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NASA SP-7037(198)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 198)

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 February 1986 in

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

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INTRODUCTION

This issue of *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 395 reports, journal articles, and other documents originally announced in February 1986 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

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

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

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

An annual cumulative index will be published.

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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 198)

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AERONAUTICS (GENERAL)

A86-13446
TECHNOLOGICAL SUPPORT FOR AIRCRAFT PRODUCTION [TEKHNOLOGICHESKAIA PODGOTOVKA AVIATSIONNOGO PROIZVODSTVA]
V. N. KRYSIN Moscow, Izdatel'stvo Mashinostroenie, 1984, 200 p. In Russian. refs

The organization of technological support for aircraft production is reviewed with particular reference to the development of new equipment and processes to reduce the time required for setting up aircraft production. The discussion covers the fundamentals of technological support planning, standardization of equipment and processes, computer-aided design of manufacturing processes, automation of software development for digitally controlled machine tools, and the use of laser technology in installing assembly lines. Other topics discussed include equipment for the fabrication of composite structures, the manufacture of large components from high-strength titanium alloy sheets, and the use of manipulators and industrial robots. V.L.

A86-13549
MANUFACTURERS PREPARE FOR EUROPE'S NEW FIGHTERS
B. WANSTALL Interavia (ISSN 0020-5168), vol. 40, Oct. 1985, p. 1133-1136.

Carbon, boron, and Kevlar fiber-reinforced polymer matrix composites are being extensively employed in the French 'Rafale' ground attack aircraft and the British-German-Italian-Spanish 'European Fighter Aircraft' (EFA) interceptor. Al-Li alloys are also under consideration, subject to their development to the required levels of economy. Attention is presently given to the similarities and differences that have become evident to date in the Rafale and EFA development programs, which are scheduled to result in maiden flights in 1986. Full authority digital fly-by-wire systems will be used by both aircraft, and are noted to be the basis of significant weight savings through lift and control surfaces' area reduction. Single crewmember operation will be achieved through advanced cockpit display and controller electronics. O.C.

A86-15285
THE AUTONOMOUS HELICOPTER SYSTEM
J. F. GILMORE (Georgia Institute of Technology, Atlanta) IN: Applications of artificial intelligence; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 146-152. refs

This paper describes an autonomous airborne vehicle being developed at the Georgia Tech Engineering Experiment Station. The Autonomous Helicopter System (AHS) is a multimission system consisting of three distinct sections: vision, planning and control. Vision provides the local and global scene analysis which is symbolically represented and passed to planning as the initial route planning constraints. Planning generates a task dependent path for the vehicle to traverse which assures maximum mission system success as well as safety. Control validates the path and either executes the given route or feeds back to previous sections in order to resolve conflicts. Author

A86-15341
EC-135 FIBER OPTIC TECHNOLOGY REVIEW
J. R. SCHULTZ and H. N. HODGES (TRW, Inc., Engineering Office, Albuquerque, NM) IN: Fiber optics in adverse environments II; Proceedings of the Meeting, San Diego, CA, August 22-24, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 70-76. refs
(Contract DAEA18-81-G-0068)

The present paper is concerned with a fiber optic technology study for EC-135 Airborne Command Post aircraft application. This study had the objective to determine the feasibility of using fiber optic technology on the EC-135. Advantages of fiber optic technology over conventional technology are related to cost and weight savings, EMP and EMI immunity, electromagnetic compatibility, high data rates, and improved hardness maintenance. The motivation for this study was provided by the possibility that fiber optic technology could reduce the hardness maintenance difficulties for nuclear hardened EC-135 systems. Attention is given to the nuclear threat to the EC-135, aspects of nuclear hardening, and the reasons for considering fiber optic technology. G.R.

A86-15600
DAMAGED RUNWAY OPTIONS EXPLORED
J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, Nov. 1985, p. 28-32.

A comparative evaluation is conducted of several concepts that have been proposed for the facilitation of aircraft takeoffs and landings on damaged airfields. Two of these rely on the air cushion effect: one, already implemented and tested in the 1970s on a Buffalo cargo aircraft, integrates the hovercraft-like inflatable hardware directly with the aircraft fuselage, while the other, still undergoing conceptual development, is a separate structure employed for takeoffs exclusively. Two other alternatives involve tank tread-like landing gears for landing and 'ski-jump' ramps for takeoff. The latter has been tested for the case of F/A-18 aircraft. O.C.

A86-16096
ARMY VTOL RESEARCH AND DEVELOPMENT - THE FIRST CENTURY
R. B. LEWIS, II (ITT Corp., Defense Space Group, Nutley, NJ) Vertiflite (ISSN 0042-4455), vol. 31, Nov.-Dec. 1985, p. 34-38.

The U.S. Army first expressed interest in VTOL aircraft in the form of balloons during the Civil War. Active engineering studies of helicopters began in 1918 and the first helicopter flight was recorded in 1922. Autorotation and mechanical cyclic pitch were demonstrated in 1923 and Congressional approval of development funds was obtained in 1938. The first Sikorsky helicopter was commissioned in 1939 and featured four rotors, one the main lifting rotor. Cyclic blade pitch eliminated two of the rotors. The Army retained responsibility for helicopter development after the Air Force was established, and by 1956 also gained procurement specifications authority, which led to a large order for OH-6A four-blade light observation helicopters in 1964. The LHX is the

next design goal for the Army and the helicopter industry.
M.S.K.

N86-12199# Aeronautical Research Labs., Melbourne (Australia).
A SURVEY OF AERONAUTICAL STRUCTURAL RESEARCH IN AUSTRALIA
F. H. HOOKE Dec. 1984 45 p
(AD-A157211; ARL/STRUC-TM-394) Avail: NTIS HC A03/MF A01 CSCL 01C

A survey of Aeronautical structural research in Australia has spanned over more than 40 years, from the establishment of the C.S.I.R. Division of Aeronautics in 1939. Industry, civil aviation and the armed services have benefited from the expertise of Structures Division in problem solving, as well as from ad-hoc research and, perhaps less immediately, from basic research. Not every avenue has been able to be explored. A major subject of research, structural fatigue, arose from an accident in 1945, and each new development in design and material has brought new problems. Standards of safety and risk have been explored. New technology of fiber composites permits better tailoring of strength and stiffness to requirements: this and the introduction to aircraft of active controls offer benefits and problems for the future.
Author (GRA)

N86-12200# Air Force Academy, Colo.
AIR FORCE ACADEMY AERONAUTICS DIGEST Final Report
J. E. DEJONGH, W. H. HEISER, and M. HALE Apr. 1985 269 p
(AD-A157215; USAFA-TR-85-2) Avail: NTIS HC A12/MF A01 CSCL 20D

Some articles of the digest are entitled: The Seven-Hole Pressure Probe; Wind Tunnel Study on the Drag Effects of an Aft-Mounted Ventral Fin on a T-38 Model; An Experimental Investigation of an Airfoil Undergoing Large Amplitude Pitching Motions; Interrelated Effects of Pitch Rate and Pivot Point on Airfoil Dynamic Stall. Other topics covered are: An Examination of Curve Smoothing Using Digital Filter Theory; Flight Test Measurement of the Aerodynamic Effect of Thrust Level on Lift and Drag; and Flight Control System Design for a Computer Controlled Aircraft with Limited Sensors. GRA

N86-13286*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASSESSMENT OF AERODYNAMIC AND DYNAMIC MODELS IN A COMPREHENSIVE ANALYSIS
W. JOHNSON Oct. 1985 39 p refs
(NASA-TM-86835; REPT-85047; NAS 1.15:86835) Avail: NTIS HC A03/MF A01 CSCL 01B

The history, status, and lessons of a comprehensive analysis for rotorcraft are reviewed. The development, features, and capabilities of the analysis are summarized, including the aerodynamic and dynamic models that were used. Examples of correlation of the computational results with experimental data are given, extensions of the analysis for research in several topics of helicopter technology are discussed, and the experiences of outside users are summarized. Finally, the required capabilities and approach for the next comprehensive analysis are described.
Author

N86-13618# Joint Publications Research Service, Arlington, Va.
ATR 42 PRODUCTION WORK IN FRENCH, ITALIAN PLANTS DETAILED
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-031) p 14-19 8 Nov. 1985 Repr. from Rev. Aerospatiale (France), Oct. 1985 p 16; 18; 20; 22; 27
Avail: NTIS HC A03/MF A01

The ATR-42 passenger aircraft is to be a product of real international cooperation. The Franco-Italian aircraft is to be produced and assembled at three plants in France and one in Italy, with engines supplied by Pratt and Whitney of Canada. The composite wing tips, control surfaces and fairings will be manufactured at Aerospatiale in Nantes. Assembly, integration, and testing of the wing are to be subsequently carried out at the Aerospatiale plant in Sainte Nazaire. The engine nacelles are to be produced by Aerospatiale Meaulte. Manufacturing the fuselage and tail assembly will be the responsibility of Aeritalia in Naples, and final assembly will take place at Aerospatiale's Toulouse plant. Production of the larger version, the ATR-72, will be similarly apportioned. F.M.R.

02

AERODYNAMICS

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

A86-13047
HYPERSONIC FLOW PAST NON-SLENDER WEDGES, CONES AND OGIVES IN OSCILLATION
K. GHOSH (Indian Institute of Technology, Kanpur, India), M. VEMPATI, and D. DAS Aeronautical Journal (ISSN 0001-9240), vol. 89, Aug.-Sept. 1985, p. 247-256. refs

Ghosh's (1977) large-deflection hypersonic similitude and consequent plane and conico annular piston theories have been applied to obtain unsteady pressure and the pitching moment derivatives for oscillating nonslender wedges, cones and ogives. The plane piston theory for a wedge is extended from a quasi-steady analysis, which gives the moment derivative due to pitch rate Cm(q), to an unsteady analysis; the two analyses combine to give the moment derivative due to incidence rate CM (alpha), which is shown here to be the same for wedges and quasi-wedges. The present theory can separately give Cm(q) and CM(alpha) for a quasi-wedge of arbitrary shape; this principle is illustrated for a particular quasi-wedge, namely the parabolic arc plane ogive. In comparison, a previous theory by Hui (1969) gave only the sum of Cm(q) and Cm(theta), only for wedges. The conico annular piston theory is employed to obtain Cm(theta), which is the moment derivative due to a steady pitch angle, and Cm(q) for nonslender cones and axisymmetric ogives in closed form for the first time.
Author

A86-13050
AERODYNAMICS - THE ROLE OF THE COMPUTER
G. J. HANCOCK (Queen Mary College, London, England) *Aeronautical Journal (ISSN 0001-9240), vol. 89, Aug.-Sept. 1985,* p. 269-279. refs

The use of computers in aerospace aerodynamics is reviewed. Computational aerodynamics has advanced due to increasing computer speeds, growth in memory capabilities, and architectural improvements. Numerical modelling of physical flows, algorithm development, research and production code development, and evaluation and validation of the codes using computational aerodynamics are described and examples are provided. The application of computational aerodynamics in aerodynamic design is discussed. In experimental aerodynamics computers are useful in rig automation, data acquistion and synthesis, the design of test facilities, and the specification of test procedures. The interaction between control systems and aerodynamics is studied. The extraction of aerodynamic information from flight tests with computers is discussed. I.F.

A86-13060#
NUMERICAL ANALYSIS OF FULLY THREE-DIMENSIONAL PERIODIC FLOWS THROUGH A TURBINE STAGE
M. KOYA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) and S. KOTAKE (Tokyo, University, Japan) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 945-952. refs
(ASME PAPER 85-GT-57)

Fully three-dimensional periodic flows through a turbine stage of stator and rotor are studied numerically by solving

time-dependent three-dimensional Euler equations with the finite-volume method. The phase relation of stator and rotor flows and the related blade-row interaction are accounted for in the time-space domain. The established method of numerical calculation makes a practical contribution to predict actual turbine flows through a turbine stage of stator and rotor which have an arbitrary number of blades. Author

A86-13062#
SECONDARY FLOWS AND LOSSES DOWNSTREAM OF A TURBINE CASCADE
J. MOORE and R. Y. ADHYE (Virginia Polytechnic Institute and State University, Blacksburg) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 961-968. Research supported by the Rolls-Royce, Ltd. refs
(ASME PAPER 85-GT-64)

The loss mechanisms and the behavior of secondary flows downstream of a large scale, linear turbine cascade have been investigated experimentally. A five-blade replica of the cascade used by Langston et al. at United Technologies Research Center was used for the present tests. Detailed flow measurements, using five-hole and three-hole probes, were made at four different planes, one just upstream of the trailing edge and the rest downstream. The secondary flow field at each measurement plane was found to be dominated by a single large passage vortex, which decayed in strength because of the mixing occurring in the flow. More than one-third of the losses were found to occur downstream of the trailing edge. This rise in total pressure loss in the present tests was almost entirely explained by a corresponding dissipation of the secondary kinetic energy of the flow. A mixing analysis of the flow was done to predict the additional losses due to 'mixing' until the flow became completely uniform. Author

A86-13063#
PERFORMANCE EVALUATION OF LINEAR TURBINE CASCADES USING THREE-DIMENSIONAL VISCOUS FLOW CALCULATIONS
J. MOORE and J. G. MOORE (Virginia Polytechnic Institute and State University, Blacksburg) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 969-975. Research supported by the Rolls-Royce, Ltd. refs
(ASME PAPER 85-G-65)

The overall performance of two geometrically similar linear turbine cascades is calculated using an elliptic flow program. The increase in the mass-averaged total pressure loss is calculated within and downstream of the cascades and the results show good agreement with the measured values. The buildup and decay of the secondary kinetic energy are also shown; measurements are available for one of the cascades near and downstream of the trailing edge and these are in close agreement with the calculated values. Details of the flow development are also compared with measurements. Calculated velocity vectors near the endwall show the overturning revealed by surface flow visualization and similarly near the suction surface the strong spanwise flow is well calculated. Calculated contours of total pressure loss in cross-sectional planes confirm the important interaction of the passage vortex with the profile boundary layer at midspan. Regions of high loss near midspan are calculated downstream of both cascades; this three-dimensional flow development is followed in the calculations. Author

A86-13065#
EFFECTS OF TIP ENDWALL CONTOURING ON THE THREE-DIMENSIONAL FLOW FIELD IN AN ANNULAR TURBINE NOZZLE GUIDE VANE. I - EXPERIMENTAL INVESTIGATION
E. BOLETIS (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genese, Belgium) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 983-990. refs
(ASME PAPER 85-GT-71)

Tip endwall contouring is one of the most effective methods for improving the performance of low aspect ratio turbine vanes. In view of the wide variety of geometric parameters, it appears that only the physical understanding of the three-dimensional flow field will allow evaluation of the probable benefits of a particular endwall contouring. The paper describes the experimental investigation of the three-dimensional flow through a low speed, low aspect ratio, high turning annular turbine nozzle guide vane with meridional tip endwall contouring. The full impact of the effects of tip contouring is evaluated by comparison with the results of a previous study in an annular turbine nozzle guide vane of the same blade and cascade geometry with cylindrical endwalls. In parallel, the present experimental study provides a fully three-dimensional test case for comparison with advanced theoretical calculation methods. The flow is explored by means of double-head, four-hole pressure probes in five axial planes from far upstream to downstream of the blade row. The results are presented in the form of contour plots and spanwise pitch-averaged distributions. Author

A86-13067#
SIMULATION OF THE EFFECTS OF SHOCK WAVE PASSING ON A TURBINE ROTOR BLADE
D. J. DOORLY and M. L. G. OLDFIELD (Oxford University, England) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 998-1006. Research supported by the Rolls-Royce, Ltd. and SERC. refs
(ASME PAPER 85-GT-112)

The unsteady effects of shock waves and wakes shed by the nozzle guide vane row on the flow over a downstream turbine rotor have been simulated in a transient cascade tunnel. At conditions representative of engine flow, both wakes and shock waves are shown to cause transient turbulent patches to develop in an otherwise laminar (suction-surface) boundary layer. The simulation technique employed, coupled with very high-frequency heat transfer and pressure measurements, and flow visualization, allowed the transition initiated by isolated wakes and shock waves to be studied in detail. On the profile tested, the comparatively weak shock waves considered do not produce significant effects by direct shock-boundary layer interaction. Instead, the shock initiates a leading edge separation, which subsequently collapses, leaving a turbulent patch that is convected downstream. Effects of combined wakeand shock wave-passing at high frequency are also reported. Author

A86-13294
CALCULATION OF FLOWS IN TWO- AND THREE-DIMENSIONAL NOZZLES BY AN APPROXIMATE FACTORIZATION METHOD [RASCHET TECHENII V DVUMERNYKH I PROSTRANSTVENNYKH SOPLAKH METODOM PRIBLIZHENNOI FAKTORIZATSII]
M. IA. IVANOV and V. V. KORETSKII Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 25, Sept. 1985, p. 1365-1381. In Russian. refs

An efficient approximate factorization procedure has been developed for calculating steady-state mixed subsonic, transonic, and supersonic potential flows in two- and three-dimensional nozzles. The method is based on the numerical integration of the full equation for the velocity potential written in divergent form and provides a second order of approximation. The advantages of the approach proposed here over other approximate factorization and relaxation methods and finite-difference schemes are demonstrated. V.L.

