01

Savings made available to an airline operator through incorporation of technology changes to engines which demonstrate a high level of reliability in service are discussed. These changes do not affect the fundamental integrity or design of the engine, but accept the basic design concept and introduce proven read-across type changes from other engines, to improve efficiency, reduce fuel consumption, increase engine life, and reduce maintenance. This contributes to significant reductions in the cost of ownership of an engine. Author (ESA)

N84-22975*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
LARGE DEFORMATION BEHAVIOR OF LONG SHALLOW CYLINDRICAL COMPOSITE PANELS Interim Report
D. M. CARPER, M. W. HYER, and E. R. JOHNSON Sep. 1983 171 p refs
(Contract NCC1-15)
(NASA-CR-173286; NAS 1.26:173286; VPI-E-83-37; IR-36) Avail: NTIS HC A08/MF A01 CSCL 20K

An exact solution is presented for the large deformation response of a simply supported orthotropic cylindrical panel subjected to a uniform line load along a cylinder generator. The cross section of the cylinder is circular and deformations up to the fully snapped through position are investigated. The orthotropic axes are parallel to the generator and circumferential directions. The governing equations are derived using laminated plate theory, nonlinear strain-displacement relations, and applying variational principles. The response is investigated for the case of a panel loaded exactly at midspan and for a panel with the load offset from midspan. The mathematical formulation is one-dimensional in the circumferential coordinate. Solutions are obtained in closed-form. An experimental apparatus was designed to load the panels. Experimental results of displacement controlled tests performed on graphite-epoxy curved panels are compared with analytic predictions. Results demonstrate that panel shallowness, material orthotropy, and stacking sequence can influence the nonlinear static response. Initial geometric imperfections, observed during testing, were found to influence the response of the panels. However, the overall correlation of analytic and experimental results were good. M.G.

N84-22976# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 16, NO. 3 Monthly Report
J. NAGLE-ESHLEMAN, ed. and L. G. TWOHIG, ed. Mar. 1984 72 p refs
(AD-A139707) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Topics covering nonlinear transient rotor dynamics and the linear dynamics of cables are presented along with book reviews, abstracts, courses of study, and news briefs that pertain to the study of shock and vibration. Abstract categories from the current literature include structural systems, mechanical systems, vehicle systems, biodynamic response, vibration control components, and design analysis.

N84-22977# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering.
NONLINEAR/TRANSIENT ROTOR DYNAMICS ANALYSIS
M. L. ADAMS *In* the Shock and Vibration Information Center The Shock and Vibration Digest, Vol. 16, No. 3 p 3-6 Mar. 1984 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

A review of nonlinear transient rotor dynamics is presented with emphasis on computerized rotor vibration analysis. Gas and

steam turbine engine systems are examined for unbalanced rotor vibration. Computer analysis techniques are employed to investigate rotor/stator rubbing, rotor cracking, and vibrational damping.
M.A.C.

N84-22979*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PREDICTION OF FATIGUE CRACK-GROWTH PATTERNS AND LIVES IN THREE-DIMENSIONAL CRACKED BODIES
J. C. NEWMAN, JR. and I. S. RAJU Apr. 1984 14 p refs
(NASA-TM-85787; NAS 1.15:85787) Avail: NTIS HC A02/MF A01 CSCL 20K

Fatigue crack growth patterns and lives for surface cracks, surface cracks at holes, and corner cracks at holes in three dimensional bodies were predicted using linear-elastic fracture mechanics concepts that were modified to account for crack-closure behavior. The predictions were made by using stress intensity factor equations for these crack configurations and the fatigue crack-growth (delta K against rate) relationship for the material of interest. The crack configurations were subjected to constant-amplitude fatigue loading under either remote tension or bending loads. The predicted crack growth patterns and crack growth lives for aluminum alloys agreed well with test data from the literature. Author

N84-22985# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
CORROSION AND LOAD TRANSFER EFFECTS ON FATIGUE OF MECHANICALLY FASTENED JOINTS. FATIGUE OF ZERO LOAD TRANSFER SPECIMEN
E. U. LEE 4 Oct. 1983 26 p
(Contract ZR0-0001)
(AD-A139042; NADC-83133-60) Avail: NTIS HC A03/MF A01 CSCL 13E

This IR program studies the effects of load transfer and corrosive environment on fatigue of mechanically fastened joints. As an initial part of the program, the fatigue crack initiation and growth, and the final fracture in zero load transfer specimens of 7475-T7351 aluminum alloy were investigated. The applied stress range was related to the fatigue crack initiation life Ni and the total fatigue Nf by empirical equations. The variation of fatigue crack growth rate with stress intensity factor range was defined. The proportion of fatigue crack initiation an growth lives was determined as a function of the stress range and the total fatigue life. GRA

N84-22990# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
THE APPLICATION OF COLD WORKED HOLES (IN AIRCRAFT STRUCTURES)
A. U. DEKONING Aug. 1983 33 p refs In DUTCH; ENGLISH summary
(NLR-TR-81120-U) Avail: NTIS HC A03/MF A01

Consequences of the application of cold worked holes in aluminum alloy aircraft structures were studied. The plastic expansion of holes method of introducing residual stresses is considered. A mathematical model of the process of this method is formulated and applied to series of expanded holes. Formulas for stresses and deformations near cold worked holes are derived. Author (ESA)

N84-23558# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
STATISTICAL AND VIBRATORY FATIGUE LIMIT CHARACTERISTICS OF ALUMINUM CAST ALLOYS [STATISCHE UND SCHWINGFESTIGKEITSKENNWERTE FUER AL-GYSSLEGIERUNGEN]
H. FROMMEYER *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 60-80 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

Statistical, fracture mechanics, dynamic, and crack propagation characteristics were determined for high strength aluminum alloy A357 T6 airframe components manufactured with the fine cast and Precial-cast Avior procedures. Statistical tests show that mechanical characteristics are better than the required values. Tensile test samples were statically loaded till fracture. For the cast method the required fracture toughness is correctly chosen; the yield point value can be increased. For the Precial-cast method the required values can be considerably higher. Author (ESA)

N84-23560# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
ECONOMIC RIVETING: DIFFERENT BORE QUALITIES, FITTINGS, CONNECTION ELEMENTS [WIRTSCHAFTLICHES NIETEN: UNTERSCHIEDLICHE BOHRUNGSQUELITATETEN, PASSUNGEN, VERBINDUNGSELEMENTE]
K. HOFFER *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 84-86 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

Riveted test rods made of the aluminum cast alloy A357 T6 were tested under single flight load FALSTAFF in order to investigate the influence of the connecting element assembling the rod and of the drilling procedure. Comparison between the connecting elements of the types Hi-Lok (screw rivet) and Lockbolt (fitting rivet) shows no considerable difference. Taper-Lok screw rivets and Hi-Tigue screw rivets have a slightly better vibratory fatigue limit behavior than Hi-Lok rivets. As compared to the riveted AGARD test rods made of the aluminum wrought alloy 3.4364 T 7357, the vibratory fatigue limit of the aluminum cast alloy is lower in the domain between 20,000 and 50,000 simulated flights. From 60,000 flights on it is equal or better. Author (ESA)

N84-23561# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallishe Werkstoffe.
WELDING OF COMPONENTS MADE OF THE ALUMINUM CAST ALLOY A357 [SCHWEISSEN VON BAUTEILEN AUS DER AL-GUSSLEGIERUNG A357]
G. MEYE *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 87-97 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

The fatigue resistance of welded A357 aluminum cast alloy samples was tested and the welding of airframe components was investigated. Electron beam and tungsten-inert gas welding were used. The effects of heat treatment were also investigated. The tests shows that the results on probes can be extrapolated to welded components, and that large scale economic production in airframe construction is possible. Author (ESA)