A86-13296
A MARCHING EXPLICIT-IMPLICIT PROCEDURE FOR CALCULATING SUPERSONIC FLOW PAST BODIES [MARSHEVYI IAVNO-NEIAVNYI METOD RASCHETA SVERKHZVUKOVOGO OBTEKANIIA TEL]
N. V. POGORELOV and IU. D. SHEVELEV Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 25, Sept. 1985, p. 1391-1400. In Russian. refs

A second-order hybrid, two-step, explicit-implicit finite difference scheme is applied to a marching procedure for calculating supersonic flow of an ideal gas past blunt bodies on the basis of a system of equations written in the form of conservation laws. Each step of the procedure consists of two half-steps; during the first half-step, a solution is sought using an explicit scheme with one-sided differences, while during the second half-step, the finite-difference equations are transformed to an implicit form. A bidiagonal block system of equations is solved at each implicit step; when the Courant condition is satisfied, the implicit steps automatically disappear, and the scheme becomes explicit. V.L.

A86-13351
THE LINEAR THEORY OF A PROFILE IN A COMPRESSIBLE GAS WITH ADDITIONAL JET FLOW [LINEINAIA TEORIIA PROFILIA V SZHIMAEMOM GAZE PRI DOPOLNITEL'NOM OBDUVE STRUEI]
G. A. PAVLOVETS TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 1-11. In Russian. refs

The problem of a profile in a compressible gas with additional compressed-gas jet flow is analyzed in the context of linear theory, and expressions are obtained for flow velocities at the jet boundaries and for the boundary shape. For an arbitrary profile, the problem is reduced to that of solving a singular integral equation. Expressions are presented which illustrate the effect of various parameters of the jet and external flow on the lifting force of the profile. It is shown that the problem of jet flow of an ideal compressible gas past a profile can be reduced to an identical problem for an ideal incompressible liquid with somewhat different flow parameters. V.L.

A86-13352
SYMMETRIC TRANSONIC FLOW PAST WINGS OF LARGE ASPECT RATIOS [O SIMMETRICHNOM OBTEKANII TRANSZVUKOVYM POTOKOM KRYL'EV BOL'SHOGO UDLINENIIA]
IU. B. LIFSHITS and A. M. SOROKIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 12-18. In Russian. refs

A study is made of the applicability of approximate similarity laws established through an analysis of the first terms of a potential expansion in a small parameter that is the reciprocal of the wing aspect ratio. For this purpose, symmetric flow past straight and swept wings is analyzed numerically for various free-stream Mach numbers, aspect ratios, and swep angles. The numerical data obtained, along with an analysis of the initial equations and equations for the terms of the asymptotic expansion, make it possible to determine the nature of the dependence of the aerodynamic characteristics on the problem parameters and also to explain a discrepancy between the numerical and analytical data. V.L.

A86-13353
A STUDY OF FLOW NEAR A SHOCK WAVE INTERSECTION LINE [ISSLEDOVANIE TECHENIIA V OKRESTNOSTI LINII PERESECHENIIA SKACHKOV UPLOTNENIIA]
V. V. KELDYSH TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 19-30. In Russian. refs

An analysis is made of three-dimensional flow in the vicinity of the intersection of two shock waves. A region of changes in the governing parameters is identified where the problem has two solutions. For the region where the problem has only one solution, a solution to the problem of the intersection of three incoming shock waves exists. It is also shown that lambda-shaped shock waves are a particular case of the same problem, with one of the waves near the intersection line degenerated to a Mach wave. V.L.

A86-13354
THE EFFECT OF THE INCALCULABLE FLOW REGIME OF AIR SCOOPS ON FLOW PAST A WING [VLIIANIE NERASCHETOROGO REZHIMA RABOTY VOZDUKHOZABORNIKOV NA OBTEKANIE KRYLA]
B. G. PIANZIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 31-39. In Russian. refs

The problem of the effect of the incalculable flow regime of wing air scoops on flow past the wing is investigated in the context of the existing linear vortex theory of a profile and a wing with an air scoop (Shurygin, 1980, 1981). In particular, the effect of air scoop flow rate distribution on the aerodynamic characteristics of the wing is analyzed numerically. Numerical calculations for wings of different shapes and air scoops of different lengths provide qualitatively consistent results. V.L.

A86-13358
SELECTING THE PRINCIPAL PARAMETERS OF A WEDGE-PROFILED WING [VYBOR OSNOVNYKH PARAMETROV KRYLA S LAMBDA-OBRAZNYM POPERECHNYM SECHENIEM]
G. I. MAIKAPAR and A. I. PIATNOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 104-109. In Russian. refs

Graphs are presented for determining the aerodynamic characteristics of a wedge-profiled wing of a specified volume for supersonic velocities. The graphs provide a way to select the geometrical parameters of a wing with allowance for additional constraints. It is shown that for a length less than optimum, part of the volume should be located over the leeside of the wing, and an oblique section can be used to reduce the wake drag. V.L.

A86-13359
AERODYNAMIC CHARACTERISTICS OF A FINITE-ASPECT-RATIO WING IN HYPERSONIC FLOW OF A RADIATING GAS [AERODINAMICHESKIE KHARAKTERISTIKI KRYLA KONECHNOGO RAZMAKHA V GIPERZVUKOVOM POTOKE IZLUCHAIUSHCHEGO GAZA]
V. N. GOLUBKIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 115-120. In Russian. refs

The problem of hypersonic flow of a radiating gas past the windward side of a finite-aspect-ratio wing at large angles of attack is solved analytically to a first approximation using the method of a thin shock layer. The wing surface is nearly plane, its leading edge is sharp, and its shape varies with time. The effect of radiation on the shock wave shape, pressure distribution, and aerodynamic coefficients is examined. V.L.

A86-13360
FLOW OF A DIATOMIC RAREFIED GAS AROUND A CONE [OBTEKANIE KONUSA DVUKHATOMNYM RAZREZHENNYM GAZOM]
S. L. GORELOV and A. I. EROFEEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 125-128. In Russian. refs

The problem of hypersonic flow of a diatomic rarefied gas around a cone with half-angles of 10 and 15 deg is solved using the Monte Carlo method. Calculations are carried out for two values of the temperature factor, 1 and 0.1. The results obtained are compared with similar calculations for a monoatomic gas and with experimental data. V.L.

A86-13363
SOME SOLUTIONS TO THE KARMAN EQUATION DESCRIBING FLOW PAST THE SALIENT POINTS OF A PROFILE [O NEKOTORYKH RESHENIIAKH URAVNENIIA KARMANA OPISYVAIUSHCHIKH OBTEKANIE TOCHEK IZLOMA PROFILIA]
V. N. DIESPEROV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 11-19. In Russian. refs

A solution to the Karman equation for flow past a salient point of a profile with a free flow line is obtained for the case where the subsonic generating line is specified by an arbitrary power law. Attention is also given to the case where the curvature of the subsonic generating line of the salient point is determined by the displacement thickness of the boundary layer during its interaction with the Vaglio-Laurin external potential flow. V.L.

A86-13364
CALCULATION OF SUPERSONIC INVISCID FLOW PAST A PLANE AIR INTAKE ELEMENT WITH AN ISOLATED HEAD WAVE [RASCHET SVERKHZVUKOVOGO NEVIAZKOGO OBTEKANIIA ELEMENTA PLOSKOGO VOZDUKHOZABORNIKA S VYDELENNOI GOLOVNOI VOLNOI]
S. M. BOSNIAKOV, V. V. KOVALENKO, and A. N. MINAILOS TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 20-29. In Russian. refs

A procedure for calculating supersonic flow past complex bodies is presented which uses a second-order finite difference scheme with nonuniform templates and head wave isolation. Numerical solutions are obtained for flow past a wedge-shaped air intake element and for its aerodynamic characteristics. The flow fields are analyzed, and the results are compared with experimental data and results obtained by using McCormack's first-order finite-difference scheme. V.L.

A86-13373
A JOINT ANALYSIS OF THE BOUNDARY LAYER AND INVISCID FLOW AROUND THE AXISYMMETRIC REAR SECTION OF A FUSELAGE [SOVMESTNYI RASCHET POGRANICHNOGO SLOIA I NEVIAZKOGO POTOKA, OBTEKAIUSHCHEGO OSESIMMETRICHNUIU KORMOVUIU CHAST' FIUZELIAZHA]
N. L. EFREMOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 119-124. In Russian. refs

Transonic flow past a body of the fuselage or engine nacelle type is analyzed, with allowance made for flow viscosity in terms of turbulent boundary layer theory. Inviscid flow is calculated using Godunov's finite difference scheme, and a joint solution is obtained by using an iteration procedure. To ensure the convergence of iterations, a relaxation (damping) procedure is used for calculating Mach number distributions at the inviscid flow boundary and the boundary layer displacement thickness on the basis of previous iterations. The approach proposed here is illustrated by an example. V.L.

A86-13374
A NUMERICAL ANALYSIS OF THE CHARACTERISTICS OF A TOLLMIEN-SCHLICHTING WAVE PACKET IN A BOUNDARY LAYER ON A FLAT PLATE [CHISLENNYI ANALIZ KHARAKTERISTIK PAKETA VOLN TOLLMINA-SHLIKHTINGA V POGRANICHNOM SLOE NA PLOSKOI PLASTINE]
A. M. TUMIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 125-127. In Russian. refs

The characteristics of Tollmien-Schlichting wave packets in a boundary layer on a flat plate are calculated for various Mach numbers using a software set developed for calculating the stability of boundary layers in a compressible gas. In all examples, the Prandtl number is 0.72, the stagnation temperature is 310 K, and the specific heat ratio is 1.41. An analysis of the results obtained shows that the development of instability waves in a packet differs substantially from the development of monochromatic perturbations. Results are presented in graphical form and compared with those obtained by the envelope method. V.L.

A86-13375
PROFILING OF SUPERSONIC DUCTS WITH SPECIFIED NONISENTROPIC PARAMETERS AT THE EXIT [O PROFILIROVANII SVERKHZVUKOVYKH KANALOV S ZADANNYMI NEIZOENTROPICHESKIMI PARAMETRAMI NA VYKHODE]
A. S. VOINOVSKII and V. I. KIREEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 128-133. In Russian. refs

Plane and axisymmetric supersonic ducts are profiled with a specified distribution of entropy or total pressure at the exit and also with specified Mach and velocity vector angle distributions at the exit and along the profiled duct walls. The specified entropy distribution at the exit is provided by a shock wave at the duct inlet. A duct is designed with Mach 3 at the inlet which ensures a compression and rotation of the flow to Mach 1.05 and a zero velocity vector angle, with varying entropy distributions at the exit. A plane supersonic duct is also designed which simulates vortex flow near the lateral surface of a blunt body in hypersonic flow. V.L.

A86-13377
A NUMERICAL STUDY OF AXISYMMETRIC FLOW PAST A DISK [CHISLENNOE ISSLEDOVANIE OSESIMMETRICHNOGO OBTEKANIIA DISKA]
V. I. MYSHENKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 139-144. In Russian. refs

The problem of axisymmetric flow of an ideal viscous heat-conducting gas past a disk is solved numerically using the Navier-Stokes equations for subsonic and supersonic flow velocities (Mach 0.5-3). The formation and evolution of separated flow in the near wake of the disk is investigated for various Mach and Reynolds numbers; changes in the geometrical and gasdynamic parameters of the separated zone are analyzed. Heat fluxes toward the disk surface are determined. V.L.

A86-13379
A STUDY OF THE NORMAL OF A DELTA-WING AIRCRAFT AT LARGE ANGLES OF ATTACK DURING UNSTEADY MOTION [ISSLEDOVANIE NORMAL'NOI SILY SAMOLETA S TREUGOL'NYM KRYLOM NA BOL'SHIKH UGLAKH ATAKI PRI NEUSTANOVIVSHEMSIA DVIZHENII]
IU. A. VINOGRADOV, IU. B. DUBOV, A. N. ZHUK, V. P. MAMROV, and G. I. STOLIAROV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 1-10. In Russian. refs

Results of an experimental study of the normal force of a model of a delta-wing aircraft during unsteady motion at subsonic speeds are reported for a wide range of angles of attack. It is shown that in the case of large angles of attack corresponding to unsteady separated flows, the aerodynamic forces differ essentially from those observed in steady flow. The results of the aerodynamic experiment are compared with flight test data. V.L.

A86-13380
A COMBINED METHOD FOR THE ANALYSIS OF THE AERODYNAMIC FORCES ACTING ON AN OSCILLATING FLIGHT VEHICLE IN SUPERSONIC FLOW [KOMBINIROVANNYI METOD RASCHETA AERODINAMICHESKIKH SIL NA KOLEBLIUSHCHEMSIA LETATEL'NOM APPARATE S SVERKHZVUKOVOM POTOKE]
V. G. BUNKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 11-22. In Russian. refs

Aerodynamic forces acting on the system wing-elevator unit in supersonic flow are calculated using the finite element approach. Both the wing and the elevator unit are analyzed using the velocity potential method as the most correct of the known linear methods, the interference between the wing and the elevator unit is analyzed using the acceleration potential method. It is shown that the substitution of a real potential for a complex potential significantly reduces the computation time (from 25 to 5 min for 160 nodes). Substantial savings in computer time and memory are also achieved by dividing the wing into sections with different type of solutions (zero, explicit, real, and complex). The application of the method

to flutter analysis is illustrated by two straightforward examples. V.L.

A86-13381
STATISTICAL FORMULATION OF THE OBJECTIVES OF THE AERODYNAMIC EXPERIMENT [STATISTICHESKAIA POSTANOVKA ZADACH AERODINAMICHESKOGO EKSPERIMENTA]
G. L. GRODZOVSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 31-44. In Russian. refs

The principal objective of the aerodynamic experiment is formulated as determining functional relations between the mathematical expectations (and other statistical moments) of the real fluctuating aerodynamic characteristics. On the basis of experimental data on the repeatability of the mean characteristics of the aerodynamic experiment (with similarity criteria observed), the ergodicity principle is established for turbulent flows. It is shown that the finite duration of the aerodynamic experiment leads to errors in determinations of the mathematical expectation of fluctuating aerodynamic characteristics. An adaptive algorithm is proposed for conducting an aerodynamic experiment with a specified stochastic error in minimum time. V.L.

A86-13389
CERTAIN CHARACTERISTICS OF PARACHUTE-WING AERODYNAMICS [NEKOTORYE OSOBENNOSTI AERODINAMIKI PARASHIUTA-KRYLA]
O. P. BRYSOV, E. P. EZEEVA, and IU. G. LIMONAD TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 121-126. In Russian.

The aerodynamic characteristics of parachute-wing models are investigated experimentally at subsonic speeds using the optical method. It is shown that the profile drag of parachutes of the wing type is a factor of 5-10 greater than that of the rigid wing of an aircraft. The probable causes of high profile drag of the parachute wing are examined; the effect of the permeability of the model shell is discussed. V.L.

A86-13390
PROPAGATION OF SMALL PERTURBATIONS DURING THE INTERACTION OF NONVISCOUS JETS [RASPROSTRANENIE MALYKH VOZMUSHCHENII PRI VZAIMODEISTVII NEVIAZKIKH STRUI]
T. V. TITOVSKAIA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 127-131. In Russian. refs

The problem of the propagation of small perturbations during the interaction of subsonic and supersonic nonviscous plane jets in a duct with parallel walls is analyzed. The discrete spectra of the true and apparent eigenvalues and eigenfunctions corresponding to the exponentially attenuated and nonattenuated small perturbations are determined numerically. The absence of complex solutions is demonstrated analytically. V.L.

A86-13391
THE EFFECT OF THE BLUNTNESS AND THE HALF-ANGLE OF A CONE ON THE TURBULENT TRANSITION OF A BOUNDARY LAYER AT FREE-STREAM MACH 6 [VLIIANIE ZATUPLENIIA I POLUUGLA RASTVORA KONUSA NA PEREKHOD LAMINARNOGO POGRANICHNOGO SLOIA V TURBULENTNYI PRI CHISLE MACH 6]
A. R. IVANOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 132-135. In Russian.

Experimental data are presented on the effect of the half-angle and bluntness of a cone model on the location of the turbulent transition of the boundary layer at free-stream Mach 6, Re = 2.8 x 10 to the 6th for large angles of attack. It is shown that the bluntness of the model delays the turbulent transition; an increase in the cone half-angle accelerates the transition. On a blunted cone, separated flow is formed at smaller angles of attack than on a sharp cone. V.L.

A86-13392
A METHOD FOR MEASURING THE DIRECTION AND THE MACH NUMBER OF A THREE-DIMENSIONAL SUPERSONIC NOZZLE [K METODIKE IZMERENIIA NAPRAVLENIIA I CHISLA M TREKHMERNOGO SVERKHZVUKOVOGO POTOKA]
M. D. BRODETSKII, G. P. OLKHOVIKOV, A. M. KHARITONOV, A. M. SHEVCHENKO, and S. I. SHPAK TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 136-139. In Russian. refs

A pneumometric technique using five-channel pneumatic nozzles is proposed for the simultaneous measurement of the direction, the Mach number, and the full pressure. The pneumatic nozzles have been calibrated with respect to the pitch and roll angles in the Mach range 2.03-4.05, and a mathematical model of a five-channel pneumatic nozzle has been developed on the basis of the calibration results. Test results for a wedge and a delta-wing model indicate that the angles are determined with an accuracy to within 1 degree and mach numbers to within 4 percent. V.L.

A86-13395
AN ANALYSIS OF SEPARATED FLOW OF AN IDEAL FLUID PAST A FINITE-ASPECT-RATIO MECHANIZED WING [RASCHET OTRYVNOGO OBTEKANIIA MEKHANIZIROVANNOGO KRYLA KONECHNOGO UDLINENIIA POTOKOM IDEAL'NOI ZHIDKOSTI]
G. G. SUDAKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 1-6. In Russian. refs

The problem of separated flow of an ideal fluid past a finite-aspect-ratio mechanized wing is solved numerically using the method of matched asymptotic expansions. As an example, aerodynamic characteristics are calculated for a rectangular wing in the presence of separation from the lateral edges. Results are presented in graphical form. V.L.

A86-13396
CONSTRUCTION OF EQUIVALENT PROFILES AND APPROXIMATE CALCULATION OF TRANSONIC FLOW PAST THE ROOT SECTION OF A SWEPT WING [POSTROENIE EKVIVALENTNYKH PROFILEI I PRIBLIZHENNYI RASCHET OKOLOZVUKOVOGO OBTEKANIIA KORNEVOGO SECHENIIA STRELOVIDNOGO KRYLA]
G. A. PAVLOVETS and A. L. SHKADOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 7-14. In Russian. refs

A method is presented for calculating the contour of a profile whose pressrue diagram in plane-parallel flow is identical to that of the root section of a swept wing. These equivalent profiles are used for calculating stress distribution for the root profile of a swept wing for large subsonic flow velocities. The calculated results are compared with experimental data. V.L.

A86-13397
DETERMINATION OF THE SHAPE OF A PROFILE FROM A SPECIFIED CHORD DIAGRAM OF MACH NUMBERS IN TRANSONIC FLOW [OPREDELENIE FORMY PROFILIA PO ZADANNOI KHORDOVOI DIAGRAMME CHISEL MAKHA V TRANSZVUKOVOM POTOKE]
A. A. SHAGAEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 15-23. In Russian. refs

The method of successive approximations is extended to the case of subsonic and transonic flows of an ideal gas. In particular, attention is given to the inverse problem in the profile theory, and an iteration procedure is presented for solving this problem on the basis of a specified chord diagram of Mach numbers for subsonic and transonic velocities. Results are presented in graphical form. V.L.

A86-13398
USING THE SHOCK-EXPANSION METHOD FOR CALCULATING THE AERODYNAMIC CHARACTERISTICS OF FLIGHT VEHICLES [PRIMENENIE METODA 'SKACHKOV-RASSHIRENII' DLIA RASCHETA AERODINAMICHESKIKH KHARAKTERISTIK LETATEL'NYKH APPARATOV]
V. F. SIAGAEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 24-28. In Russian. refs

The principal relationship of the second-order shock-expansion method is analyzed. A further simplification of this relationship is then proposed, which makes it possible to reduce the time required for the approximate calculation of the aerodynamic characteristics of bodies with nearly linear generatrices. Calculations are carried out for a cone-cylinder combination. V.L.

A86-13399
A STUDY OF HEAT TRANSFER ON WEDGES WITH A SWEPT LEADING EDGE AND A SHARPLY BENT GENERATRIX [ISSLEDOVANIE TEPLOPEREDACHI NA KLIN'IAKH SO SKOSHENNOI PEREDNEI KROMKOI I IZLOMOM OBRAZUIUSHCHEI]
V. N. BRAZHKO, A. P. KOSYKH, and N. N. SHKIRIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 29-37. In Russian. refs

The aerodynamic and heat transfer characteristics of wedges with various degrees of the leading edge sweep (0-75 deg) and with a sharply bent generatrix are investigated experimentally and analytically for free-stream Mach 4 and 5 and for Re = (7.1-20.7)x10 to the 6th. It is shown that an increase in the leading edge sweep and local roughness of the leading edge lead to a premature turbulent transition of the boundary layer, with the associated maxima of heat transfer coefficients on the wedge surface. The end of the transition region can be located very close to leading edge of the wedge. V.L.

A86-13406
THE EFFECT OF A PERFORATED WALL ON INCOMPRESSIBLE FLOW PAST A U-SHAPED VORTEX [VLIIANIE PERFORIROVANNOI STENKI NA OBTEKANIEI U-OBRAZNOGO VIKHRIA NESZHIMAEMYM POTOKOM]
A. V. SEMENOV and O. K. CHIKINA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 99-102. In Russian.

The perturbed velocity potential due to the interaction between a U-shaped vortex and a horizontal or vertical permeable wall in incompressible flow is determined. It is shown that the effect of a permeable wall can be simulated by a simple set of singularities. Corrections for the induction downwash over the span of a U-shaped vortex are calculated for various wall permeability coefficients. V.L.

A86-13411
LINEAR THEORY OF AN EQUIVALENT PROFILE IN THE PROBLEM CONCERNING THE INFLUENCE OF POROUS FLOW BOUNDARIES [LINEINAIA TEORIIA EKVIVALENTNOGO PROFILIA V ZADACHE O VLIIANII PERFORIROVANNYKH GRANITS POTOKA]
L. G. IVANTEEVA and G. A. PAVLOVETS TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 1-9. In Russian. refs

A solution is obtained for the flow problem for a profile situated in the middle of a channel with porous walls. The analysis is based on a numerical solution of a singular integral equation for the density of the vortex sheet distributed along the chord of the profile. Equivalent-profile theory is used to determine the pressure distribution on a given profile in a channel with porous walls for large subsonic and transonic speeds. B.J.

A86-13412
THE USE OF REVERSE FLOW TO CALCULATE TRANSONIC FLOW PAST BODIES [ISPOL'ZOVANIE OBRASHCHENNOGO POTOKA DLIA RASCHETA OKOLOZVUKOVOGO OBTEKANIIA TEL]
IU. A. ARUTIUNOV and V. V. VYSHINSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 10-18. In Russian. refs

The reversibility paradox, valid for subcritical transonic flows, is extended to the case of isentropic flow with compression shocks by introducing rarefaction shocks into the reverse flow. It is shown that the same solution can be obtained when calculating the flow in forward and reverse flows. The use of the reverse flow makes possible a two-fold reduction in computational time when implementing transonic-flow computation methods on multiprocessors. B.J.

A86-13413
ASYMPTOTIC SOLUTION OF THE FLUID-FLOW PROBLEM IN THE CORE OF A VORTEX SHEET [ASIMPTOTICHESKOE RESHENIE ZADACHI O TECHENII ZHIDKOSTI V IADRE VIKHREVOI PELENY]
A. M. GAIFULLIN and A. V. ZUBTSOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 19-29. In Russian. refs

An analysis is made of the flow arising in the core of a vortex sheet due to flow separation from a low-aspect-ratio delta wing at small angles of attack and large Reynolds numbers. An asymptotic solution is obtained on the basis of the complete equations of motion of a viscous incompressible fluid. The asymptotic dependence of flow characteristics in the core of the vortex sheet on alpha, Re, and mean alpha is obtained. B.J.

A86-13422
EFFECT OF CANTILEVERS ON THE LIFT CHARACTERISTICS OF A THIN SWEPT WING AND VORTEX-WAKE STABILITY [VLIIANIE KONSOLEI NA NESUSHCHIE SVOISTVA TONKOGO STRELOVIDNOGO KRYLA I USTOICHIVOST' VIKHREVOGO SLEDA]
E. P. VIZEL TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 113-118. In Russian. refs

Experimental results indicate that the placement of cantilevers on a delta wing leads to the interaction of vortex sheets separating from the leading edges and the cantilever, and having different degrees of stability. The presence of a leading-edge break point and a reduction in the cantilever sweep leads to an accelerated breakdown of the vortex and a reduction in c(ya)max. B.J.

A86-13423
CALCULATION OF SUPERSONIC FLOW PAST A THREE-DIMENSIONAL CONFIGURATION USING INTEGRAL RELATIONSHIPS [RASCHET SVERKHZVUKOVOGO OBTEKANIIA PROSTRANSTVENNOI KONFIGURATSII S ISPOL'ZOVANIEM INTEGRAL'NYKH SOOTNOSHENII]
T. V. POGREBNAIA and V. V. SAMSONOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 119-124. In Russian. refs

A numerical method is proposed which can be used to determine the distributed and overall aerodynamic characteristics in supersonic flow past a system of arbitrary surfaces (wings, tail unit, air intake, and the vehicle as a whole) in the framework of the linear approximation. A uniform accuracy of aerodynamic-load determination is assured on all the surfaces. The boundary value problem concerning the determination of surface loads is reduced to a system of integral equations, which are solved by the method of successive approximations. B.J.

A86-13426
CALCULATION OF FLOW AROUND ROTATING CIRCULAR CASCADES WITH ALLOWANCE FOR CIRCUMFERENTIAL FLOW NONUNIFORMITY INDUCED BY A PERTURBATION AT THE INLET [K RASCHETU OBTEKANIIA VRASHCHAIUSHCHIKHSIA KRUGOVYKH RESHETOK S UCHETOM OKRUZHNOI NERAVNOMERNOSTI POTOKA, VYZVANNOI VOZMUSHCHENIEM NA VKHODE]
E. S. BELIANOVSKII, V. B. KURZIN, and T. S. SOLOMAKHOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 137-142. In Russian. refs

The method of solution and results are presented for the direct problem concerning the unsteady flow around a rotating circular cascade of thin curved profiles with allowance for circumferential flow nonuniformity induced by a perturbation at the inlet. The perturbation is modeled as a displacement of a vortex source from the center of the cascade. The solution of the integral equation for the circulation intensity on the profiles is obtained by the discrete-vortex method. The effect of cascade parameters and of the displacement magnitude of the vortex source on the circulation intensity on the profiles is analyzed. B.J.

A86-13427
THEORY OF SELF-SIMILAR REGIMES OF SUPERSONIC FLOW IN AN AXISYMMETRIC CHANNEL WITH A SUDDEN EXPANSION [K TEORII AVTOMODEL'NYKH REZHIMOV SVERKHZVUKOVOGO TECHENIIA V OSESIMMETRICHNOM KANALE S VNEZAPNYM RASSHIRENIEM]
A. I. OVCHINNIKOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 143-148. In Russian. refs

The paper develops a method for calculating base pressure at an annular projection in a system comprising a supersonic nozzle and a cylindrical channel for regimes where the relative base pressure is self-similar with respect to the gas-jet pressure. The method is based on an interpretation of available experimental data and does not contain any empirical coefficients. The calculation results are compared with the experimental results of previous studies. B.J.

A86-13429
FORMATION OF ASYMMETRIC SEPARATED FLOW PAST SLENDER BODIES OF REVOLUTION AT LARGE ANGLES OF ATTACK [K VOZNIKNOVENIIU NESIMMETRICHNOGO OTRYVNOGO OBTEKANIIA TONKIKH TEL VRASHCHENIIA NA BOL'SHIKH UGLAKH ATAKI]
M. G. GOMAN and A. N. KHRABROV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 1-9. In Russian. refs

The paper examines the problem of determining stationary positions of pairs of vortices of unequal intensity in the flow behind a cylinder modeling the axisymmetric separated flow past a slender body at large angles of attack. The possible asymmetric stationary positions of two vortices are calculated, and their stability with respect to small perturbations is determined. Bifurcations of the flow field with changes in vortex intensity are analyzed. B.J.

A86-13431
CERTAIN PROPERTIES OF TWO-DIMENSIONAL FLOWS IN THE CASE OF FLOW PAST BODIES WITH JETS [O NEKOTORYKH SVOISTVAKH PLOSKIKH TECHENII PRI OBTEKANII TEL SO STRUIAMI]
V. M. SHURYGIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 19-26. In Russian.

Shurygin's (1977) approach is used to study the nonseparated flow, an ideal incompressible fluid past bodies with jets as Be numbers not equal to zero. Representations of the Joukowski functions at an infinitely distant point are given, and formulas for the overall forces acting on the body are presented. A relationship is established between the behavior of the Joukowski functions, the total circulation, and the overall flowrate. B.J.

A86-13433
COMPACT GAS EJECTOR OF A HIGH DEGREE OF COMPRESSION WITH SPIRAL ARRANGEMENT OF THE NOZZLES [KOMPAKTNYI GAZOVYI EZHEKTOR BOL'SHOI STEPENI SZHATIIA S RASPOLOZHENIEM SOPL PO SPIRALI]
IU. K. ARKADOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 35-42. In Russian. refs

The design is described and experimental results are presented for a compact gas ejector which achieves a high degree of compression (up to 500). The ejector has a single forechamber, a single mixing chamber, and a single regulating element. High-pressure-head gas is fed into the ejector through 45 inclined supersonic nozzles spirally distributed around and along the mixing chamber. Besides exhibiting a high degree of compression, this ejector has 30 percent better cost efficiency than existing multistage ejectors. B.J.

A86-13440
SUPERSONIC GAS FLOW PAST A V-SHAPED WING [OBTEKANIE V-OBRAZNOGO KRYLA SVERKHZVUKOVYM POTOKOM GAZA]
T. M. PRITULO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 97-102. In Russian. refs

Pritulo's (1983) method is used to calculate pressure on the surface of a V-shaped wing with supersonic leading edges. On the lower surface of the wing, the flow is linearized with respect to a plane-parallel stream that has passed through a shock attached to the leading edge, the shock is calculated approximately as an isentropic compression. On the upper surface of the wing, the flow is linearized with respect to a plane-parallel stream that has passed through a rarefaction wave. B.J.

A86-13456
AEROHYDROMECHANICS [AEROGIDROMEKHANIKA]
A. M. MKHITARIAN, ED. Moscow, Izdatel'stvo Mashinostroenie, 1984, 352 p. In Russian. No individual items are abstracted in this volume.

The theoretical fundamentals of aerohydromechanics are examined, with attention given to hydroaerostatics, fluid and gas kinematics, ideal fluid dynamics, similarity and dimensionalities, isentropic flows, shock waves, hydraulic path drag, and boundary layer theory. Various problems in applied aerohydromechanics are then discussed, including wings and airfoils in subsonic, transonic, and supersonic flight, the aerodynamics of bodies of revolution and controls, and the aerodynamic characteristics of an aircraft as a whole. Finally, the discussion focuses on problems in hydraulics, such as calculation of local hydraulic resistance, hydraulic lines, and flows from holes and nozzles. V.L.

A86-13532
BOUNDARY-LAYER DEVELOPMENT ON THE AFTERBODY OF AN ENGINE NACELLE
E. LAI and L. C. SQUIRE (Cambridge University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 158, Sept. 1985, p. 23-46. Research supported by the Ministry of Defense (Procurement Executive) and Department of Trade and Industry. refs

In the context of the estimation of the drag of a complete aircraft, the calculation of the drag associated with the engine installation presents some particular difficulties. Thus, the nacelle afterbody drag represents a critical area which has been investigated for the past few years. The present paper provides the results of an experimental investigation of the boundary-layer development on a body of revolution with a jet issuing from the base. Detailed boundary-layer measurements were made with a jet velocity of 2.5 times the free-stream velocity. The main effects of replacing a jet by a solid cylindrical sting are discussed. G.R.