N84-23562# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
SUPERPLASTIC TRANSFORMATION AND DIFFUSION WELDING OF TITANIUM ALLOYS [SUPERPLASTISCHES UMFORMEN DIFFUSIONSSCHWEISSEN VON TI-LEGIERUNGE]
W. BECK *In its* Develop. and Demonstration of Econ. Production Systems in Airframe Construct., Part 2, Part 6 p 98-123 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

Propeller ribs were manufactured in order to study construction details, manufacturing parameters and cost data of the superplastic forming/diffusion ion bonding (SPF/DB) technology. The use of titanium is justified by the presence of high thermal and mechanical loads. The test results demonstrate that the SPF construction technique is suitable for three-dimensional structures in titanium alloys, and that the combination SPF/DB technique is suitable for flat components. The required weight and cost reductions can be realized by the SPF/DB combination for three-dimensional airframe components. Author (ESA)

N84-23563# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Metallische Werkstoffe.
ALUMINUM PRECISION FORGING COMPONENTS [AL-GENAUSCHMIEDETEILE]
W. ZINK *In its* Develop. and Demonstration of Econ. Production Systems in Aircraft Construct., Part 2, Part 6 p 124-147 Nov. 1983 In GERMAN
Avail: NTIS HC A08/MF A01

Economic and production characteristics of precision forged aluminum alloy fighter aircraft components were investigated, using MRCA aircraft components. Test results show that large precision forging components (projected surface 1000 sq cm) can be technically and economically produced. Author (ESA)

N84-23572# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
TURBULENT DIFFUSER FLOW STUDIES RELATED TO THE DESIGN OF THE ETW DIFFUSER
H. W. STOCK *In* Agard Wind Tunnels and Testing Tech. 9 p Feb. 1984 refs Sponsored in part by Technical Group ETW, Amsterdam
Avail: NTIS HC A22/MF A01

A computational method based on the boundary layer concept is used for calculating turbulent flows in diffusers with circular cross sections. That newly developed method is shown to produce reasonable agreement with a critical experiment for which existing methods fail. In a parametric study, varying Reynolds- and Mach number for different diffuser inlet conditions, turbulent flows in the diffuser are considered to describe the efficiency of the diffuser and the danger of flow separation. The Reynolds number range investigated was such, to cover flow situations from the 1:7.2 scale test diffuser under non cryogenic conditions to the full scale diffuser applying cryogenic conditions. In supplement some geometry modifications are studied to see whether the efficiency of the diffuser can possibly be augmented. Author

N84-23576# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Abteilung Turbulenzforschung.
DEFINITION, SOURCES AND LOWEST POSSIBLE LEVELS OF WIND-TUNNEL TURBULENCE
U. MICHEL and E. FROEBEL *In* Agard Wind Tunnels and Testing Tech. 12 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

Wind tunnel turbulence is defined to include the fluctuations of all flow quantities in an empty tunnel test section. It can be separated into three modes, vorticity, entropy, and pressure. The pressure model is discussed in more detail. It is shown that contributions from the free shear layers of open test sections or the boundary layers of closed test sections are accompanied by much higher velocity fluctuations than plane sound waves. The lowest possible velocity fluctuation level in an open test section is determined by the pressure field generated by the free shear layer. The German-Dutch Wind Tunnel (DNW) is shown to reach this level. It is assumed that the lowest possible turbulence level in a closed test section is determined by the pressure field that is generated by the boundary layers in the test section. A spectral energy distribution and a Reynolds number scaling law for this contribution are derived. Author

N84-23577*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EVALUATION OF FACTORS AFFECTING THE FLOW QUALITY IN WIND TUNNELS
F. K. OWEN (Complere Inc., Palo Alto, Calif.), P. C. STAINBACK, and W. D. HARVEY *In* Agard Wind Tunnels and Testing Tech. 22 p Feb. 1984 refs
(Contract NAS1-16643; NAS2-10859; NAS2-11080)
Avail: NTIS HC A22/MF A01 CSCL 20D

Tests were conducted in a number of NASA wind tunnels to measure disturbance levels and spectra in their respective settling chambers, test sections, and diffusers to determine the sources of these disturbances. Results indicate that properly designed and located second minimum in transonic tunnels prevent fluctuation originating at struts and in diffusers from propagating upstream into the test section. The installation in or upstream of the settling chamber of carefully selected screens, honeycomb, and acoustic baffles could further reduce test section turbulence levels and scales without significant pressure losses. The performance of these modifications is strongly influenced by tunnel geometry and their influence on the mean flow around the circuit. Author

N84-23578# Dornier-Werke G.m.b.H., Munich (West Germany). Theoretical Aerodynamics.
PREDICTION OF CONDENSATION ONSET AND GROWTH IN THE EUROPEAN TRANSONIC WIND TUNNEL (ETW)
B. WAGNER and M. DOKER (DFVLR, Goettingen, West Germany) *In* Agard Wind Tunnels and Testing Tech. 11 p Feb. 1984 refs Sponsored in part by the German Ministry of Research and Technology, and by the Technical Group ETW, Amsterdam
Avail: NTIS HC A22/MF A01

Experimental and theoretical investigations were carried out to allow reliable prediction of condensation onset and growth in cryogenic wind tunnels. The idea of streamline duplication was used in the experiments in order to simulate European Transonic Wind Tunnel (ETW) streamlines in an experimental facility of small cross section but with real ETW length scale. Classical nucleation theory was used for developing computer programs which can predict condensation processes in one dimensional flow including real gas effects. Experiments and calculations show satisfactory agreement and confirm the possibility of an operating range extension for the ETW. The results provide some new data with respect to those cases where the condensate consists of solid particles. Author

N84-23579# Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Subdiv.
NONADIABATIC MODEL WALL EFFECTS ON TRANSONIC AIRFOIL PERFORMANCE IN A CRYOGENIC WIND TUNNEL
F. T. LYNCH, M. F. FANCHER, D. R. PATEL, and G. R. INGER (West Virginia Univ., Morgantown) *In* Agard Wind Tunnels and Testing Tech. 11 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The need to match the aircraft surface thermal conditions that exist at in-flight conditions when testing models in a cryogenic wind tunnel is addressed. Effects of non-representative heat transfer are reviewed for such basic viscous characteristics as the effect on boundary-layer transition location, the effects on turbulent boundary-layer integral parameters and skin friction, the effect on the transonic turbulent boundary-layer/shock-wave interaction, and the effects on separation onset and the extent of separated flow regions. A complementary experimental and computational investigation was conducted in order to help quantify the impact that nonadiabatic model wall conditions would have on the measured aerodynamic characteristics of transport (and other) airplane configurations tested in a cryogenic wind tunnel, and to help establish the allowable deviation from adiabatic wall conditions that can be tolerated if reliable results are to be obtained. Test results are presented which illustrate the large impact of moderate amounts of heat transfer on the lift and drag characteristics for both free-transition flow in the absence of any shock waves, and for typical cruise conditions with moderate strength shocks on the airfoil. In addition, test results are shown which illustrate a very large effect of heat transfer on buffer onset conditions and conditions near maximum lift. M.G.

N84-23598# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VORTICAL FLOW EXPLORATION METHODS DEVELOPED FOR THE F1 WIND TUNNEL
Y. BROCARD and P. DESPLAS *In* AGARD Wind Tunnels and Testing Tech. 15 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

Flow field investigation methods are developed by Office National d'Etudes et de Recherches Aerospatiales for its large wind tunnels. The means - exploring device, motorized probe holders, piloting computer system - used to position and point the probes are described. For vortex flow investigations five hole probes and two or three hot wire probes are used. The measuring and data processing techniques for the various probes are given. Finally typical results obtained in the O.N.E.R.A. F1 wind tunnel are presented. M.A.C.