A86-13546#
A SOLUTION OF INVERSE PROBLEM FOR MULTI-ELEMENT AEROFOILS THROUGH APPLICATION OF PANEL METHOD
M. SHIGEMI (National Aerospace Laboratory, Tokyo, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 28, Aug. 1985, p. 97-107. refs

A solution to the inverse problem of a multielement airfoil is presented. This solution is based on the panel method, in which vortex is chosen as singularity to be distributed around the airfoil. Because of this choice, the solution becomes very simple in comparison with other types of panel methods. To meet the requirements for the solution of inverse problem as a tool to design airfoils, it is possible in this method to obtain an airfoil whose trailing edge is always closed, and the velocity distribution around which is as close to the prescribed one as possible. With a little modification, the present method can give a solution to a problem, which is direct for some elements of a multielement airfoil, but inverse for other elements. This solution is useful when some elements of a multielement airfoil are modified in shape to get a better performance. Author

A86-13933
A METHOD FOR NUMERICAL ANALYSIS OF THE AERODYNAMIC CHARACTERISTICS OF AN AEROPLANE WING IN THE SUBCRITICAL RANGE OF THE FLYING VELOCITY
Z. DZYGADLO and T. X. CHU Journal of Technical Physics (ISSN 0324-8313), vol. 25, no. 1, 1984, p. 127-141. refs

A method for determining the aerodynamic characteristics of an aircraft wing making use of a hydrodynamic model composed of discrete vortices is described. Using this method, the coefficients of lift, drag, and transverse force, as well as those of the rolling, pitching, and yawing moments, which act on a wing in incompressible or compressible flow, can be obtained. Here, the circulation flow with attached vortices and separated vortices flowing away from the edges of the wing are studied.Two models of flow are analyzed, with and without leading-edge separation. C.D.

A86-14186
A STUDY OF THE FLOW AROUND A WING EQUIPPED WITH A SPOILER [CONTRIBUTION A L'ETUDE EXPERIMENTALE ET THEORIQUE DE L'ECOULEMENT AUTOUR D'UN PROFIL D'AILE MUNI D'UN SPOILER]
B. C. JAEGGY, W. CZICHOWSKY, P. MEYER, G. KOERBER, and R. KAUFFMANN (Saint-Louis, Institut Franco-Allemand de Recherches, France) L'Aeronautique et L'Astronautique (ISSN 0001-9275), no. 112, 1985, p. 2-20. In French. refs
(Contract DRET-82-318; DRET-84-047)

Laser velocimetry and flow visualization data were analyzed for flow around a wing equipped with a spoiler. Two- and three-dimensional velocity data were collected and photographs were taken of the flow seeded with dense oil smoke and illumined by a laser beam and a stroboscope. Attention was focused on the unsteady wake characteristics, the turbulent structures and length scales, the velocity profiles, the Reynolds stress and the pressure distributions. The data were analyzed using the nonviscous model of Maskew and Dvorak (1979). The results demonstrate the feasibility of examining separated flows using laser velocimetry and minimal computing power. Studies of the flows past a spoiler will require further trials, however, particularly for the Re stress. M.S.K.

A86-14359
UNSTEADY POTENTIAL FLOW FOR OSCILLATING AIRFOILS
I. PARASCHIVOIU (Montreal, Universite, Montreal, Canada) and J.-M. PARROUFFE Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, June 1985, p. 142-158. refs

Attention is given to the development status of an aerodynamic model for the unsteady potential flow about a blade profile, which would be applicable in calculations of the forces acting on Darrieus wind turbine rotor blades. The technique applied to unsteady potential flow distributes elementary singularities uniformly over the profile surface, as well as local singularities in the wake. Such parameters as pressure distribution, lift coefficient, moment coefficient, and time-dependent variations of the wake, are thereby calculated for various profile motions. The model has been validated for symmetrical profiles (undergoing pitching) whose maximum incidence does not exceed the static stall angle. O.C.

A86-14360#
A NEW FAST SOLVER PROCEDURE APPLIED TO THE BGK COMPUTER PROGRAM FOR TRANSONIC FLOW PAST AN AEROFOIL
Y. S. WONG (Alberta, University, Edmonton, Canada) and D. J. JONES (National Aeronautical Establishment, Ottawa) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, June 1985, p. 159-169. refs
(Contract NSERC-U-0375)

A fast iterative procedure has been developed for calculating the nonconservative full potential transonic flow equation. The numerical method consists of two level iterations: the outer iterate is based on a Newton-like algorithm, and the inner iterate is based on a preconditioned minimal residual method. This method has been tested on the computer program for transonic flow past an aerofoil, originally developed by Bauer, Garabedian and Korn (1972) and often referred to as the 'BGK' code. Computational results from the present method are compared with results from a previous fast solver due to Jameson (1974). The comparison for different Mach numbers and angles of attack is very good in the inviscid case, and reasonably good in the viscous case in which Green's (1973) boundary layer method is used. The present method, however, gives a reduction in computing time of 40 percent in inviscid calculations, while in the viscous case savings of about 25 percent can be achieved in computer time. Author

A86-14432#
EVALUATION OF A METHOD FOR ANALYZING THE APERTURE REGION OF TWO-DIMENSIONAL EXTERNAL COMPRESSION INLETS
A. F. CAMPBELL and C. K. FORESTER (Boeing Military Airplane Co., Seattle, WA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 10 p. refs
(AIAA PAPER 85-3072)

A two-dimensional Navier-Stokes code is used to compute the flow field in the aperture region of a two-dimensional external compression inlet. The goals of the study are to first establish the ability of the code to correctly predict the relative performance characteristics of previously tested aperture region designs and then use the code as a tool to derive additional design information for optimizing external compression inlet performance. Progress on the validation of the two-dimensional Navier-Stokes procedure is reported. Analytical results are compared with experimental data for one aperture region geometry. The influence of numerical smoothing and cross stream grid resolution on solution accuracy is investigated. Author

A86-14451#
VISCOUS FLOW RESULTS FOR THE VORTEX-AIRFOIL INTERACTION PROBLEM
J. C. WU, T. M. HSU, W. TANG, and L. N. SANKAR (Georgia Institute of Technology, Atlanta) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 10 p. USAF-Army-supported research. refs
(AIAA PAPER 85-4053)

The unsteady airfoil-vortex interaction problem is analyzed using two solution procedures. In the first procedure, the unsteady, incompressible Navier-Stokes equations are solved in the vorticity-stream function form using an integro-differential formulation. In the second approach, the compressible Navier-Stokes equations are solved using an Alternating Direction Implicit (ADI) procedure. Both the approaches use a body-fitted coordinate system. The effects of turbulence are modeled using a two-layer eddy viscosity model. Numerical results are presented for the interaction of a passing vortex with a NACA 0012 airfoil

and a NACA 64A006 airfoil for a wide range of flow parameters and compared with available numerical data. Author

A86-14452*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFICIENT SIMULATION OF SEPARATED THREE-DIMENSIONAL VISCOUS FLOWS USING THE BOUNDARY-LAYER EQUATIONS
W. R. VAN DALSEM and J. L. STEGER (NASA, Ames Research Center, Moffett Field, CA) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 10 p. refs
(AIAA PAPER 85-4064)

A simple and computationally efficient algorithm for solving the unsteady three-dimensional boundary-layer equations in the time-accurate or relaxation mode is presented. Results of the new algorithm are shown to be in quantitative agreement with detailed experimental data for flow over a swept infinite wing. The separated flow over a 6:1 ellipsoid at angle of attack, and the transonic flow over a finite-wing with shock-induced 'mushroom' separation are also computed and compared with available experimental data. It is concluded that complex, separated, three-dimensional viscous layers can be economically and routinely computed using a time-relaxation boundary-layer algorithm. Author

A86-14453#
UNSTEADY AERODYNAMICS OF AIRFOILS OSCILLATING IN AND OUT OF DYNAMIC STALL
C. M. WANG, J. C. WU, and L. N. SANKAR (Georgia Institute of Technology, Atlanta) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 10 p. Army-supported research. refs
(AIAA PAPER 85-4078)

A solution procedure is presented for the computation of dynamic stall phenomena encountered by arbitrary shaped airfoils under arbitrary flow conditions. This procedure solves the unsteady, incompressible Navier-Stokes and the unsteady boundary layer equations using an efficient, zonal approach. A number of results for a modified NACA 0012 airfoil experiencing dynamic stall are presented and compared with available numerical data. Qualitative comparisons with flow visualization experiments are also presented. The present study also illustrates the effect of numerical viscosity on the accuracy and robustness of the solution procedure.
Author

A86-14454*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
JUNCTURE FLOW CONTROL USING LEADING-EDGE FILLETS
L. R. KUBENDRAN and W. D. HARVEY (NASA, Langley Research Center, Hampton, VA) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 6 p. Research supported by the National Research Council and NASA. refs
(AIAA PAPER 85-4097)

Flow measurements have been made in the wake region of a simulated wing-fuselage juncture, with and without leading-edge fillets, in order to assess the effect of leading-edge modifications on the flow field around the juncture. Preliminary results indicate that there is some reduction in juncture drag at moderate angles of attack with the use of leading-edge fillets. There is also evidence of improvement in the flow characteristics on the surface downstream of the juncture when fillets are used. As the fillet size is increased, flow characteristics start deteriorating at some point, and an optimum fillet size may be required to achieve an overall improvement in the flow field. Author

A86-14455#
COMPUTATION OF ROTOR BLADE FLOWS USING THE EULER EQUATIONS
B. E. WAKE, N. L. SANKAR, and S. G. LEKOUDIS (Georgia Institute of Technology, Atlanta) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 9 p. Army-supported research. refs
(AIAA PAPER 85-5010)

The Euler equations are used to compute steady and unsteady three-dimensional transonic flows around nonlifting rotor blades. A hybrid numerical procedure is used that treats the spanwise derivatives explicitly and the other spatial derivatives implicitly. The steady state results are in excellent agreement with results obtained from the full potential equation. The results for unsteady flow compare well with measurements. These results demonstrate the ability of the Euler solver to compute transonic flow around helicopter blades. Author

A86-14456#
SOLUTION OF TRANSONIC FLOW PAST ROTOR BLADES USING THE CONSERVATIVE FULL POTENTIAL EQUATION
L. N. SANKAR (Georgia Institute of Technology, Atlanta) and D. PRICHARD (McDonnell Douglas Helicopter Co., Culver City, CA) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 11 p. Research supported by the McDonnell Douglas Helicopter Co. refs
(AIAA PAPER 85-5012)

A solution procedure is presented for the prediction of unsteady, transonic flow past helicopter rotor blades in forward flight. This procedure solves the three-dimensional, unsteady, compressible full potential equation in conservation form in a body-fitted coordinate system using a Strongly Implicit Procedure (SIP). It is assumed that the structure of the unsteady wake, as well as the structural deformation of the rotor blade due to the aerodynamic loads are known independently from a free wake-aeroelastic analysis. These effects are accounted for as corrections to the section angle of attack at several radial stations. Numerical results are presented for a number of rotor configurations in forward flight, and compared with available experimental data. Author

A86-14457#
VELOCITY MEASUREMENTS IN THE NEAR FIELD OF A ROTOR BLADE IN HOVER
N. M. KOMERATH, T. L. THOMPSON, and R. B. GRAY (Georgia Institute of Technology, Atlanta) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 13 p. refs
(Contract DAAG29-82-K-0094)
(AIAA PAPER 85-5013)

Measurements of the velocity field close to a model rotor blade in hover are described. The flow around the tip of the blade has been emphasized in determining the measurement grid. A large data base has been constructed for quantitative comparison with predictions. The data has been used to construct qualitative pictures of the instantaneous flow field in several planes parallel and normal to the blade planform. Selected plots of velocity components measured during the passage of the blade have also been presented for quantitative comparison with prediction techniques. Preliminary comparison of the spanwise distribution of circulation with computed values is shown. The data shows the roll-up of the velocity field around the tip into a tip vortex and the flow patterns on planes above and below the blade. Predicted results are seen to be in good agreement with the measured values at inboard stations, but more work is seen to be necessary for better prediction of the flow around the tip. Sources of possible error in the measurement are discussed. Author

A86-14529#
SEPARATED FLOW UNSTEADY AERODYNAMIC THEORY
R. M. CHI (United Technologies Research Center, East Hartford, CT) (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, p. 27-37) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 956-964. Research sponsored by the United Technologies Corp. Previously cited in issue 13, p. 1832, Accession no. A84-31687. refs

A86-14537#
DOUBLET STRIP METHOD FOR OSCILLATING SWEPT TAPERED WINGS IN INCOMPRESSIBLE FLOW
A. ICHIKAWA (Civil Aviation College, Miyazaki, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 1008-1012. refs

An improved numerical method is developed for calculating the load distributions on oscillating swept tapered wings in incompressible flow. The integration domains is transformed into a rectangular domain, and the domain is divided into many chordwise strips. In the strip containing the control point, the proposed method properly accounts for Cauchy and logarithmic singularities. The solutions generally compared well with other lifting-surface theories, but with much smaller computational times. Author

A86-14541#
COMMENT ON 'AERODYNAMIC ESTIMATION TECHNIQUES FOR AEROSTATS AND AIRSHIPS'
G. DELEUTERIO (Toronto, University, Canada) and B. ETKIN Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 1023; Authors' reply, p. 1023, 1024. refs

A86-14556#
MULTISTAGE COMPRESSOR STATOR/ROTOR INTERACTION
D. L. TWEEDT, T. H. OKIISHI (Iowa State University of Science and Technology, Ames), and M. D. HATHAWAY (U.S. Army, Research and Technology Laboratories, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 449-455. Previously cited in issue 07, p. 835, Accession no. A85-19455. refs
(Contract F49620-83-K-0023)

A86-14558*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
CALCULATION OF UNSTEADY FAN ROTOR RESPONSE CAUSED BY DOWNSTREAM FLOW DISTORTIONS
W. F. OBRIEN, W.-F. NG, and S. M. RICHARDSON (Virginia Polytechnic Institute and State University, Blacksburg) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 464-469. Previously cited in issue 03, p. 254, Accession no. A85-13960. refs
(Contract NAG1-156)

A86-14559#
CALCULATION OF STEADY FLOW ABOUT PROPELLERS USING A SURFACE PANEL METHOD
J. L. HESS and W. O. VALAREZO (Douglas Aircraft Co., Long Beach, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 470-476. Navy-sponsored research. Previously cited in issue 07, p. 842, Accession no. A85-19634. refs

A86-14560#
A LINEAR MULTIVARIABLE DYNAMICAL MODEL OF A SUPERSONIC INLET-ENGINE COMBINATION
Y. GUAN, S. YARNG (Northwestern Polytechnical University, Xian, People's Republic of China), and J. YARNG Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 477-484. Previously cited in issue 16, p. 2278, Accession no. A84-35239. refs

A86-14561*# Texas Technological Univ., Lubbock.
MULTISPARK FLOW VISUALIZATION OF LATERAL JET INJECTION INTO A SWIRLING CROSS FLOW
G. B. FERRELL (Texas Tech University, Lubbock), K. AOKI, and D. G. LILLEY (Oklahoma State University, Stillwater) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 485-487. Previously cited in issue 07, p. 836, Accession no. A85-19490. refs
(Contract NAG3-549)

A86-14679
A NUMERICAL METHOD FOR CALCULATING INTERNAL SUBSONIC SWIRLING FLOWS OF AN IDEAL GAS [CHISLENNYI METOD RASCHETA VNUTRENNIKH DOZVUKOVYKH TECHENII IDEAL'NOGO GAZA S ZAKRUTKOI]
V. P. PASHCHENKO Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 25, Oct. 1985, p. 1573-1577. In Russian. refs

An analysis is made of internal subsonic swirling flows of an ideal gas in axisymmetric ducts with a sharp bend. Calculations are carried out in orthogonal coordinates using an iteration procedure; examples of calculations are presented. V.L.

A86-14743
MEASUREMENT OF THE HETEROGENEOUS RECOMBINATION PROBABILITY OF OXYGEN ATOMS IN THE COURSE OF SUPERSONIC DISSOCIATED GAS FLOW INTERACTION WITH SOLID BODY SURFACES
V. D. BERKUT, V. V. KOVTUN, N. N. KUDRIAVTSEV, S. S. NOVIKOV, and A. I. SHAROVATOV (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) International Communications in Heat and Mass Transfer (ISSN 0735-1933), vol. 12, Sept.-Oct. 1985, p. 567-575. refs

A method for determining time-resolved heterogeneous recombination probabilities of oxygen atoms is described. This technique is based on the comparison of the measured and calculated heat fluxes to a flat wedge-like plate set at a small expansion angle to a supersonic dissociated gas flow with pressure of 100 mm Hg, temperature 3000-4000 K, and velocity of 2.5-3.0 km/sec. The relationship between incident shock wave Mach numbers and full dissociation of oxygen and the absence of gas recombination in the boundary layer is analyzed. The calculation of the relative fraction of the recombination of heat flux using a new heat transfer gauge technique is examined. This gauge technique, which is dependent on the surface reaction Damkohler number produces higher fractions of the recombination of heat fluxes than the previous gauge method. Experimental procedures and results revealing the applicability of this method for calculating recombination probabilities are provided. I.F.

A86-15980
EXPERIMENTAL STUDY OF GAS FLOW AROUND BLUNT OBJECTS
A. P. BEDIN, G. I. MISHIN, and M. V. CHISTIAKOVA (AN SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 55, Apr. 1985, p. 719-722) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 30, April 1985, p. 423-425. Translation. refs

The effects the physical properties of a gas have on the flow around segmented and conical objects were studied experimentally using ballistic models in air, argon and Freon-12. Air trials were carried out at ambient pressure while the pressures of the other gases were altered to maintain an Re of 650,000 at Mach numbers from 0.5-4 in Ar (and air) and from 1-9 in Freon-12. The flows were monitored in separated and attached regions and in the near wake. The rotation angle of the flow about the apex increased with decreases in the specific heat ratio (SHR), and was associated with expansion of the area of attached flow on the lateral surface. A relationship was observed between critical angle for separation and the Mach number in all gases. Any decrease in the SHR was accompanied by a decrease in the size of the detached flow region. M.S.K.

A86-16102
MEASUREMENTS IN THE TURBULENT BOUNDARY LAYER ON AN 'INFINITE' SWEPT WING
P. BRADSHAW and N. S. PONTIKOS (Imperial College of Science and Technology, London, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 159, Oct. 1985, p. 105-130. refs

The present paper is concerned with turbulence measurements on an 'infinite' swept wing, simulated by a duct attached to a blower tunnel. The work considered represents an extension of studies reported by van den Berg et al. (1975) and Elsenaar and Boelsma (1974). The current work shows in greater detail that the influence of mean-flow three-dimensionality on the dimensionless structure parameters of the turbulence is more extensive and more subtle than assumed in present calculation methods, which concentrate on the lag in direction of the shear-stress vector while not fully accounting for the decrease in magnitude implied by the experimental results. A few sample results for Reynolds-stress transport normal to the surface are presented. The paper is mainly concerned with the outer layer of the boundary layer. G.R.

A86-16122
PRESSURE FLUCTUATIONS ON ROTOR BLADES GENERATED BY BLADE-VORTEX INTERACTION
G. NEUWERTH and R. MUELLER (Aachen, Rheinisch-Westfaelische Technische Hochschule, West Germany) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 3, 1985, p. 227-239. refs

During some flight operations of helicopters the main rotor blades pass close to or intersect the trailing tip vortices of the main rotor. These blade-vortex interactions (BVI) generate strong fluctuating blade pressures leading to dynamic structural loads and impulsive noise radiation. Currently, accurate load predictions are limited by the lack of knowledge of the tip vortex structure. Therefore, a special test facility was built to investigate the basic mechanism of BVI: a special delta wing generates two leading edge vortices with a structure measured by a five-hole probe. One of these vortices interacts with a rotor which represents the main rotor. The forward flight of the helicopter is simulated by a wind tunnel. By this arrangement a better physical understanding of the BVI can be obtained. Additionally, theoretical methods for computing the local unsteady blade pressures can be checked more reliably. The pressure fluctuations are computed by means of a theory which was derived from the unsteady airfoil theory of Naumann and Yeh. Measured and computed pressure fluctuations are in good agreement. Author

N86-12202*# Grumman Aerospace Corp., Bethpage, N.Y.
GRUMFOIL: A COMPUTER CODE FOR THE VISCOUS TRANSONIC FLOW OVER AIRFOILS Final Report
H. R. MEAD and R. E. MELNIK Washington NASA Oct. 1985 76 p refs
(Contract NAS1-12426)
(NASA-CR-3806; NAS 1.26:3806; RE-681) Avail: NTIS HC A05/MF A01 CSCL 01A

A user's manual which describes the operation of the computer program, GRUMFOIL is presented. The program computes the viscous transonic flow over two dimensional airfoils using a boundary layer type viscid-inviscid interaction approach. The inviscid solution is obtained by a multigrid method for the full potential equation. The boundary layer solution is based on integral entrainment methods. E.A.K.

N86-12203*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE STATUS OF TWO-DIMENSIONAL TESTING AT HIGH TRANSONIC SPEEDS IN THE UNIVERSITY OF SOUTHAMPTON TRANSONIC SELF-STREAMLINING WIND TUNNEL Progress Report
M. C. LEWIS Washington NASA Oct. 1985 57 p refs
(Contract NSG-7172)
(NASA-CR-3919; NAS 1.26:3919) Avail: NTIS HC A04/MF A01 CSCL 01A

This report briefly outlines the progress made during the last 2 years in extending the operational range of the Transonic Self-Streamlining Wind Tunnel (at the University of Southampton) into high subsonic speeds. Analytical preparation completed in order to achieve such an extension is outlined and a summary of the preliminary model validation tests is presented. Future work necessary to allow further validation and development is discussed. Author

N86-12204*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
DERIVATION OF JACK MOVEMENT INFLUENCE COEFFICIENTS AS A BASIS FOR SELECTING WALL CONTOURS GIVING REDUCED LEVELS OF INTERFERENCE IN FLEXIBLE WALLED TEST SECTIONS
M. J. GOODYER Oct. 1985 14 p refs Prepared for Kentron International, Inc., Hampton, Va.
(Contract NAS1-16000)
(NASA-CR-177992; NAS 1.26:177992) Avail: NTIS HC A02/MF A01 CSCL 01A

This report covers work done in a transonic wind tunnel towards providing data on the influence of the movement of wall-control jacks on the Mach number perturbations along the test section. The data is derived using an existing streamline-curvature program, and in application is reduced to matrices of influence coefficients. Author

N86-12205*# Rockwell International Corp., Columbus, Ohio. Aircraft Operations.
AERODYNAMIC CHARACTERISTICS OF A PROPULSIVE WING-CANARD CONCEPT AT STOL SPEEDS Interim Report
V. R. STEWART Nov. 1985 423 p refs
(Contract NAS1-17171)
(NASA-CR-177982; NAS 1.26:177982; NA84-0148) Avail: NTIS HC A18/MF A01 CSCL 01A

A full span model of a wing/canard concept representing a fighter configuration has been tested at STOL conditions in the NASA Langley 4 x 7 meter tunnel. The results of this test are presented, and comparisons are made to previous data of the same configuration tested as a semispan model. The potential of the propulsive wing/canard to develop very high lift coefficients was investigated with several nozzle spans (nozzle aspect ratios). Although longitudinal trim was not accomplished with the blowing distributions and configurations tested, the propulsive wing/canard appears to offer an approach to managing the large negative pitching moments associated with trailing edge flap blowing. Also presented are data showing the effects of large flap deflections and relative wing/canard positions. Presented in the appendix to the report are limited lateral-directional and ground effects data, as well as wing downwash measurements. Author

N86-12206*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF SURFACE WAVINESS ON A SUPERCRITICAL LAMINAR-FLOW-CONTROL AIRFOIL
D. V. MADDALON and M. L. MCMILLIN Oct. 1983 25 p refs
(NASA-TM-85705; NAS 1.15:85705) Avail: NTIS HC A02/MF A01 CSCL 01A

Calculations were made of the effects of surface waviness on the external pressure of a supercritical airfoil at design conditions. Wave parameters varied include amplitude, wavelength, phase, and number of cycles. Effects of single and multiple waves are calculated at various chordwise locations. General trends of surface

waviness effects on pressure distribution are determined and these solutions are reported. Contour deviations are imposed on the upper surface of the airfoil. Results are presented in a manner designed to facilitate ready comparison with the ideal contour static pressure distribution. Author

N86-12207*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME RECENT ADVANCES IN COMPUTATIONAL AERODYNAMICS FOR HELICOPTER APPLICATIONS
W. J. MCCROSKEY and J. D. BAEDER (Army Aviation and Technology Activity-AVSCOM, Moffett Field, Calif.) Oct. 1985 20 p refs
(NASA-TM-86777; REPT-85345; NAS 1.15:86777; USAVSCOM-TR-85-A-06) Avail: NTIS HC A02/MF A01 CSCL 01A

The growing application of computational aerodynamics to nonlinear helicopter problems is outlined, with particular emphasis on several recent quasi-two-dimensional examples that used the thin-layer Navier-Stokes equations and an eddy-viscosity model to approximate turbulence. Rotor blade section characteristics can now be calculated accurately over a wide range of transonic flow conditions. However, a finite-difference simulation of the complete flow field about a helicopter in forward flight is not currently feasible, despite the impressive progress that is being made in both two and three dimensions. The principal limitations are today's computer speeds and memories, algorithm and solution methods, grid generation, vortex modeling, structural and aerodynamic coupling, and a shortage of engineers who are skilled in both computational fluid dynamics and helicopter aerodynamics and dynamics. Author

N86-12208*# Grumman Aerospace Corp., Bethpage, N.Y.
AN IMPROVED VISCID/INVISCID INTERACTION PROCEDURE FOR TRANSONIC FLOW OVER AIRFOILS Final Report
R. E. MELNIK, R. R. CHOW, H. R. MEAD, and A. JAMESON Washington NASA Oct. 1985 132 p refs
(Contract NAS1-12426)
(NASA-CR-3805; NAS 1.26:3805; RE-682) Avail: NTIS HC A07/MF A01 CSCL 01A

A new interacting boundary layer approach for computing the viscous transonic flow over airfoils is described. The theory includes a complete treatment of viscous interaction effects induced by the wake and accounts for normal pressure gradient effects across the boundary layer near trailing edges. The method is based on systematic expansions of the full Reynolds equation of turbulent flow in the limit of Reynolds numbers, Reynolds infinity. Procedures are developed for incorporating the local trailing edge solution into the numerical solution of the coupled full potential and integral boundary layer equations. Although the theory is strictly applicable to airfoils with cusped or nearly cusped trailing edges and to turbulent boundary layers that remain fully attached to the airfoil surface, the method was successfully applied to more general airfoils and to flows with small separation zones. Comparisons of theoretical solutions with wind tunnel data indicate the present method can accurately predict the section characteristics of airfoils including the absolute levels of drag. E.A.K.

N86-12209# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
AN EVALUATION OF FOUR METHODS OF NUMERICAL ANALYSIS FOR TWO-DIMENSIONAL AIRFOIL FLOWS. REVISION Departmental Report
R. BURKE 6 Jul. 1985 29 p
(Contract S12-66)
(AD-A157248; DTNSRDC/SPD-1139-01-REV) Avail: NTIS HC A03/MF A01 CSCL 09B

Four computer programs for analyzing the inviscid and boundary layer flow over two dimensional airfoils are exercised in comparisons against experimental data from two wind tunnel studies. The solution method of each computer program is discussed, followed by a description of the airfoil geometries used in the model comparisons. Measured values of pressure distribution, turbulent separation point, and boundary layer properties are compared against predicted values. GRA

N86-12210# Naval Weapons Center, China Lake, Calif.
PARACHUTE RECOVERY SYSTEMS DESIGN MANUAL, CHAPTERS 1 THROUGH 4 OFFPRINT Partial Report, Jan. 1984 - Jul. 1985
T. W. KNACKE Jul. 1985 56 p
(AD-A157839; AD-E900488; NWC-TP-6575-CH-1/4) Avail: NTIS HC A04/MF A01 CSCL 01C

This manual provides the recovery system engineer in Government and industry with tools to evaluate, select, design, test, manufacture, and operate parachute recovery systems. These systems range from simple, one-parachute assemblies to multiple-parachute systems, and may include equipment for impact attenuation, flotation, location, retrieval, and disposition. All system aspects are discussed, including the need for parachute recovery, the selection of the most suitable recovery system concept, a computerized approach to parachute performance, force and stress analysis, geometric gore design, component layout, material selection, system design, manufacturing, and in-service maintenance. GRA

N86-12434# Joint Publications Research Service, Arlington, Va.
BLR STUDIES ON CONIC MODEL WITH LDA IN FL-1 WIND TUNNEL
Z. ZHAN and Y. YONG *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-034) p 67-70 1 Oct. 1985 Transl. into ENGLISH from Guoji Hangkong (Beijing), no. 6, Jun. 1985 p 9-10
Avail: NTIS HC A08/MF A01

Boundary layer velocity measurement over a cone using laser (LDA) was studied in the FL-1 wind tunnel of the Shengyang Aerodnamics Research Institute. Velocity distributions at two cross-sections of the boundary layer of a 20 deg conic model under different Mach numbers are measured. The measured results are in agreement with theoretical calculations. E.A.K.

N86-13287*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
EFFECTS OF VELOCITY PROFILE AND INCLINATION ON DUAL-JET-INDUCED PRESSURES ON A FLAT PLATE IN A CROSSWIND
A. L. JAKUBOWSKI, J. A. SCHETZ, C. L. MOORE, and R. JOAG Oct. 1985 52 p refs
(Contract NAG2-256)
(NASA-CR-177361; NAS 1.26:177361) Avail: NTIS HC A04/MF A01 CSCL 01A

An experimental study was conducted to determine surface pressure distributions on a flat plate with dual subsonic, circular jets exhausting from the surface into a crossflow. The jets were arranged in both side-by-side and tandem configurations and were injected at 90 deg and 60 deg angles to the plate, with jet-to-crossflow velocity ratio of 2.2 and 4. The major objective of the study was to determine the effect of a nonuniform (vs uniform) jet velocity profile, simulating the exhaust of a turbo-fan engine. Nonuniform jets with a high-velocity outer annulus and a low-velocity core induced stronger negative pressure fields than uniform jets with the same mass flow rate. However, nondimensional lift losses (lift loss/jet thrust lift) due to such nonuniform jets were lower than lift losses due to uniform jets. Changing the injection angle from 90 deg to 60 deg resulted in moderate (for tandem jets) to significant (for side-by-side jets) increases in the induced negative pressures, even though the surface area influenced by the jets tended to reduce as the angle decreased. Jets arranged in the side-by-side configuration led to significant jet-induced lift losses exceeding, in some cases, lift losses reported for single jets. B.W.

N86-13288# National Aerospace Lab., Tokyo (Japan).
A METHOD FOR CALCULATING FLOW FIELDS AROUND MOVING BODIES
S. OGAWA and T. ISHIGURO May 1985 23 p refs
(NAL-TR-859T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A new method for calculating flow fields with arbitrarily moving boundaries is proposed. Under the concept of Lie derivative, field equation moving coordinates are derived. There are several kinds of such equations; an exmaple is one written in Viviand's conservative form. According to the formulation presented, it is natural and reasonable to consider that the computation coordinates fitted to the body move in space. This is the reverse of the usual computational procedures. The two dimensional incompressible Navier-Stokes equations in general moving coordinates are solved by a finite difference method. Using the third-order upwind scheme (Kawamura scheme), the present calculations are made for the dynamic stall process on an oscillating airfoil, and the flow generated by a moving cylinder. Consequently it is shown that the flow generated by a moving body can easily be analyzed by the present method. Author

N86-13291*# Informatics General Corp., Palo Alto, Calif.
PLTTER USER'S GUIDE
A. BARLOW, D. HERMSTAD, and J. TROSIN Nov. 1985 64 p
(Contract NAS2-11555)
(NASA-CR-177385; NAS 1.26:177385; TN-85-7104-306-23)
Avail: NTIS HC A04/MF A01 CSCL 01A

The PLTTER graphics system, which is part of CDDMS is discussed. CDDMS is a comprehensive system for data basing and subsequent plotting of data acquired during wind tun;nel tests or from computational flow analyses. The PLTTER is a system which creates report-quality plots of data which is stored on a CDDMS data base. The Requests file system allows plot-controlling information to be arranged in the way which is most appropriate for any application. The PLTTER system features many capabilities which are especially useful when plotting wind tunnel data. The PLTTER offers a variety of page formats, different grid options and parametric curve fitting algorithms, and a powerful legend capability to identify relevant information about individual curves. One or more plots on a page can be suppressed if desired so that an established page format can be maintained. Final plot output may be standard Versatec plots, QMS Laser printer plots, or microfiche. E.A.K.