N84-23831# Air Force Geophysics Lab., Hanscom AFB, Mass.
DEVELOPMENT OF A COMMAND CONTROL AND COMMUNICATIONS SYSTEM FOR LIGHT AIRCRAFT Final Technical Report
A. R. GRIFFIN 5 Oct. 1983 30 p
(Contract AF PROJ. 7659)
(AD-A139474; AFGL-TR-83-0275; AFGL-IP-319) Avail: NTIS HC A03/MF A01 CSCL 17B

This report describes a state-of-the-art command control and communications system developed for use aboard a light aircraft during high altitude scientific research balloon flights. Author (GRA)

N84-23835# Institut fuer Digitale Bildverarbeitung und Graphik, Graz (Austria).
EVALUATION OF RADARGRAMMETRIC STEREO Final Report, 1 Jul. 1982 - 30 Jun. 1983
G. DOMIK, F. LEBERL, and J. RAGGAM Wright-Patterson AFB, Ohio 11 Oct. 1983 131 p
(Contract F49620-82-C-0053)
(AD-A139565) Avail: NTIS HC A07/MF A01 CSCL 17I

The ability of an observer to stereoscopically view overlapping radar image pairs is evaluated. This analysis is based on a set of aircraft and satellite radar data, and on data generated by means of computer simulation. Synthesis of radar images is based on digital elevation models, allowing one to study a much wider range of flight parameters and sensor geometries than is currently available for study with real data. The report discusses simulation techniques, presents an evaluation of different radar-grammetric stereo geometries and analyses effects of squint angle, look angles and look angle differences on the stereoscopic view-ability of overlapping radar images. Author (GRA)

N84-23861# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SWIRL AT GAS-INTAKE INLET
A. Y. MIROSHNICHENKO 22 Feb. 1984 8 p Transl. into ENGLISH from Samolyotostroyeniye i Tekhn. Vozdushnogo Flota (USSR), no. 12, 1967 p 128-129
(AD-A139472; FTD-ID(RS)T-1801-83) Avail: NTIS HC A02/MF A01 CSCL 20D

Formation of a swirl at a gas intake inlet promotes suction of solid particles into the gas intake from the Earth's surface, leading to damage of the machine. Damage is avoided by the use of a thick filter installed at the inlet to the suction line. In a number of cases this method proves to be completely unacceptable, due to the large hydraulic resistance of the filter. Flow visualization by various methods makes it possible to study this problem. Author

N84-23919# Institute for Defense Analyses, Alexandria, Va. Science and Technology Div.
NONDESTRUCTIVE EVALUATION TECHNOLOGY WORKING GROUP REPORT (IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY STUDY) Final Report, Jul. 1982 - Aug. 1983
G. MAYER Aug. 1983 471 p
(Contract MDA903-79-C-0018)
(AD-A139484; AD-E500625; IDA/HQ-83-25921; IDA-D-37) Avail: NTIS HC A20/MF A01 CSCL 14B

This document records the activities and presents the findings of the Nondestructive Evaluation Technology Working Group part of the IDA/OSD Reliability and Maintainability Study, conducted during the period from July 1982 through August 1983. GRA

N84-23923*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION AND FLUTTER OF MISTUNED BLADED-DISK ASSEMBLIES
K. R. V. KAZA and R. E. KIELB 1984 17 p refs Presented at the 25th Struct., Struct. Dyn. and Mater. Conf., Palm Springs, Calif., 14-16 May 1984; sponsored by the AIAA, ASME, ASCE and AHS
(NASA-TM-83634; E-2074; NAS 1.15:83634; AIAA-84-0991)
Avail: NTIS HC A02/MF A01 CSCL 20K

An analytical model for investigating vibration and flutter of mistuned bladed disk assemblies is presented. This model accounts for elastic, inertial and aerodynamic coupling between bending and torsional motions of each individual blade, elastic and inertial couplings between the blades and the disk, and aerodynamic coupling among the blades. The disk was modeled as a circular plate with constant thickness and each blade was represented by a twisted, slender, straight, nonuniform, elastic beam with a symmetric cross section. The elastic axis, inertia axis, and the tension axis were taken to be noncoincident and the structural warping of the section was explicitly considered. The blade aerodynamic loading in the subsonic and supersonic flow regimes was obtained from two-dimensional unsteady, cascade theories. All the possible standing wave modes of the disk and traveling wave modes of the blades were included. The equations of motion were derived by using the energy method in conjunction with the assumed mode shapes for the disk and the blades. Continuities of displacement and slope at the blade-disk junction were maintained. The equations were solved to investigate the effects of blade-disk coupling and blade frequency mistuning on vibration and flutter. Results showed that the flexibility of practical disks such as those used for current generation turbofans did not have a significant influence on either the tuned or mistuned flutter characteristics. However, the disk flexibility may have a strong influence on some of the system frequencies and on forced response. Author

N84-23924*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN AEROELASTICIAN'S PERSPECTIVE OF WIND TUNNEL AND FLIGHT EXPERIENCES WITH ACTIVE CONTROL OF STRUCTURAL RESPONSE AND STABILITY
P. W. HANSON Apr. 1984 78 p refs
(NASA-TM-85761; NAS 1.15:85761) Avail: NTIS HC A05/MF A01 CSCL 20K

Active controls technology is assessed based on a review of most of the wind-tunnel and flight tests and actual applications of active control concepts since the late sixties. The distinction is made between so-called "rigid-body" active control functions and those that involve significant modification of structural elastic response or stability. Both areas are reviewed although the focus is on the latter area. The basic goals and major results of the various studies or applications are summarized, and the anticipated use of active controls on current and near-future research and demonstration aircraft is discussed. Some of the "holes" remaining in the feasbility/benefits demonstration of active controls technology are examined. A.R.H.

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GEOSCIENCES

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

N84-23037# Rolls-Royce Ltd., Derby (England).
AIRCRAFT NOISE LEGISLATION: AN OVERKILL
M. J. T. SMITH 1 Dec. 1982 12 p Presented at Australian Acoustical Soc., Sydney, Dec. 1982
(PNR-90167; REPRINT-870) Avail: NTIS HC A02/MF A01

The cost to the aircraft industry of noise legislation is criticized. The need to rationalize noise certification procedures is pointed out. The relative contribution of high and low bypass engines to noise pollution is assessed. Author (ESA)

N84-24009# Naval Civil Engineering Lab., Port Hueneme, Calif.
THERMAL ENERGY RECOVERY IN GAS TURBINE ENGINE TEST CELLS Final Report, Oct. 1982 - Sep. 1983
C. A. KODRES Nov. 1983 112 p
(Contract ONR PROJ. Z08-29)
(AD-A139457; NCEL-TN-1679) Avail: NTIS HC A06/MF A01
CSCL 10A

The economics of thermal energy recovery in jet engine test cells is examined. A numerical model to simulate the test cell augmenter tube is developed. This model is employed to determine the feasibility of installing heat exchangers along the augmenter or at the augmenter exit and using these heat exchangers to generate steam or electricity from the thermal energy in the jet exhaust. In general, energy recovery is not practical. The exhaust is quickly diluted by the entrained augmentation air, decreasing temperature gradients necessary for heat transfer. Most test cells are used too infrequently to warrant the cost of the hardware.
Author (GRA)

N84-24017# Atmospheric Physics, Inc., Peralta, N. Mex.
THE TRANSFER FUNCTION MODEL: A COMPUTER PROGRAM FOR DETERMINATION OF JET ENGINE TEST CELL EXHAUST PARTICULATES AND OPACITY Final Report, Mar. - Sep. 1983
C. RICHARDS Feb. 1984 14035 p
(Contract N66001-83-C-0237)
(AD-A139222; NOSC-CR-224) Avail: NTIS HC A03/MF A01
CSCL 21B