N86-13292*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON APPLICATIONS OF CHIMERA GRID SCHEMES TO STORE SEPARATION
F. C. COUGHERTY, J. A. BENEK (Calspan Field Services, Arnold Air Force Station, Tenn.), and J. L. STEGER Oct. 1985 14 p refs
(NASA-TM-88193; REPT-86045; NAS 1.15:88193) Avail: NTIS HC A02/MF A01 CSCL 01A

A finite difference scheme which uses multiple overset meshes to simulate the aerodynamics of aircraft/store interaction and store separation is described. In this chimera, or multiple mesh, scheme, a complex configuration is mapped using a major grid about the main component of the configuration, and minor overset meshes are used to map each additional component such as a store. As a first step in modeling the aerodynamics of store separation, two dimensional inviscid flow calculations were carried out in which one of the minor meshes is allowed to move with respect to the major grid. Solutions of calibrated two dimensional problems indicate that allowing one mesh to move with respect to another does not adversely affect the time accuracy of an unsteady solution. Steady, inviscid three dimensional computations demonstrate the capability to simulate complex configurations, including closely packed multiple bodies. Author

N86-13293*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NUMERICAL SOLUTIONS OF NAVIER-STOKES EQUATIONS FOR A BUTLER WING Progress Report, 1 Jan. - 31 Aug. 1985
J. S. ABOLHASSANI and S. N. TIWARI Oct. 1985 50 p refs
(Contract NCC1-68)
(NASA-CR-174202; NAS 1.26:174202) Avail: NTIS HC A03/MF A01 CSCL 01A

The flow field is simulated on the surface of a given delta wing (Butler wing) at zero incident in a uniform stream. The simulation is done by integrating a set of flow field equations. This set of equations governs the unsteady, viscous, compressible, heat conducting flow of an ideal gas. The equations are written in curvilinear coordinates so that the wing surface is represented accurately. These equations are solved by the finite difference method, and results obtained for high-speed freestream conditions are compared with theoretical and experimental results. In this study, the Navier-Stokes equations are solved numerically. These equations are unsteady, compressible, viscous, and three-dimensional without neglecting any terms. The time dependency of the governing equations allows the solution to progress naturally for an arbitrary initial initial guess to an asymptotic steady state, if one exists. The equations are transformed from physical coordinates to the computational coordinates, allowing the solution of the governing equations in a rectangular parallel-piped domain. The equations are solved by the MacCormack time-split technique which is vectorized and programmed to run on the CDC VPS 32 computer. Author

N86-13294*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
AN INVESTIGATION INTO THE VERTICAL AXIS CONTROL POWER REQUIREMENTS FOR LANDING VTOL TYPE AIRCRAFT ONBOARD NONAVIATION SHIPS IN VARIOUS SEA STATES
M. E. STEVENS and J. ROSKAM Jul. 1985 216 p
(Contract NCC2-242)
(NASA-CR-176355; NAS 1.26:176355; KU-FRL-623-1) Avail: NTIS HC A10/MF A01 CSCL 01A

The problem of determining the vertical axis control requirements for landing a VTOL aircraft on a moving ship deck in various sea states is examined. Both a fixed-base piloted simulation and a nonpiloted simulation were used to determine the landing performance as influenced by thrust-to-weight ratio, vertical damping, and engine lags. The piloted simulation was run using a fixed-based simulator at Ames Research center. Simplified versions of an existing AV-8A Harrier model and an existing head-up display format were used. The ship model used was that of a DD963 class destroyer. Simplified linear models of the pilot, aircraft, ship motion, and ship air-wake turbulence were developed for the nonpiloted simulation. A unique aspect of the nonpiloted simulation was the development of a model of the piloting strategy used for shipboard landing. This model was refined during the piloted simulation until it provided a reasonably good representation of observed pilot behavior. B.W.

N86-13296*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATIONAL ASPECTS OF ZONAL ALGORITHMS FOR SOLVING THE COMPRESSIBLE NAVIER-STOKES EQUATIONS IN THREE DIMENSIONS
T. L. HOLST, S. D. THOMAS (Informatics General Corp., Palo Alto, Calif.), U. KAYNAK, K. L. GUNDY, J. FLORES, and N. M. CHADERJIAN Oct. 1985 15 p refs
(NASA-TM-86774; REPT-85340; NAS 1.15:86774) Avail: NTIS HC A02/MF A01 CSCL 01A

Transonic flow fields about wing geometries are computed using an Euler/Navier-Stokes approach in which the flow field is divided into several zones. The flow field immediately adjacent to the wing surface is resolved with fine grid zones and solved using a Navier-Stokes algorithm. Flow field regions removed from the wing are resolved with less finely clustered grid zones and are solved with an Euler algorithm. Computational issues associated with this

zonal approach, including data base management aspects, are discussed. Solutions are obtained that are in good agreement with experiment, including cases with significant wind tunnel wall effects. Additional cases with significant shock induced separation on the upper wing surface are also presented. Author

N86-13297*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TOMOGRAPHIC TECHNIQUE FOR AERODYNAMICS AT TRANSONIC SPEEDS
G. LEE Oct. 1985 11 p refs
(NASA-TM-86766; REPT-85318; NAS 1.15:86766) Avail: NTIS HC A02/MF A01 CSCL 01A

Computer aided tomography (CAT) provides a means of noninvasively measuring the air density distribution around an aerodynamic model. This technique is global in that a large portion of the flow field can be measured. A test of the applicability of CAT to transonic velocities was studied. A hemispherical-nose cylinder afterbody model was tested at a Mach number of 0.8 with a new laser holographic interferometer at the 2- by 2-Foot Transonic Wind Tunnel. Holograms of the flow field were taken and were reconstructed into interferograms. The fringe distribution (a measure of the local densities) was digitized for subsequent data reduction. A computer program based on the Fourier-transform technique was developed to convert the fringe distribution into three-dimensional densities around the model. Theoretical aerodynamic densities were calculated for evaluating and assessing the accuracy of the data obtained from the tomographic method. Author

N86-13298*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DOUBLE-BRANCHED VORTEX GENERATOR
E. R. CANTWELL, R. V. WESTPHAL, and R. D. MEHTA (Stanford Univ., Calif.) Nov. 1985 25 p refs
(NASA-TM-88201; REPT-86064; NAS 1.15:88201) Avail: NTIS HC A02/MF A01 CSCL 01A

In order to assess the suitability of using a double branched vortex generator in parametric studies involving vortex interactions, an experimental study of the main vortex and secondary flows produced by a double branched vortex generator was conducted in a 20-by-40 cm indraft wind tunnel. Measurements of the cross flow velocities were made with a five hole pressure probe from which vorticity contours and vortex parameters were derived. The results showed that the optimum configuration consisted of chord extensions with the absence of a centerbody. Author

N86-13299*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GROUND EFFECTS ON V/STOL AND STOL AIRCRAFT: A SURVEY
R. E. KUHN and J. ESHLEMAN Nov. 1985 27 p refs
(NASA-TM-86825; A-85356; NAS 1.15:86825) Avail: NTIS HC A03/MF A01 CSCL 01A

The flow fields encountered by jet- and fan-powered Vertical/Short Takeoff and Landing (V/STOL) aircraft operating in ground effect are reviewed and their general effects on the aerodynamic characteristics are discussed. The ground effects considered include: (1) the suckdown experienced by a single jet configuration in hover; (2) the fountain flow and additional suckdown experienced by multiple jet configurations in hover; (3) the ground vortex generated by jet and jet flap configurations in short takeoff and landing (STOL) operation and the associated aerodynamic and hot-gas-ingestion effects; and (4) the change in the downwash at the tail due to ground proximity. After over 30 years of research on V/STOL aircraft, the general flow phenomena are well known and, in most areas, the effects of ground proximity can be established or can be determined experimentally. However, there are some anomalies in the current data base which are discussed. Author

N86-13300*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
A DIRECT-INVERSE METHOD FOR TRANSONIC AND SEPARATED FLOWS ABOUT AIRFOILS Final Report
L. A. CARLSON Dec. 1985 80 p refs
(Contract NSG-1174)
(NASA-CR-176403; NAS 1.26:176403; TAMRF-3224-85-12)
Avail: NTIS HC A05/MF A01 CSCL 01A

A direct-inverse technique and computer program called TAMSEP that can be sued for the analysis of the flow about airfoils at subsonic and low transonic freestream velocities is presented. The method is based upon a direct-inverse nonconservative full potential inviscid method, a Thwaites laminar boundary layer technique, and the Barnwell turbulent momentum integral scheme; and it is formulated using Cartesian coordinates. Since the method utilizes inverse boundary conditions in regions of separated flow, it is suitable for predicing the flowfield about airfoils having trailing edge separated flow under high lift conditions. Comparisons with experimental data indicate that the method should be a useful tool for applied aerodynamic analyses. Author

N86-13301# Royal Aircraft Establishment, Farnborough (England).
STUDIES OF THE FLOW FIELD NEAR A NACA 4412 AEROFOIL AT NEARLY MAXIMUM LIFT
R. C. HASTINGS and B. R. WILLIAMS Dec. 1984 35 p
(AD-A157750; RAE-TM-AERO-2026; DRIC-BR-96009) Avail: NTIS HC A03/MF A01 CSCL 02D

Measurements made at a Mach number of 0.18 and a chord-based Reynolds number of 4.2 x million on a constant-chord model having a NACA 4412 aerofoil section are described and compared with the results of flow field calculations. Both the experimental arrangement and the difficulties initially experienced in achieving an adequate approximation to two-dimensional flow above the wing are briefly outlined. The measurements include static pressure distributions on the wing surface and on the wind tunnel walls above and below the mid-span section of the wing. The main emphasis in the experiment was, however, on defining the development of the upper surface boundary layer through separation (at about 20% chord ahead of the trailing-edge) and on into the wake, making extensive use of laser anemometry. The flow field calculations are the semi-inverse kind in which an inverse momentum-integral treatment of the shear flow, used to avoid difficulties at separation, is coupled to a direct solution of the inviscid flow problem. The main features of the method are outlined. GRA

N86-13302# Royal Aircraft Establishment, Bedford (England).
RECENT EXPERIENCE IN THE RAE (ROYAL AIRCRAFT ESTABLISHMENT) 5-METRE WIND TUNNEL OF A CHINA CLAY METHOD FOR INDICATING BOUNDARY LAYER TRANSITION
I. R. M. MOIR Aug. 1984 11 p
(AD-A157943; RAE-TM-AERO-2007; DRIC-BR-94478) Avail: NTIS HC A02/MF A01 CSCL 14B

The china clay method is based on the differential rate of evaporation, beneath laminar and turbulent boundary layers, of a liquid absorbed on a solid spread on the surface. The liquid is chosen to have a similar refractive index to the solid so that the mixture appears to be transparent until evaporation has taken place, when the color of the solid becomes visible. The solid layer consists of china clay powder mixture with certain chemicals to form a lacquer, which is sprayed onto the surface. When dry, this forms a semi-permanent white absorbent film. A suitable liquid sprayed on to this film is absorbed by it, causing it to become transparent. Details of a visual method for indicating boundary layer transition are given, with particular reference to tests at high Reynolds number in the RAE 5-meter pressurized low-speed wind tunnel on a slender-body model. The method is compared with other techniques on the basis of ease of use and quality of the indication. GRA

N86-13303# Institut de Mecanique des Fluides de Lille (France).
STUDY OF THE INFLUENCE OF AN OSCILLATING SPOILER ON THE SURROUNDING AERODYNAMIC FIELD [ETUDE DE L'INFLUENCE D'UNE PROTUBERANCE DE PAROI OSCILLANTE SUR LE CHAMP AERODYNAMIQUE ENVIRONNANT]
O. RODRIGUEZ and J. M. DESSE 12 Nov. 1984 69 p refs In FRENCH
(Contract DRET-83-250)
(IMFL-3119) Avail: NTIS HC A04/MF A01

Transonic wind tunnel tests were carried out on a wall protuberance vibrating with sinudoidal oscillations. The experiments studied spoiler efficiency. The unsteady phenomena following the sinusoidal excitation were studied by ultrafast visualization and by unsteady pressure measurement on the obstacle. The free stream Mach number was 0.5. Spectrum analysis proves the nonlinear nature of the flow. The dimension of the separated flow region varies with the position of the spoiler on the body. The results show that at the frequences considered the response to the oscillations can be studied in steady flow tests. Author (ESA)

N86-13304*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRESSURE-DISTRIBUTION MEASUREMENTS ON A TRANSONIC LOW-ASPECT RATIO WING
E. R. KEENER Sep. 1985 77 p refs
(NASA-TM-86683; REPT-85131; NAS 1.15:86683) Avail: NTIS HC A05/MF A01 CSCL 01A

Experimental surface pressure distributions and oil flow photographs are presented for a 0.90 m semispan model of NASA/Lockheed Wing C, a generic transonic, supercritical, low aspect ratio, highly 3-dimensional configuration. This wing was tested at the design angle of attack of 5 deg over a Mach number range from 0.25 to 0.96, and a Reynolds number range from 3.4 x 1,000,000 to 10 x 1,000,000. Pressures were measured with both the tunnel floor and ceiling suction slots open for most of the tests but taped closed for some tests to simulate solid walls. A comparison is made with the measured pressures from a small model in high Reynolds number facility and with predicted pressures using two three dimesional, transonic full potential flow wing codes: design code FLO22 (nonconservative) and TWING code (conservative). At the given design condition, a small region of flow separation occurred. At a Mach number of 0.82 the flow was unseparated and the surface flow angles were less than 10 deg, indicating that the boundary layer flow was not 3-D. Evidence indicate that wings that are optimized for mild shock waves and mild pressure recovery gradients generally have small 3-D boundary layer flow at design conditions for unseparated flow. Author

03

AIR TRANSPORTATION AND SAFETY

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

A86-13452
AIR TRAFFIC PREDICTION AND OPTIMAL CONTROL OF AIR TRANSPORTATION SYSTEM [PROGNOZIROVANIE AVIAPOTOKOV I OPTIMIZATSIIA UPRAVLENIIA VOZDUSHNOI TRANSPORTNOI SISTEMOI]
R: G. LEONTEV Moscow, Izdatel'stvo Nauka, 1984, 184 p. In Russian. refs

The theoretical and practical methods of the planning and optimization of the transportation of passengers by air are reviewed, as are the planning of airport networks and the regional planning of civil aviation facilities. In particular, attention is given to the selection of the most efficient numerical methods of problem solving, the formulation of optimization criteria, and the development of computational algorithms and computer software. V.L.

A86-14237*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GROUND-SIMULATION INVESTIGATION OF VTOL AIRWORTHINESS CRITERIA FOR TERMINAL AREA OPERATIONS
J. V. LEBACQZ (NASA, Ames Research Center, Moffett Field, CA) and B. C. SCOTT (FAA, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Nov.-Dec. 1985, p. 761-767. Previously cited in issue 20, p. 2849, Accession no. A84-42353. refs

A86-14427*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ICE SHAPES AND THE RESULTING DRAG INCREASE FOR A NACA 0012 AIRFOIL
W. OLSEN, R. SHAW, and J. NEWTON (NASA, Lewis Research Center, Cleveland, OH) AIAA, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 30 p. Previously announced in STAR as N85-27839. refs
(AIAA PAPER 84-0109)

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

A86-15308
RESPONSE DETERMINATION OF PROPELLER TO BIRD STRIKE USING HIGH SPEED PHOTOGRAPHY
R. S. BERTKE (Dayton, University, OH) and R. L. EDINGER (TRW, Inc., Hartzell Propeller Products Div., Piqua, OH) IN: High speed photography, videography, and photonics II; Proceedings of the Meeting, San Diego, CA, August 21, 22, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 4-8.