The Transfer Function Model (TFM) is an extensive computer program which is capable of computing the downstream parameters of a jet engine exhaust plume for generalized initial conditions, duct system geometry, and liquid and/or gas dilution. For example, the TFM can be used to predict the opacity of a plume at any distance from the engine exhaust plane, or the change in opacity as the engine load is changed. More specifically, the following parameters of the exhaust plume can be calculated by the TFM at any arbitrary point downstream from the jet exhaust plane: (1) Particulate size distribution, (2) Gas temperature, (3) Gas density (and water vapor density), (4) Gas velocity, (5) Droplet size distribution (if condensation has occurred or if water has been injected), (6) Light scattered and absorbed by each of the various sized particulates, and (7) Total plume opacity. Author (GRA)

N84-24044*# National Aeronautics and Space Administration, Washington, D. C.
A SPATIAL MODEL OF WIND SHEAR AND TURBULENCE FOR FLIGHT SIMULATION Ph.D. Thesis - Colorado State Univ.
C. W. CAMPBELL May 1984 131 p refs
(NASA-TP-2313; NAS 1.60:2313) Avail: NTIS HC A07/MF A01
CSCL 04B

A three dimensional model which combines measurements of wind shear in the real atmosphere with three dimensional Monte Carlo simulated turbulence was developed. The wind field over the body of an aircraft can be simulated and all aerodynamic loads and moments calculated. M.A.C.

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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.

A84-30429
THE PROBLEM OF THE ANALYTICAL FORMULATION OF AIRCRAFT SURFACES [K ZADACHE ANALITICHESKOGO POSTROENIIA POVERKHNOSTEI LETATEL'NYKH APPARATOV]
V. F. SNIGIREV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 4, 1983, p. 100-102. In Russian. refs

Reference is made to studies by Zav'ialov et al. (1980) and Ahlberg et al. (1972) in which two-dimensional splines were constructed for rectangular regions; one-dimensional splines were set up with respect to coordinate lines. For the case of an arbitrary arrangement of interpolation knots, however, a method of this type cannot be used. In the study made by Marchuk (1977), a two-dimensional spline was set up from the minimization of a certain functional. For this functional, however, the selection of joint approximating functions on the interpolation network of knots involves considerable difficulty. Consideration is therefore given to a different functional, one which, it is shown, makes it easier to find a solution. C.R.

A84-30447
MACHINE-ORIENTED METHOD FOR THE SYNTHESIS OF OPTIMAL CONTROLS [MASHINNO-ORIENTIROVANNYI METOD SINTEZA OPTIMAL'NYKH UPRAVLENII]
A. P. BATENKO (Tsentral'nyi Nauchno-Issledovatel'skii Institut Morskogo Flota, Riga, Latvian SSR) Elektronnoe Modelirovanie (ISSN 0204-3572), vol. 6, Mar.-Apr. 1984, p. 81-86. In Russian. refs

An iterative algorithm, based on an adaptive random retrieval procedure, is proposed for the retrieval of optimal controls. Terminal control theory provides a mathematically rigorous observance of the boundary conditions. The method is realized in a package of standard FORTRAN subroutines. B.J.

A84-30701
THE BOUNDARY ELEMENT METHOD IN AN INDUSTRIAL ENVIRONMENT
G. KUICH (Brown, Boveri et Cie. AG, Baden, Switzerland) IN: Boundary element methods in engineering; Proceedings of the Fourth International Seminar, Southampton, England, September 21-23, 1982 . Berlin, Springer-Verlag, 1982, p. 576-593.

The introduction of a BEASY (boundary element analysis system) system in an industrial setting demonstrates the application of the boundary element method in areas previously the preserve of the finite element method. It has been found that CAD programs and the pre- and postprocessors used in connection with the finite element programs can be adapted with little effort to the generation of geometry and the plotting of results for the boundary element method. Practical applications are cited to demonstrate the many advantages conferred by the boundary element method, in particular, in connection with an existing program for contact calculations. Comparisons are also made with finite element calculations. C.R.

A84-30972
DESIGN OF AUTOMATED MONITORING SYSTEMS FOR ON-BOARD FLIGHT EQUIPMENT [PROEKTIROVANIE AVTOMATIZIROVANNYKH SISTEM KONTROLIA BORTOVOGO OBORUDOVANIIA LETATEL'NYKH APPARATOV]
A. V. SELEZNEV, B. T. DOBRITSA, and R. R. UBAR Moscow, Izdatel'stvo Mashinostroenie, 1983, 224 p. In Russian. refs

Theoretical principles for the design of systems for the automated monitoring and diagnostics of flight equipment are

developed. Attention is given to the determination of optimal control planning for dependent diagnostic processes, as well as to the calculation of both statistical and deterministic diagnostic models. A discussion of automated system verification of analog equipment includes multiplexing. Areas of study related to discrete diagnostics systems and on-board digital computers such as fault location and the differentiation of Boolean functions are considered. Other topics include the representation of digital units by alternative graphs and the application of vector alternative graphs in synthesizing tests for microprocessors. Particular attention is given to the development of methods for locating open- and short-circuit-type faults and for the successive localization of multiple malfunctions. J.N.

A84-31580#
SEQUENTIAL QUADRATIC PROGRAMMING APPROACH IN ENGINEERING STRUCTURAL OPTIMIZATION
L. QIAN, W. ZHONG, G. CHENG, and Y. SUI (Dalian Institute of Technology, Dalian, People's Republic of China) Acta Mechanica Solida Sinica, Dec. 1983, p. 469-480. In Chinese, with abstract in English. refs

A number of engineering structural optimization problems are efficiently solved by the Sequential Quadratic Programming (SQP) Approach. The nonlinear programming arising from optimization of structures analyzed by the Finite Element Method is approximated by a sequence of quadratic programming (QP) aided by mechanical treatment and Taylor's expansion. Depending on the separability of the objective function of QP, dual or primal QP is solved at each step. Design standard problems often lead to highly nonlinear geometrical programming. By making use of dual theory and a suitable Taylor's expansion, the present work shows that SQP also provides a very effective tool for solving various types of geometrical programming. Author

N84-23156# Army Construction Engineering Research Lab., Champaign, Ill.
USER MANUAL FOR DRIVER PROGRAM Final Report
B. SWAIN and D. EFFLAND Jan. 1984 127 p
(AD-A139028; AD-E401136; CERL-TR-N-162) Avail: NTIS HC A07/MF A01 CSCL 09B

NOISEMAP3.4 computer program efficiently computes the noise level of aircraft, which is one step in the determination of the noise impact created. DRIVER is a program that will simplify the use of NOISEMAP3.4 when evaluating simple rectangular flight patterns. This manual was designed to guide the reader in using the DRIVER program. DRIVER takes a more general description of the flight pattern and computes the necessary input for NOISEMAP3.4. This manual uses the helicopter training flight patterns as examples. Author (GRA)

N84-23587# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Div. Avions.
THE 310 AIRBUS TEST IN THE ONERA WIND TUNNEL: FLIGHT-WIND TUNNEL COMPARISON [AIRBUS A310 ESSAIS DANS LA SOUFFLERIE F1 DE L'ONERA COMPARAISON VOL-SOUFFLERIE]
M. SAIZ and C. QUEMARD (ONERA, Paris) *In* AGARD Wind Tunnels and Testing Tech. 23 p Feb. 1984 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A22/MF A01

Methods used to obtain measurements on the 1/14 scale model of the A 310 in the F1 wind tunnel are described. The use of three types of mounts permitted a critical analysis of the results and assured their validity. Direct comparison of the measurements obtained with performances deduced from flight are remarkable. Transl. by A.R.H.

N84-24231# Naval Postgraduate School, Monterey, Calif.
COMPUTER PROGRAMS FOR HELICOPTER DATA DISPLAY AND CONCEPTUAL DESIGN M.S. Thesis
G. M. BISHOP Dec. 1983 171 p
(AD-A139096) Avail: NTIS HC A08/MF A01 CSCL 09B

This thesis allows a person with access to a computer that uses the FORTRAN language and that is equipped with the DISSPLA software system the ability to select and graphically portray for analysis the critical design parameters of actual helicopters. It also allows a person with access to any computer that uses the FORTRAN language the ability to do a complete conceptual design of a helicopter at one sitting in accordance with the procedures in the Helicopter Design Manual published as course notes for Helicopter Design course at the Naval Postgraduate School. Author (GRA)

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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.

A84-30082
STIRLING ENGINE - AVAILABILITY CRITERIA
G. RICE (Reading, University, Reading, England) IN: IECEC '83; Proceedings of the Eighteenth Intersociety Energy Conversion Engineering Conference, Orlando, FL, August 21-26, 1983. Volume 2 . New York, American Institute of Chemical Engineers, 1983, p. 791-795.

Attention is given to Stirling cycle engine applications in which heater exhaust losses are not recuperated, as in the waste heat recovery system described by Shoureshi et al. (1982), and the low pressure air-charged engine for Third World use of Wood et al. (1982), whose fuel is waste agricultural biomass. An analysis of the Stirling engine's performance in such applications indicates that the use of cycle efficiency (based on temperature ratios) as the basis of evaluation produces an anomalous result. True performance value should instead be defined in terms of available energy, or exergy. It is shown that there exists an optimum engine temperature ratio for a specified combustion temperature, in the cases where the engine is operating without a recuperator or is being used as a waste recovery system. The engine should be heated to a temperature that is equal to the geometric mean of the combustion and ambient temperatures. O.C.

A84-30648*# Texas A&M Univ., College Station.
MODIFIED SHIELDING JET MODEL FOR TWIN-JET SHIELDING ANALYSIS
C. H. GERHOLD and J. GILBRIDE (Texas A&M University, College Station, TX) American Society of Mechanical Engineers, Winter Annual Meeting, Boston, MA, Nov. 13-18, 1983. 6 p. refs
(Contract NAG1-11)
(ASME PAPER 83-WA/NCA-2)

An analytical model to estimate the shielding of noise emitted from a point noise source has been developed assuming the shielding jet to be a cylinder of constant radius with uniform flow across the cross section. Comparison to experiment indicated that the model overestimates diffraction of sound around the jet in the far downstream region. The shielding jet model is modified to include widening downstream of the nozzle exit. This not only represents a more realistic model of the jet, but is also expected to improve the shielding estimate downstream. The modified jet model incorporates a Mach number dependent widening rate, a corresponding decrease in flow velocity downstream and an equivalent slug flow evaluation to retain the locally parallel flow approximation of the model development. The shielding analysis with modified jet model is compared to measured data for a

subsonic isothermal air jet and a simulated hot subsonic jet. Improvement of the shielding estimate is discussed. Author

A84-30809*# Massachusetts Inst. of Tech., Cambridge.
COMPARISON OF MODEL HELICOPTER ROTOR PRIMARY AND SECONDARY BLADE/VORTEX INTERACTION BLADE SLAP
J. E. HUBBARD, JR. and K. P. LEIGHTON (MIT, Cambridge, MA) Journal of Aircraft (ISSN 0021-8669), vol. 21, May 1984, p. 346-350. refs
(Contract NSG-1583)
Previously cited in issue 10, p. 1475, Accession no. A83-25934

A84-30912
THE ACOUSTIC ANALOGY - THIRTY YEARS ON
J. E. F. WILLIAMS (Cambridge University, Cambridge, England) IMA Journal of Applied Mathematics (ISSN 0272-4960), vol. 32, Jan.-May 1984, p. 113-124. refs

The concept of acoustic analogy was first conceived and developed by Lighthill (1952, 1954). He devised a major extension of acoustics and formulated for the first time the science of how sound is generated. Lighthill's investigations were conducted in response to a pressing aeronautical noise issue, the jet noise problem. The main activity of today's aeroacoustics is possibly related to the adaptation of Lighthill's theory to the problem of noise produced by helicopter blades and by large aircraft being propelled with supersonically moving propellers. The basic approach regarding Lighthill's theory and its application is discussed. G.R.

A84-31648*# Columbia Univ., New York.
NOISE TRANSMISSION THROUGH AIRCRAFT PANELS
R. VAICAITIS (Columbia University, New York, NY), F. W. GROSVELD (Bionetics Corp., Hampton, VA), and J. S. MIXSON (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1984, p. 211-221. refs
(Contract NSG-1450)
(AIAA PAPER 84-0911)

This paper describes analytical and experimental studies of noise transmission through aircraft panels. The theoretical solutions of the governing acoustic-structural equations are developed utilizing modal decomposition and a Galerkin-type procedure. Single, discretely stiffened, and double wall panels are considered. Theoretical predictions are compared with experimental measurements and differences are identified. Author

A84-32609*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
RECOVERY OF BURNER ACOUSTIC SOURCE STRUCTURE FROM FAR-FIELD SOUND SPECTRA
J. R. MAHAN and J. D. JONES (Virginia Polytechnic Institute and State University, Blacksburg, VA) AIAA Journal (ISSN 0001-1452), vol. 22, May 1984, p. 631-637. refs
(Contract NAG3-124)
(AIAA PAPER 83-0763)

A method is presented that permits the thermal-acoustic efficiency spectrum in a long turbulent burner to be recovered from the corresponding far-field sound spectrum. An acoustic source/propagation model is used based on the perturbation solution of the equations describing the unsteady one-dimensional flow of an inviscid ideal gas with a distributed heat source. The technique is applied to a long cylindrical hydrogen-flame burner operating over power levels of 4.5-22.3 kW. The results show that the thermal-acoustic efficiency at a given frequency, defined as the fraction of the total burner power converted to acoustic energy at that frequency, is rather insensitive to burner power, having a maximum value on the order of 10 to the -4th at 150 Hz and rolling off steeply with increasing frequency. Evidence is presented that acoustic agitation of the flame at low frequencies enhances the mixing of the unburned fuel and air with the hot products of combustion. The paper establishes the potential of the technique as a useful tool for characterizing the acoustic source structure in any burner, such as a gas turbine combustor, for which a reasonable acoustic propagation model can be postulated. Author

N84-23234*# Wyle Labs., Inc., Huntsville, Ala.
ACOUSTIC ENVIRONMENTAL ACCURACY REQUIREMENTS FOR RESPONSE DETERMINATION Final Report
M. R. PETTITT Dec. 1983 378 p refs
(Contract NAS8-33379)
(NASA-CR-171003; NAS 1.26:171003; WR83-43) Avail: NTIS HC A17/MF A01 CSCL 20A

A general purpose computer program was developed for the prediction of vehicle interior noise. This program, named VIN, has both modal and statistical energy analysis capabilities for structural/acoustic interaction analysis. The analytic models and their computer implementation were verified through simple test cases with well-defined experimental results. The model was also applied in a space shuttle payload bay launch acosutics prediction study. The computer program processes large and small problems with equal efficiency because all arrays are dynamically sized by program input variables at run time. A data base is built and easily accessed for design studies. The data base significantly reduces the computational costs of such studies by allowing the reuse of the still-valid calculated parameters of previous iterations. Author

N84-23235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FAN NOISE REDUCTION ACHIEVED BY REMOVING TIP FLOW IRREGULARITIES BEHIND THE ROTOR - FORWARD ARC TEST CONFIGURATIONS
J. H. DITTMAR, R. P. WOODWARD, and M. J. MACKINNON 1984 17 p refs Presented at the 107th Meeting of the Acoustical Soc. of Am., Norfolk, Va. 7-10 May 1984
(NASA-TM-83616; E-2047; NAS 1.15:83616) Avail: NTIS HC A02/MF A01 CSCL 20A