Static bench type impact tests of 4.0 and 1.5 pound artificial birds striking the leading edge of composite propeller blades are conducted to determine the damage response of the blades to bird strike. The artificial birds (cylindrical in shape) are launched at velocities up to 900 ft/sec (275 m/sec) to demonstrate that composite construction propeller blades will pass the Federal Aviation Administration (FAA) bird strike requirements. A high speed framing camera is used to determine the impact velocity of the birds, maximum tip deflections, bird/blade contact time, and the elapsed time required to achieve maximum deflection. Author

N86-12212*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN ANALYSIS OF THE APPLICATION OF AI TO THE DEVELOPMENT OF INTELLIGENT AIDS FOR FLIGHT CREW TASKS
S. BARON and C. FEEHRER Washington NASA Oct. 1985 114 p refs
(Contract NAS1-17335)
(NASA-CR-3944; NAS 1.26:3944) Avail: NTIS HC A06/MF A01 CSCL 05H

This report presents the results of a study aimed at developing a basis for applying artificial intelligence to the flight deck environment of commercial transport aircraft. In particular, the study was comprised of four tasks: (1) analysis of flight crew tasks, (2) survey of the state-of-the-art of relevant artificial intelligence areas, (3) identification of human factors issues relevant to intelligent

cockpit aids, and (4) identification of artificial intelligence areas requiring further research. Author

N86-12213# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
G PROTECTION BY AN EXTREME CROUCH POSITION Phase Report, 1 Aug. 1983 - 1 Sep. 1984
H. J. VONBECKH 4 Sep. 1984 14 p
(Contract NR PROJ. F58-523)
(AD-A157081; NADC-84162-60) Avail: NTIS HC A02/MF A01 CSCL 06S

In World War II the pilots of diving bombers tolerated high G loads by assuming a crouch position. The Dynamic Flight Simulator (Human Centrifuge) was used to prove the advantages of the crouch position. Two subjects were located in an extreme crouch position, the upper spine being at an angle of 80 to 90 degrees from the vertical. They tolerated 6.5 and 7.5 G respectively. Both subjects have tolerated only 3.5 G in former experiments when seated upright. The use of an Anti-G suit did not improve further G tolerance. Both subjects abandoned the experiment not because of the Loss of Vision, but because of the discomfort of overfilling of the facial area with blood. It is planned to find a crouch position where the vision is still maintained and the blood filling of the facial area is mitigated. This would probably be a crouch position of 45 to 60 degrees from the vertical. Author (GRA)

N86-12214# Federal Aviation Agency, Atlantic City, N.J.
AIRCRAFT INTERIOR PANEL TEST CRITERIA DERIVED FROM FULL-SCALE FIRE TESTS Final Report
R. G. HILL, T. I. EKLUND, and C. P. SARKOS Sep. 1985 65 p refs Original contains color illustrations
(FAA/CT-85/23) Avail: NTIS HC A04/MF A01

Full scale cabin fire tests were conducted to determine potential increases in passenger survivability associated with different interior honeycomb panel constructions. The test fuselage was a C-133 with a simulated wide body door opening exposed to an 8 foot by 10 foot fuel fire. In the first series, the interior near the door was lined with the honeycomb panels to determine whether earlier studies performed with small scale enclosures were consistent with the full scale counterpart. These earlier studies resulted in the selection of the Ohio State University (OSU) Rate of Heat Release Apparatus as the most appropriate type test to evaluate aircraft panels. The first series was followed by tests that included fire blocked seats and carpeting as well as the panels to determine the type survivability increases that could be attained from low heat release materials. The scenario employed generally resulted with flashover within 2 minutes for panels considered typical in performance. A low heat release phenolic/fiberglass panel demonstrated a flashover delay until about 4 minutes into the test. An incombustible panel prevented flashover altogether. The performance of the various panels was evaluated to develop recommended flammability criteria for a modified OSU Rate of Heat Release Apparatus. Author

N86-12215# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.
FAA (FEDERAL AVIATION ADMINISTRATION) COULD IMPROVE OVERALL AVIATION SAFETY AND REDUCE COSTS ASSOCIATED WITH AIRPORT INSTRUMENT LANDING SYSTEMS
3 Apr. 1985 50 p
(PB85-195444; GAO/RCED-85-24; B-215115) Avail: NTIS HC A03/MF A01 CSCL 01E

The Federal Aviation Administration (FAA) operates and maintains over 700 instrument landing systems at airports throughout the United States. The Government Accounting Office (GAO) found that FAA could save about $31 million between now and the year 2000 if it replaced some of its older instrument landing systems with newer systems, which are less costly to operate. GAO also found that FAA could improve overall aviation safety and reduce cost by ensuring that existing systems are located where they are needed most. GRA

N86-13305*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED EMERGENCY OPENINGS FOR COMMERCIAL AIRCRAFT
L. J. BEMENT and M. L. SCHIMMEL Nov. 1985 18 p refs Presented at the 30th Corporate Aviation Safety Seminar, Dallas, Texas, 14-16 Apr. 1985
(NASA-TM-87580; L-16012; NAS 1.15:87580) Avail: NTIS HC A02/MF A01 CSCL 01C

Explosively actuated openings in composite panels are proposed to enhance passenger survivability within commercial aircraft by providing improvements in emergency openings, fuselage venting, and fuel dump. The concept is to embed a tiny, highly stable explosive cord in the periphery of a load-carrying composite panel; on initiation of the cord, the panel is fractured to create a well-defined opening. The panel would be installed in the sides of the fuselage for passenger egress, in the top of the fuselage for smoke venting, and in the bottoms of the fuel cells for fuel dump. Described are the concerns with the use of explosive systems, safety improvements, advantages, experimental results, and recommended approach to gain acceptance and develop this concept. Author

N86-13306* Ecosystems International, Inc., Crofton, Md.
NASA FLIGHT OPERATIONS REVIEW Final Report
Sep. 1985 113 p Sponsored by NASA
(NASA-CR-176393; NAS 1.26:176393) Avail: Issuing Activity CSCL 01C

Independent assessments of the provisions taken by NASA to assure the safety of their aviation operations are reported. Aviation operations conducted at the Lewis Research Center (LeRC) are reviewed. These reviews and independent assessments were undertaken as part of an on-going effort to provide NASA management with a qualitative evaluation of the overall organizational structure, administrative policy. A report which provides NASA management with a broad overview of the current status and safety of aviation operations at LeRC is presented. Recommendations for improvements are provided whenever a significant impact on the present level of safety assurance is judged to be feasible, or an existing situation has the potential for creating a hazardous condition. E.A.K.

N86-13307# Department of the Navy, Washington, D. C.
PASSIVE ARM RETENTION CURTAIN Patent Application
T. J. ZENOBI, inventor (to Navy) 2 Nov. 1984 12 p
(AD-D011876; US-PATENT-APPL-SN-667685) Avail: NTIS HC A02/MF A01 CSCL 01C

A pilot arm retention system for an aircraft ejection seat which includes inertia reels and a parachute is comprised of a pair of nets connected between respective sides of the seat and a pair of deployment straps which are releasably coupled to the inertia reel straps and parachute risers and routed down over the front of the seat through a pair of snubbers to fixed points on the cockpit floor. Author (GRA)

N86-13308# Institut de Mecanique des Fluides de Lille (France).
AIRCRAFT CRASHING. ANALYSIS AND IDENTIFICATION METHODS. PRESENTATION OF A SOLUTION METHOD [CRASH D'AVIONS. METHODES D'ANALYSE ET D'IDENTIFICATION. PRESENTATION D'UNE METHODOLOGIE DE RESOLUTION]
P. GEOFFROY and E. HAUG (ESI SA) 19 Feb. 1985 102 p refs In FRENCH
(Contract DRET-83-452)
(IMFL-4116) Avail: NTIS HC A06/MF A01

An aircraft landing crash with a vertical velocity 5 m/sec is discussed. The tail section is assumed to make first contact. The nonlinear aspect of the problem is emphasized and a numerical solution is worked out. Superelements methods are found to be best suited to the problem. They conserve existing programs and finite element computations. An identification method is used to adjust the physical parameters in the superelements. The

implementation of these techniques in the NL-CRASH program is proposed. Author (ESA)

N86-13617# Joint Publications Research Service, Arlington, Va.
CERTIFICATION GRANTED TO FRANCO-ITALIAN ATR 42
In its West Europe Rept.: Sci. and Technol. (JPRS-WST-85-031) p 10-13 8 Nov. 1985 Repr. from Rev. Aerospatiale (France), Oct. 1985 p 10; 12
Avail: NTIS HC A03/MF A01

The Franco-Italian (Aerospatiale/Aeritalia) ATR-42 commercial aircraft has been granted certification. The first production model was to be delivered in November 1985. The joint European venture expects to capture a generous share of the expected market (into the year 2000) of 2200 thirty-fifty and over 100 fifty-seventy passenger aircraft. F.M.R.

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A86-12677
USING ROLL-ANGLE MEASUREMENTS TO TRACK AIRCRAFT MANEUVERS
C. C. LEFAS (Ministry of Physical Planning, Housing, and Environment, Athens, Greece) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-20, Nov. 1984, p. 672-681. Research supported by Eurocontrol. refs

Present day radar trackers used for air traffic control purposes perform satisfactorily during straight-line flight, but their performance during maneuvers is sometimes degraded. The introduction of the secondary surveillance radar mode S system makes transmission of several airborne measurements to the ground station possible. This paper investigates the use of one such parameter, roll angle, to assist present trackers during maneuvers to achieve accuracies comparable to those achieved during straight-line flight. Author

A86-12698*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELT ANTENNA GAIN DISTRIBUTIONS UNDER SIMULATED CRASH CONDITIONS
H. ESTEP (NASA, Goddard Space Flight Center, Greenbelt, MD) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-20, Nov. 1984, p. 841-843.

A study of the relative merits of ELT antenna positions, when mounted on a small aircraft, is presented. The gain distribution of the best antenna position together with the worst crash scenario is also given. Author

A86-13216
THE RAJPO GPS RANGE EQUIPMENT FAMILY
D. L. HOLEMAN and E. G. BLACKWELL (SRI International, Menlo Park, CA) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 173-181.

Equipment that is to be developed by the Global Positioning System (GPS) Range Applications Joint Program Office (RAJPO) for use on test and training ranges is discussed. The purpose of the tri-service program is to develop a family of modules that can be assembled to provide GPS time-space position-information determination functions. The RAJPO is sponsoring development of specific configurations of the equipment to demonstrate GPS integration concepts on several existing and planned range systems, including the Army Mobile Automated Field Instrumentation System (MAFIS) at Fort Hood, the Air Force Gulf Range Drone Control Upgrade System (GRDCUS) at Tyndall AFB, the Navy Extended Area Test System (EATS) at the Pacific Missile Test Center, the Air Force Advanced Range Data System (ARDS) at Edwards AFB, and the Navy/Air Force Tactical Aircrew Combat Training System/Air Combat Maneuvering Instrumentation (TACTS/ACMI) at a location to be determined. D.H.

A86-13217
CORRELATION OF GPS RECEIVER CHANNEL TRACK CONTINUITY WITH AIRCRAFT STRUCTURAL MASKING
E. G. BLACKWELL, E. T. FICKAS, and D. Y. RICHARDSON (SRI International, Menlo Park, CA) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 189-197.
(Contract DAEA18-81-G-0062)

A GPS receiver with antennas located in an aircraft-mounted pod will be subject to signal blockage due to masking of the GPS satellite constellation by the aircraft structure. Analysis of aircraft flight test data involving a wing-mounted GPS antenna has shown that most of the receiver's loss-of-lock occurrences can be correlated with the optical shadow of the aircraft. Shadow regions of various tactical aircraft are used to estimate the extent of tracking outages for GPS pod antennas with the full 18-satellite constellation. Author

A86-13224
AN OVER THE HORIZON COMMAND/DATA LINK SYSTEM
W. C. TURNER (Electro Magnetic Processes, Inc., Chatsworth, CA) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 327-340.

A three channel iink, L-band, MDI band, and S-band, over which command, television, and telemetry are transmitted over a 100 mile range is discussed. A general description and diagram of the over the horizon command/data link system utilizing a three channel link is presented. The components and functions of the shore station, aircraft repeater station, and ship's station are described. Range altitude coverage profiles for the shore station and ship's station, revealing the range of each antenna, are provided. Techniques for determining antenna selection and location, and the selection of link transmitter power and system noise figure to achieve a carrier-to-noise ratio of ratio of 12dB or greater are analyzed. Link budgets for two paths of the over-the-horizon relay link are given. Design parameters for an over the horizon microwave link are listed. I.F.

A86-13225
AIRBORNE TELEMETRY - THE ADVANCED RANGE INSTRUMENTATION AIRCRAFT
L. G. AVERY, JR. (USAF, ARIA Programs Div., Wright-Patterson AFB, OH) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 341-347.

The ARIA which tracks and obtains telemetry data to support lunar missions, orbital vehicles, and ballistic and cruise missiles with nonreal-time and real-time coverage is discussed. The ARIA contains a 30,000 pound modular package of instrumentation subsystems, Prime Mission Electronic Equipment (PMEE). The functions of the antenna, radio frequency, record, timing, communications, and data separation subsystems and the master control console of PMEE are described. Improvements in the PMEE, and cruise missile, Pershing II, and airframe modifications are examined. Proposed modifications to the ARIA fleet include: the use of C-18 airframes; a cruise missile mission control aircraft; an advanced medium-range air-to-air missile; and a sonobuoy missile impact location system. I.F.

A86-13226
AN INTEGRATED SOLUTION FOR FLIGHT TEST DATA HANDLING
W. E. DUNN (Fairchild Weston Systems, Inc., Sarasota, FL) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 349-362.

An integrated airborne/ground data acquisition and processing system is being implemented for McClellan AFB. This Flight Data Acquisition and Processing System is capable of gathering large amounts of varied types of instrumentation data during F-111 test flights and providing general purpose computer processing of the test data results. A programmable PCM data acquisition system was developed along with companion acquisition systems for monitoring the F-111 SRAM, MARK II, PAVETACK, and MIL-STD-1553 on board computer busses. The information is stored on an IRIG instrumentation recorder for subsequent processing and display by a DEC VAX 11/780 computer in the ground station. The VAX in the ground station is supported by multiple programmable preprocessors for data compression/engineering unit conversion and a specially developed software system provides a unique integration of the airborne/ground system capabilities via a parameter data base. A special capability of the system is the ability to process a typical flight tape utilizing a single playback of the instrumentation tape at the recorded speed. Author

A86-13227
AN EXTENDED PHASE-LOCK TECHNIQUE FOR AIDED ACQUISITION
S. BARBOUR (Figgie International, Inc., Hartman Systems Div., Huntington Station, NY) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 363-370.

A novel approach is described to extend the threshold for a phase-locked loop designed for a particular telemetry receiver. By phase remodulating the error signal, the network reduces the phase swing of the signal and restores the carrier power so as to provide anti-sideband properties for biphase and PM modulation up to 1.3 radians deviation at all modulation frequencies and at a signal level where CNR is greater than 5 dB above PM threshold. D.H.

A86-13230
THE USE OF TRANSLATORS WITH GPS
E. E. WESTERFIELD (Johns Hopkins University, Laurel, MD) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 391-396.

An alternative approach is described that can obviate putting expensive receivers onboard expendable platforms to use the Air Force Global Positioning System (GPS) for position and velocity determination. If either a translator or a transdigitizer is used in the vehicle under test, signals transmitted by GPS satellites are received by vehicle antennas, translated to a frequency in the telemetry band, amplified, and transmitted to a receiving station. Specially designed receiving equipment on the ground processes the transmissions from the translator/transdigitizer, tracks the transmissions from each satellite, and makes the measurements necessary to allow computation of the platform position and velocity. Systems concepts are discussed and two current systems - one using a translator in a missile and the other a transdigitizer in a sonobuoy - are described in detail. D.H.

A86-13576
REQUIREMENTS FOR GYROSCOPES FOR INERTIAL NAVIGATION
J. D. NUTTALL (Ferranti Defence Systems, Ltd., Edinburgh, Scotland) IEE Proceedings, Part J - Optoelectronics (ISSN 0267-3932), vol. 132, pt. J, no. 5, Oct. 1985, p. 250-254.

Work regarding the fiber-optic rotation sensor is now proceeding at an estimated forty or fifty institutions in the UK, U.S., and Western Europe. Many of the institutions have had no previous experience of rotation sensors (or gyroscopes, as they are traditionally called), while some workers in the field have little idea of the current state-of-the-art of mechanical ('spinning mass') gyros and ring laser gyros (RLGs). It is pointed out that this paper is intended as a briefing for such people, taking into account the performance needed from a gyroscope suitable for use in inertial navigation today. The gimballed and strapdown systems of inertial navigation are discussed along with the use of a gyroscope for north finding, the operation of gyros with and without torquers, requirements on maximum detectable rotation rate, requirements on scale factor accuracy, gyro drift or bias, and some examples of real gyros. G.R.