The noise source caused by the interaction of the rotor tip flow irregularities (vortices and velocity defects) with the downstream stator vanes was studied. Fan flow was removed behind a 0.508 meter (20 in.) diameter model turbofan through an outer wall slot between the rotor and stator. Noise measurements were made with far-field microphones positioned in an arc about the fan inlet and with a pressure transducer in the duct behind the stator. Little tone noise reduction was observed in the forward arc during flow removal; possibly because the rotor-stator interaction noise did not propagate upstream through the rotor. Noise reductions were maded in the duct behind the stator and the largest decrease occurred with the first increment of flow removal. This result indicates that the rotor tip flow irregularity-stator interaction is as important a noise producing mechanism as the normally considered rotor wake-stator interaction. Author

N84-23239# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
AERODYNAMIC SOUND GENERATION BY TURBULENT BOUNDARY LAYER FLOW ALONG SOLID AND COMPLIANT WALLS
F. OBERMEIER and W. MOEHRING Oct. 1983 41 p refs Submitted for publication
(MPIS-116/1983) Avail: NTIS HC A03/MF A01

Flow noise generated by boundary layer flows over solid walls is discussed and the effects of compliant walls on noise generation by boundary layer flows are investigated. The effects of monopole-like and dipole-like sources on noise radiation when nonlinear effects of the wall motion are accounted for are considered. Results suggest that their effects are negligible. Author (ESA)

N84-23580# National Aeronautical Establishment, Ottawa (Ontario).
PREDICTION OF RESONANCE FREQUENCIES FOR VENTILATED WALL WIND TUNNELS
M. MOKRY *In* AGARD Wind Tunnels and Testing Tech. 10 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

Based on the reflection and refraction of plane acoustic waves at an interface between the moving stream and the stagnant plenum air, a simple theory is developed for the prediction of transverse resonance in the two-dimensional test section with ventilated walls. The intensity and the frequency of resonance are determined from the modulus and the argument of the wall reflection coefficient respectively. In contrast to the eigenvalue method, the present technique is capable of predicting partial resonance, occurring in perforated walls and also in slotted walls at Mach numbers below 0.6.18, for which the resonant waves are partly reflected and partly transmitted at the wall. The reverse transmission of waves from the plenum into the test section is found to be inconsistent with the postulated resonance condition. M.G.

N84-23583# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Technische Akustik.
PROPELLER AND ROTOR NOISE TESTING IN AEROACOUSTIC WIND TUNNELS
H. H. HELLER, W. R. SPLETTSTOESSER, R. F. NEUBAUER, F. R. GROSCHE, M. K. KALLERGIS, and K. J. SCHULTZ *In* AGARD Wind Tunnels and Testing Tech. 18 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The availability of newly constructed low-noise aeroacoustic facilities - such as the German-Dutch-Windtunnel/DNW and the French CEPRA 19 Anechoic Open Jet Windtunnel - provides excellent experimental possibilities for conducting high-quality acoustic source-studies on aerospace-vehicle noise generators. This paper discusses recent and ongoing model-scale research on basic phenomena and applied problems pertaining to the generation and radiation of propeller and helicopter rotor noise. The importance and potential of aeroacoustic wind tunnel experiments in special facilities will be stressed, and illustrated mostly by examples of DFVLR and US-Army/DFVLR research projects. Emphasis is also put on the fruitful interrelationship of model-, wind-tunnel and full-scale flight testing. Author

N84-23584# Middle East Technical Univ., Ankara (Turkey). Dept. of Mechanical Engineering.
AEROACOUSTIC NOISE MEASUREMENTS IN WIND TUNNEL
H. N. ALEMDAROGLU *In* AGARD Wind Tunnels and Testing Tech. 14 p Feb. 1984 refs
Avail: NTIS HC A22/MF A01

The paper describes the general characteristics of the lowspeed Acoustic Research Wind Tunnel constructed in the Aerodynamics Laboratory of E.N.S.M.A (poitiers/France) and presents the results of the preliminary experiments conducted in this wind tunnel. The wind tunnel is of open test section, open circuit and blower type. It has a test section of 30x30 sq cm and a mean velocity of 42 m/s. Aerodynamic measurements revealed a maximum turbulence intensity of less than 1%. The open test section is completely enclosed within a acoustically lined semi-anechoic chamber of dimensions 3.3x4/2.8 sq cm. Acoustic calibration of the wind tunnel is done by using both white noise and pure tone noise sources and it was observed that the tunnel can be considered to be anechoic above 100 Hz for white noise tests. Preliminary measurements of aerodynamic noise are performed by using both smooth and artificially roughened circular cylinders placed in the open test section of the wind tunnel. An aeroacoustic coherence function is deviced in order to classify the subsonic flow at moderate Reynolds numbers 5.05x10 to the 4th power Re sub d around a circular cylinder in its different flow regimes; subcritical, transcritical and supercritical. The method uses simultaneous measurements of the power spectra of the far field acoustic pressure and of the turbulent longitudinal velocity fluctuations in the wake of the cylinder as well as their cross spectra density functions CSD and especially the coherence function between the two signals. The values of the coherent function corresponding to the critical Strouhal frequencies are intense in the subcritical regime, decrease sharply in the transcritical domain and then increase and stabilize in the supercritical regime. Author

N84-24323*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
EXPERIMENTAL INVESTIGATION OF SHOCK-CELL NOISE REDUCTION FOR DUAL-STREAM NOZZLES IN SIMULATED FLIGHT COMPREHENSIVE DATA REPORT. VOLUME 1: TEST NOZZLES AND ACOUSTIC DATA
K. YAMAMOTO, B. A. JANARDAN, J. F. BRAUSCH, D. J. HOERST, and A. O. PRICE Feb. 1984 533 p 2 Vol.
(Contract NAS3-23166)
(NASA-CR-168336; NAS 1.26:168336; R83AEB358-VOL-1)
Avail: NTIS HC A23/MF A01 CSCL 20A

Parameters which contribute to supersonic jet shock noise were investigated for the purpose of determining means to reduce such noise generation to acceptable levels. Six dual-stream test nozzles with varying flow passage and plug closure designs were evaluated under simulated flight conditions in an anechoic chamber. All nozzles had combined convergent-divergent or convergent flow passages. Acoustic behavior as a function of nozzle flow passage geometry was measured. The acoustic data consist primarily of 1/3 octave band sound pressure levels and overall sound pressure levels. Detailed schematics and geometric characteristics of the six scale model nozzle configurations and acoustic test point definitions are presented. Tabulation of aerodynamic test conditions and a computer listing of the measured acoustic data are displayed. R.S.F.

N84-24324*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
EXPERIMENTAL INVESTIGATION OF SHOCK-CELL NOISE REDUCTION FOR DUAL-STREAM NOZZLES IN SIMULATED FLIGHT COMPREHENSIVE DATA REPORT. VOLUME 2: LASER VELOCIMETER DATA, STATIC PRESSURES AND SHADOWGRAPH PHOTOS
K. YAMAMOTO, B. A. JANARDAN, J. F. BRAUSCH, D. J. HOERST, and A. O. PRICE Feb. 1984 525 p 2 Vol.
(Contract NAS3-23166)
(NASA-CR-168336; NAS 1.26:168336; R83AEB358-VOL-2)
Avail: NTIS HC A22/MF A01 CSCL 20A

Parameters which contribute to supersonic jet shock noise were investigated for the purpose of determining means to reduce such noise generation to acceptable levels. Six dual-stream test nozzles with varying flow passage and plug closure designs were evaluated under simulated flight conditions in an anechoic chamber. All nozzles had combined convergent-divergent or convergent flow passages. Mean velocity and turbulence velocity measurements of 25 selected flow conditions were performed employing a laser Doppler velocimeter. Static pressure measurements were made to define the actual convergence-divergence condition. Test point definition, tabulation of aerodynamic test conditions, velocity histograms, and shadowgraph photographs are presented. Flow visualization through shadowgraph photography can contribute to the development of an analytical prediction model for shock noise from coannular plug nozzles. R.S.F.

N84-24327*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACOUSTIC MEASUREMENTS OF A FULL-SCALE ROTOR WITH FOUR TIP SHAPES. VOLUME 1: TEXT, APPENDICES A AND B
M. MOSHER Apr. 1984 90 p refs
(NASA-TM-85878-VOL-1; A-9602-VOL-1; NAS 1.15:85878-VOL-1)
Avail: NTIS HC A05/MF A01 CSCL 20A

A full-scale helicopter with four different blade-tip geometries was tested in the 40- by 80-foot wind tunnel at Ames Research Center. Performance, loads, and noise were measured. The four tip shapes tested were rectangular, tapered, swept, and swept-tapered. Noise measurements from that test are presented

in the form of tables and plots. The noise data include measurements of the sound pressure level in dB, dBA, and tone-corrected PNdB, for all of the conditions tested. Detailed measurements, 1/3-octave spectra and time-histories for some selected data are included as well as plots of dBA as function of test condition. Some performance measurements are given to aid interpretation of the noise data. Author

N84-24328# Army Field Artillery School, Fort Sill, Okla.
NOISE, A BIBLIOGRAPHY Final Report
L. L. MILLER, JR. 1 Mar. 1984 7 p
(AD-A138896; USAFAS/MSLD/SB105) Avail: NTIS HC A02/MF A01 CSCL 20A

Noise is the subject of this bibliography which has been developed from the military point-of-view. Operationally it may be defined as sound which lacks musical quality due to its discordant harmonic features. Selection of material coverage has been drawn from the unclassified book, document, and military periodicals holdings of the Morris Swet Technical Library, USAFAS. Inclusion of an item, or omission, neither implies USAFAS indorsement or sanction of the compiler's approach. GRA

N84-24329# Technische Hochschule, Darmstadt (West Germany).
FLIGHT SIMULATION INVESTIGATIONS FOR THE PROBLEM OF FLYABILITY OF NOISE OPTIMAL APPROACH AND TAKEOFF PATHS Final Report [FLUGSIMULATIONSUNTERSUCHUNGEN ZUR FRAGE DER FLIEGBARKEIT LAERMOPTIMALER AN- UND ABFLUGBAHNEN]
R. FRIEDEL 3 Oct. 1983 100 p refs In GERMAN
(Contract HA-514/59)
(IFD-3/83) Avail: NTIS HC A05/MF A01

Noise reduction during takeoff and landing of the A 300 B Airbus was studied using flight simulation. Operational aspects such as flyability and safety were emphasized. The investigations were limited to aircraft control in the vertical path plane, since the extension to the horizontal path control can only be made for a real airport and its surroundings. Noise emission parameters included noise frequency, direction and thrust dependence of propulsion system noise emission, aircraft spatial position, air damping as a function of noise frequency, air temperature and relative humidity as a function of flight height, and soil damping. The results show that reductions of the noise in the neighborhood of airports are possible, compared to the usual takeoff and landing methods (IATA steep takeoff method, low drag low power approach method). Author (ESA)

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SOCIAL SCIENCES

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

N84-23334# Clemson Univ., S.C.
AN AUTOMATED AIRFRAME PRODUCTION COST MODEL Final Report
N. K. WOMER *In* AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 222-228 1983
(AD-P002787) Avail: NTIS HC A24/MF A01 CSCL 15E

This paper is dedicated to developing a better understanding of the factors and forces that determine weapons system cost during production. Here we report on a tool that provides timely estimates of the cost impacts of program policy decisions. This tool was developed from theoretical principles. The economists production function was incorporated into a model which addressed the realities of program management. The model uses the calculus of variations to include the production cost drivers of learning by doing, learning over time, the speed of the production line and production line length. It is estimated from data on the C-141 program and tested on other Air Force programs. This work is fully documented in Cost Functions for Airframe Production Programs a report prepared for the Air Force Business Research Management Center and the Office of Naval Research by Womer and Gulledge. This paper concentrates on the results and applications of that study. Author (GRA)

N84-23343# Management Consulting and Research, Inc., Falls Church, Va.
INDEPENDENT COST ESTIMATES: A CASE STUDY JOINT VERTICAL LIFT AIRCRAFT (JVX) PROGRAM Final Report
G. R. MCNICHOLS and G. L. SORRELL *In* AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 280-283 1983
(AD-P002797) Avail: NTIS HC A24/MF A01 CSCL 15E

In 1982, the Army was intrigued with a concept known as the Joint Vertical Lift Aircraft (JVX). Because of the nature of the program, an Independent Cost Estimate (ICE) was performed to double check the Program Office estimate. While the Army appears to have lost some interest in the program, this cost study illustrates the process of independent cost estimating. Author (GRA)

N84-23362# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THE AVIONICS INTEGRITY PROGRAM (AVIP) Final Report
T. J. DICKMAN and L. F. CHESHIRE *In* AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 411-415 1983
(AD-P002817) Avail: NTIS HC A24/MF A01 CSCL 15E

The Avionics Integrity Program (AVIP) is an Aeronautical Systems Division initiative to develop an orderly procedure to assure that we acquire reliable, high quality, and supportable avionics systems. A draft military standard has been prepared and has been distributed for review and comment. The draft standard outlines an orderly process using existing tools in order to assure integrity. The orderly technical process combined with an appropriate contract strategy using incentives is expected to yield the highest probability of success in achieving integrity. This paper introduces the Avionics Integrity Program (AVIP) and answers the questions often asked regarding the program. Author (GRA)

N84-23384# Air Force Systems Command, Bolling AFB, Washington, D.C.
AIR FORCE SYSTEMS COMMAND RESEARCH PLANNING GUIDE (RESEARCH OBJECTIVES)
1 Feb. 1984 209 p
(AD-A138851; AFSC-TR-84-02; AFSC-TR-82-01) Avail: NTIS HC A10/MF A01 CSCL 05A

The purpose of the Planning Guide is to direct the attention of the scientific community to the technology interests of the Air Force, to provide a prospectus of research objectives to which the scientific community can respond, and to document the relevancy of fundamental to the Air Force mission. The research objectives described here represent the combined counsel of technical directors and program managers at the Air Force research and development laboratories. These objectives enunciate scientific opportunities which, when exploited, will provide fundamental knowledge required to develop future Air Force systems, prevent technological surprises, and provide alternatives in solving technological problems which mitigate the quantitative superiority of Air Force systems. The objectives are grouped into eight technical areas: life sciences, materials, geophysics, aerospace vehicles, propulsion and power, weaponry, electronics, and computational sciences. These areas relate directly to Air Force mission areas and involve such scientific disciplines as physics, chemistry, biology, psychology, mathematics, and engineering. GRA

N84-23401*# Arinc Research Corp., Annapolis, Md.
ASSESSMENT OF THE NASA FLIGHT ASSURANCE REVIEW PROGRAM
J. HOLMES and G. PRUITT Aug. 1983 172 p refs
(Contract NASW-3787)
(NASA-CR-173418; NAS 1.26:173418;
ARINC-RES-PUBL-3104-01-TR-3100) Avail: NTIS HC A08/MF A01 CSCL 05B

The NASA flight assurance review program to develop minimum standard guidelines for flight assurance reviews was assessed. Documents from NASA centers and NASA headquarters to determine current design review practices and procedures were evaluated. Six reviews were identified for the recommended minimum. The practices and procedures used at the different centers to incorporate the most effective ones into the minimum standard review guidelines were analyzed and guidelines for procedures, personnel and responsibilities, review items/data checklist, and feedback and closeout were defined. The six recommended reviews and the minimum standards guidelines developed for flight assurance reviews are presented. Observations and conclusions for further improving the NASA review and quality assurance process are outlined. E.A.K.

N84-23403# Army Natick Research and Development Command, Mass.
BIBLIOGRAPHY OF TECHNICAL PUBLICATIONS AND PAPERS, OCTOBER 1982 - SEPTEMBER 1983 Annual Report, for FY 1983
Nov. 1983 27 p
(AD-A138907; NATICK/TR-84/001) Avail: NTIS HC A03/MF A01 CSCL 05B

This report contains a bibliographic listing of technical publications and papers presented by personnel of the US Army Natick Research & Development Center and its contractors for the period October 1982 through September 1983.
Author (GRA)

N84-23553# Joint Publications Research Service, Arlington, Va.
LEGAL EXPERT EXPOUNDS ON NEW CIVIL AIR CODE
N. VASILYEV *In its* USSR Rept.: Transportation (JPRS-UTR-84-004) p 6-11 24 Feb. 1984 Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 10, Oct. 1983 p 18-19
Avail: NTIS HC A04/MF A01

Provisions of the USSR Civil Air Code of 1983 are examined in light of the previous code. Changes in the use of airspace which led to the adoption of the new code are discussed. Important changes in terminology are reviewed. M.G.

N84-24502# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AGARD INDEX OF PUBLICATIONS, 1980-1982
Jan. 1984 412 p
(ISBN-92-835-1462-9) Avail: NTIS HC A18/MF A01

Full bibliographic citations and abstracts for AGARD documents published in the 1980-1982 period are given. Entries are arranged under the major subject divisions and specific categories used by NASA in its abstract journals and bibliographies. Within each category, the abstracts are arranged by series and year. Subject (based on NASA Thesaurus nomenclature), personal author, corporate source, report accession number, and accession number indexes are included. A.R.H.

N84-24506# Committee on Commerce, Science, and Transportation (U. S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION BILL, 1984
Washington GPO 1984 41 p A bill, H.R. 5154, referred to the Comm. on Com., Sci. and Transportation, 98th Congr., 2d Sess., 14 May 1984
(S-REPT-98-455) Avail: US Capitol, Senate Document Room

The advanced communication technology satellite, space commercialization, space station development, and the design of a single rotation or counter rotation turboprop are among the NASA research and development programs funded. Appropriations for other research and development activities are itemized as well as those for space flight, control, and data communication; construction, modification, and repairs to facilities; and program management. The National Commission on Space Act comprises Title 2 of the legislation. A.R.H.

N84-24507# Committee on Commerce, Science, and Transportation (U. S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT
Washington GPO 1984 69 p Rept. to accompany H. R. 5154 presented by the Comm. on Com., Sci., and Transportation, 98th Congr., 2nd Sess., 17 May 1984
(S-REPT-98-455; GPO-31-010) Avail: US Capitol, Senate Document Room

Committee adjustments to NASA's request for fiscal year 1985 are elaborated and summarized. The appropriations authorized total $7,582,400,00. A.R.H.

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GENERAL

N84-24526# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CALENDAR OF AGARD TECHNICAL MEETINGS 1984
Loughton, England 1984 6 p
Avail: NTIS HC A02/MF A01

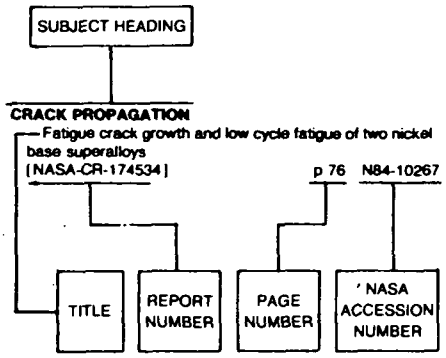
The calendar of technical meetings for the Advisory Group for Aerospace Research and Development (AGARD) is presented. Conference topics include aerospace engineering of structures and materials, propulsion system configurations, aerospace medicine, guidance and flight control, avionics, and fluid dynamics. The dates and locations of administrative meetings for AGARD are included. M.A.C.

N84-24527# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AGARD BULLETIN: MEETINGS, PUBLICATIONS, MEMBERSHIP
Jan. 1984 77 p
(AGARD-BUL-84/1) Avail: NTIS HC A05/MF A01

A summary of technical meetings and themes, publications, and membership is presented. Conference and publication topics include: aerospace medicine, avionics, electromagnetic wave propagation, flight mechanics, fluid dynamics, flight guidance and control, propulsion and energetics, structures and materials, and technical information dissemination. The 76 publications listed include an abstract. R.S.F.

AERONAUTICAL ENGINEERING / *A Continuing Bibliography (Supplement 177)* AUGUST 1984

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

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Optical gas temperature measurement in gas turbines
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ACCEPTABILITY
Physiological acceptability tests of the modified SJU-5/A ejection seat for the F-18 aircraft
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ACOUSTIC EMISSION
Acoustic emission: A brief introduction to some of its uses in the aero engine industry
[PNR-90172] p 536 N84-22571
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Nondestructive Evaluation Technology Working Group report (IDA/OSD R and M (Institute for Defense Analyses/Office of the Secretary of Defense Reliability and Maintainability study)
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Experimental investigation of shock-cell noise reduction for dual-stream nozzles in simulated flight comprehensive data report. Volume 1: Test nozzles and acoustic data
[NASA-CR-168336] p 567 N84-24323
Acoustic measurements of a full-scale rotor with four tip shapes. Volume 1: Text, appendices A and B
[NASA-TM-85878-VOL-1] p 567 N84-24327
ACOUSTIC PROPAGATION
Recovery of burner acoustic source structure from far-field sound spectra
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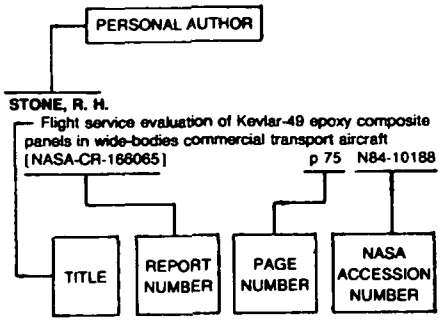

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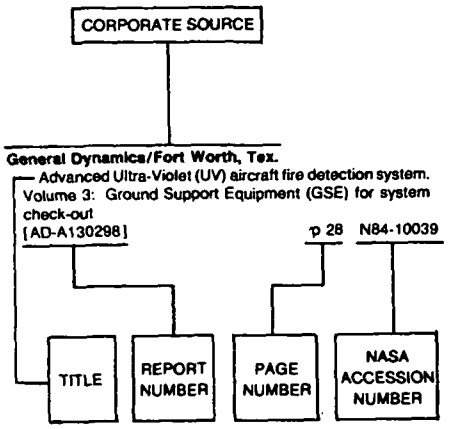

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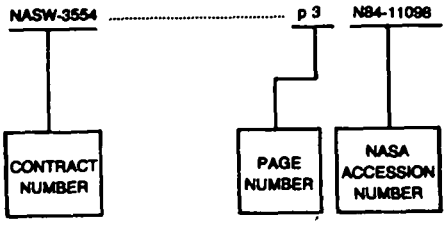

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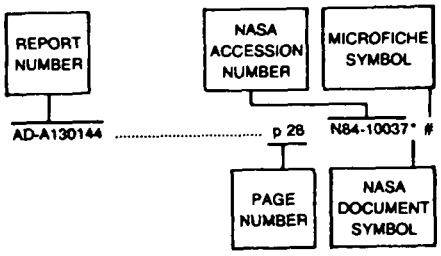

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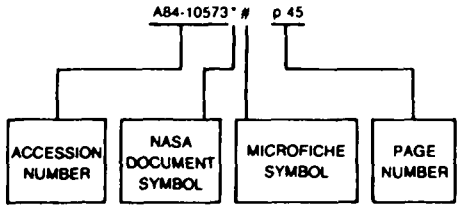

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