N86-12216*# Ohio State Univ., Columbus. ElectroScience Lab.
SIMULATION OF THE ENHANCED TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS 2) Semiannual Report
R. G. ROJAS, W. D. BURNSIDE, P. LAW, and B. GRANDCHAMP Sep. 1985 86 p refs
(Contract NSG-1498)
(NASA-CR-176328; NAS 1.26:176328; SAR-716199-3) Avail: NTIS HC A05/MF A01 CSCL 17G

The OSU aircraft code is used to analyze and simulate the TCAS 2 circular array which is mounted on the fuselage of a Boeing 737 aircraft. It is shown that the sum and difference patterns radiated by the circular array are distorted by the various structures of the aircraft, i.e., wings, tail, etc. Furthermore, monopulse curves are calculated and plotted for several beam positions and THETA angles. As expected, the worst cases of distortion occur when the beams are pointed toward the tail of the aircraft. Author

N86-13309# Aeronautical Research Labs., Melbourne (Australia).
AN ANALYTICAL COMPARISON OF THREE VISUAL APPROACH SLOPE INDICATORS: VASIS, T-VASIS AND PAPI
J. MILLAR Aug. 1984 56 p refs Original contains color illustrations
(ARL/SYS-R-33; AR-003-963; SR-33) Avail: NTIS HC A04/MF A01

The three Visual Approach Slope Indicators (VASIs), VASIS, T-VASIS and PAPI, approved by the international Civil Aviation Organization (ICAO) for use by turbojet aeroplanes are compared. The discussion is based upon published performance data including approach path measurements and pilot opinion, ergonomics and the ability to fulfill operational requirements. It is concluded from flight trial data and operational experience that T-VASIS is a more precise and sensitive aid than Red-White VASIS which has several deficiencies. The current policy of not using Red-White VASIS for routine operations in Australia is supported by the conclusions. It is predicted that PAPI also will be less satisfactory than T-VASIS. This prediction is based mainly on ergonomic principles. Performance data about PAPI is limited and consists mainly of relatively uninformative pilot acceptance surveys. Because insufficient objective parameters describing trajectories of aircraft from the intended user-population have been published, most of the claims for PAPI superiority remain unsubstantiated. Accordingly, it is recommended that PAPI be evaluated using objective measures in a controlled experimental environment with transport aircraft. Author

N86-13310*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
THE EVALUATION OF FAILURE DETECTION AND ISOLATION ALGORITHMS FOR RESTRUCTURABLE CONTROL Interim Report, Dec. 1983 - May 1984
P. MOTYKA, W. BONNICE, S. HALL, and E. WAGNER Aug. 1984 207 p refs
(Contract NAS1-17556)
(NASA-CR-177983; NAS 1.26:177983; CSDL-R-1799) Avail: NTIS HC A10/MF A01 CSCL 01C

Three failure detection and identification techniques were compared to determine their usefulness in detecting and isolating

failures in an aircraft flight control system; excluding sensor and flight control computer failures. The algorithms considered were the detection filter, the Generalized Likelihood Ratio test and the Orthogonal Series Generalized Likelihood Ratio test. A modification to the basic detection filter is also considered which uses secondary filtering of the residuals to produce unidirectional failure signals. The algorithms were evaluated by testing their ability to detect and isolate control surface failures in a nonlinear simulation of a C-130 aircraft. It was found that failures of some aircraft controls are difficult to distinguish because they have a similar effect on the dynamics of the vehicle. Quantitative measures for evaluating the distinguishability of failures are considered. A system monitoring strategy for implementing the failure detection and identification techniques was considered. This strategy identified the mix of direct measurement of failures versus the computation of failure necessary for implementation of the technology in an aircraft system. Author

N86-13311*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DISCOVERY OF THE KALMAN FILTER AS A PRACTICAL TOOL FOR AEROSPACE AND INDUSTRY
L. A. MCGEE and S. F. SCHMIDT Nov. 1985 24 p refs
(NASA-TM-86847; REPT-85424; NAS 1.15:86847) Avail: NTIS HC A02/MF A01 CSCL 17G

The sequence of events which led the researchers at Ames Research Center to the early discovery of the Kalman filter shortly after its introduction into the literature is recounted. The scientific breakthroughs and reformulations that were necessary to transform Kalman's work into a useful tool for a specific aerospace application are described. The resulting extended Kalman filter, as it is now known, is often still referred to simply as the Kalman filter. As the filter's use gained in popularity in the scientific community, the problems of implementation on small spaceborne and airborne computers led to a square-root formulation of the filter to overcome numerical difficulties associated with computer word length. The work that led to this new formulation is also discussed, including the first airborne computer implementation and flight test. Since then the applications of the extended and square-root formulations of the Kalman filter have grown rapidly throughout the aerospace industry. Author

N86-13312# National Airspace System Program Office, Washington, D.C.
NATIONAL AIRSPACE SYSTEM, SYSTEM REQUIREMENTS SPECIFICATION
21 Mar. 1985 209 p
(AD-A157944; NAS-SR-1000) Avail: NTIS HC A10/MF A01 CSCL 01E

The NAS System Requirements Specification (NASSRS) is a compilation of requirements which describe the operational capabilities for the National Airspace System (NAS) as the NAS is envisioned to exist by the year 1995. In that context, it includes those existing and transitional capabilities that will also exist in the 1995 system. It is intended primarily for use as an internal FAA management tool to support the NAS design, engineering, and acquisition activities and to manage and control change to the NAS. The document provides a ground-based systems representation of the proposed operational capabilities planned for the NAS. As programs and subsystems are developed and implemented the capabilities they provide will be compared to this document as a measure of success of NAS Plan Implementation. The contents of the document include: overview; flight planning; traffic control and airspace management; monitoring; navigation; air defense and law enforcement surveillance; aircraft detection and identification; communications; maintenance and support: system effectiveness. GRA

N86-13314# Army Construction Engineering Research Lab., Champaign, Ill.
DESIGN CRITERIA UPGRADE FOR US ARMY TYPE 2 AIR TRAFFIC CONTROL TOWERS Final Report
T. R. NAPIER, W. E. BACK, and M. MCCULLEY Jun. 1985 72 p
(AD-A159115; CERL-TR-P-85/13) Avail: NTIS HC A04/MF A01 CSCL 17G

This report documents research conducted to identify problem areas in; the design of existing Type 2 Air Traffic Control Tower (ATCT) installations and to develop standard design criteria to avoid these problems in future installations. Many design problem areas were identified in the ATCT structure's architectural design, substructure, superstructure, roof systems, exterior walls, interior construction, mechanical systems, electrical systems, and air traffic control interfaces. For each of these areas, specific solutions to the problems were recommended. However, incorporation of these solutions must consider a specific site location and environmental conditions. GRA

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A86-13052#
F-4 FUNCTIONAL MODERNIZATION
W. D. POULIN (United Technologies Corp., Government Products Div., West Palm Beach, FL) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 815-820.
(ASME PAPER 85-GT-69)

Attention is given to the F-4 'Super Phantom' as an exemplary case of the functional modernization of an existing aircraft, as an alternative to the more expensive acquisition of new types. The F-4 modernization package considered in the present feasibility study encompasses a novel centerline (conformal) fuel tank, digital avionics, and PW1120 reengining for greater thrust. The reengining, in particular, leads to a 1:1 thrust-to-weight ratio, which is deemed capable of sustaining fighter survivability against threats anticipated through the 1990s. The performance levels obtained are comparable to those of the most recent fighter designs, at less than half the cost. O.C.

A86-13106
STRUCTURAL BONDING WITH POLYSULFIDE ADHESIVE ON B-1B AIRCRAFT
J. FASOLD (Rockwell International Corp., Columbus, OH) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 461-470.

A novel technique has been developed for the bonding of composite antiicing blankets to directionalizing vanes that are located inside the nacelle ducts of the B-1B aircraft. The selection of the adhesive system was based on the ability of the adhesive to allow removal of the blankets from the vane if necessary, while retaining the bond in the severe load spectrum created by the nacelle inlet's vibroacoustic environment. A 100-percent solids polysulfide adhesive was selected on the basis of trade studies, while structural films and pastes were rejected. O.C.

A86-13127
THE USE OF AUTOMATED RIVETING SYSTEMS IN AIRCRAFT CONSTRUCTION
J. MASKOW (Messerschmitt-Boelkow-Blohm GmbH, Hamburg, West Germany) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 855-863.

A riveting system has been developed for spherical surface airframe structures that is fully automated, using an optical sensor which automatically compensates for dimensional variations through adjustment of component tolerances. Also developed is a riveting system for the assembly of clip-to-frame connections which exmploys a numerically controlled positioner with an optical sensor. These systems facilitate the manufacture of longitudinal joint connections on closed aircraft fuselages. O.C.

A86-13213
X-29 FLIGHT TESTING
D. SANGL (Grumman Data Systems Corp., Bethpage, NY) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 139-146.

Attention is given to the methods used to achieve real time flight test monitoring of the NASA X-29 forward swept wing research aircraft, such that flight test analysts and design engineers in Bethpage, NY, were privy to aircraft behavior during flight testing in California. The X-29's telemetry data is PCM at 500 kb/sec, and beamed at a geosynchronous satellite. A transponder channel receives this beam and retransmits it on an antenna that covers most of the U.S. An earth station system at Calverton, NY, receives this signal and regenerates the aircraft PCM signal through a modem. O.C.

A86-13219
TELEMETRY FROM EXPERIMENTAL RESCUE- AND RECOVERY SYSTEMS
H.-J. KLEWE (DFVLR, Institut fuer Flugmechanik, Brunswick, West Germany) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 217-224. refs

Measuring techniques in rescue and recovery systems are mainly applied to parachute and ejection seat systems. Thereby, the measurements of special interest are forces occurring in the suspension lines of parachutes during inflation; accelerations acting on persons to be rescued or on materials to be recovered; the progress of velocities during the retarding of persons, ejection seats, test vehicles and so on; as well as measurements of the static pressure and possibly the outside temperature for the determination of altitudes. Further, the change of the projected area of a parachute during inflation will also be of interest. The data values are transformed by the transducers to analogue electric signals and telemetered to the ground station. To determine the projected area of the parachute during inflation this event is filmed by a high speed film camera which is installed in the rear of the test vehicle. Furthermore, the entire experiment is filmed from the ground by another high speed camera. On request, a cinetheodolite and a tracking radar installation is used additionally to get data concerning rate of descent and trajectory of the parachute-load system. Author

A86-13264
THE INFLUENCE OF ADVANCED PROPULSION ON SHORT- TO MEDIUM-RANGE TRANSPORT DESIGN
G. E. LEDBETTER (Boeing Commercial Airplane Co., Seattle, WA) Aerospace (UK) (ISSN 0305-0831), vol. 12, Oct. 1985, p. 30-32.

The effect of advanced propulsion and improved wings on the design of passenger transport aircraft is examined. A comparison of the effects of bypass ratio on the weight and thrust specific fuel consumption of turbofan and turboprop aircraft with engine cruise thrust of 4000 pounds at M = 0.75 at 3500 ft is presented; the high-speed turboprop is predicted to save 27 percent more fuel than the turbofan. An experiment evaluating the fuel efficiency of six 150-passenger transport aircraft at M = 7.5 at 35,000 ft with a design range of 1700 n mi and wing-mounted or aft-mounted engines, and various wing aspect ratios is described and a graph is provided. The results reveal the improved efficiency of the turboprop over the turbofan for each wing configuration. I.F.

A86-13275
MODELING REALISTIC ENVIRONMENTAL STRESSES ON EXTERNAL STORES
H. W. ALLEN (LTV Aerospace and Defense Co., Dallas, TX) Journal of Environmental Sciences (ISSN 0022-0906), vol. 28, Sept.-Oct. 1985, p. 26-33. refs

This paper presents a method for achieving realism required by recent DOD tailoring documents. Use of this approach can be cost-effective for modeling realistic external-store environmental vibration stresses, where no measured data is available. The emphasis presented herein is in tailoring vibration levels to actual mission-defined captive and free-flight profiles. This approach uses a 'maximum predicted environment' derived from the statistical analyses of 1839 random vibration flight data measurements made on six different external stores. The basic vibration data used in these analyses were measured on six different host aircraft under a wide variety of captive flight conditions. In comparison, the MIL-STD-810D calculated qualification test requirement for an aft-half, MER cluster, air-to-air missile, produced a required testing level greater than twice the maximum predicted environment (overall grms level) for an equivalent missile. Author

A86-13315#
STRAIN MEASUREMENT OF THE USB-FLAP STRUCTURES OF NAL STOL AIRCRAFT
K. EGAWA and M. SANO (National Aerospace Laboratory, Chofu, Japan) IN: International Congress on Experimental Mechanics, 5th, Montreal, Canada, June 10-15, 1984, Proceedings . Brookfield Center, CT, SESA, 1984, p. 236-244. refs

A reversible strain gage was developed for strain measurements in the safety tests of the upper surface blowing type flap structures that are used as high lift devices in new STOL aircraft. The strain gage has a room-temperature curing adhesive on the reverse, allowing it to be used twice, and fulfills the requirements imposed on it by the acoustically excited conditions of the test. In particular, it (1) can be attached at the measuring points without heating to avoid deforming of the test panels, (2) attains more accuracy on the first test run, permitting conductance of one-shot tests, and (3) has high durability. The gage can be used at 150 C for about 110 hours. I.S.

A86-13368
WING STRUCTURE DESIGN FOR MAXIMUM AILERON EFFICIENCY [PROEKTIROVANIE KONSTRUKTSII KRYLA IZ USLOVIIA MAKSIMIZATSII EFFEKTIVNOSTI ELERONOV]
A. V. SHARANIUK and IU. F. IAREMCHUK TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 82-89. In Russian. refs

The objective of the study is to determine the effect of changes in the stiffness of the wing structure on the efficiency of ailerons. The gradient of the aileron efficiency function is determined by using the method of Lagrangian multipliers. A low-aspect-ratio wing is considered as an example, and the aileron efficiency gradient is calculated from the wing stiffness parameters for a constant total mass of the structure, with constraints imposed on the thickness of the isotropic and orthotropic panels and on the stiffness of the beams. V.L.

A86-13369
EQUATIONS OF ROLLING FOR A WHEEL WITH AN ELASTIC TIRE [OB URAVNENIIAKH KACHENIIA KOLESA S UPRUGOI SHINOI]
V. S. GOZDEK TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 90-99. In Russian. refs

The problem of the small oscillations of a rolling wheel with an elastic tire is formulated as a boundary value problem for a partial differential equation. A method is proposed for reducing this problem to a system of ordinary differential equations. A method is also proposed for deriving equations of rolling which approximately allow for the inertia of the deformable tire. V.L.

A86-13371
CHARACTERISTICS OF THE LIFTING PROPERTIES OF AIRCRAFT WITH SWEPTFORWARD WINGS AT SUPERSONIC VELOCITIES [OSOBENNOSTI NESUSHCHIKH SVOISTV SAMOLETOV S KRYL'IAMI OBRATNOI STRELOVIDNOSTI PRI SVERKHZVUKOVYKH SKOROSTIAKH]
A. A. GLADKOV and R. A. RATNER TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 109-113. In Russian. refs

The lifting force distributions over the elements of schematic aircraft configurations with swept and sweptforward wings are compared for the case of supersonic flow using the panel method. It is shown that the main difference between the two wing configurations consists in the body-wing interference pattern. It is further shown that the difference between the lifting properties of the two types of wings becomes less pronounced with increasing Mach numbers. V.L.

A86-13421
ANALYTICAL METHOD FOR CONSIDERING THE ELASTICITY OF THE BLADES IN THE AERODYNAMIC CALCULATION OF A HELICOPTER PROPELLER [ANALITICHESKII METOD UCHETA UPRUGOSTI LOPASTEI V ZADACHE AERODINAMICHESKOGO RASCHETA NESUSHCHEGO VINTA VERTOLETA]
V. S. VOZHDAEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 99-112. In Russian. refs

Approximate analytical solutions of the partial differential equations of the combined bending and torsional vibrations of a propeller blade are obtained along with instantaneous coefficients for the influence of circulations on the vertical displacements and elastic-twist angles of blade elements. These solutions are obtained on the basis of periodic solutions of second-order differential equations, reduced to integral operators transforming the input force excitation into the periodic response of the system. The problem thus becomes one of the aerodynamic calculation of an absolutely rigid propeller with allowance for the effect of elasticity in the influence-function matrix of induced velocities. B.J.

A86-13437
DESIGN OF A MINIMUM-WEIGHT GLIDING WING [PROEKTIROVANIE SKOL'ZIASHCHEGO KRYLA MINIMAL'NOI MASSY]
N. V. BANICHUK, V. I. BIRIUK, and I. I. KOANDE TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 71-76. In Russian.

The problem of the optimal distribution of the stiffness characteristics over the span of a gliding swept wing is solved according to a minimum-weight criterion. Constraints are imposed on the aerodynamic load-bearing capacity of the wing and on the difference of moments between cantilevers of the wing. The influence of different structural parameters on the optimal solution is examined. B.J.

A86-13438
OPTIMIZATION OF STRUCTURAL LOAD-BEARING DESIGNS USING ANISOTROPIC MODELS ACCORDING TO AEROELASTICITY CONDITIONS [OPTIMIZATSIIA KONSTRUKTIVNO-SILOVYKH SKHEM PRI ISPOL'ZOVANII ANIZOTROPNYKH MODELEI PO USLOVIIAM AEROUPRUGOSTI]
V. I. BIRIUK and A. V. SHARANIUK TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 77-84. In Russian. refs

The optimization of the structural load-bearing designs of wings according to aeroelasticity conditions using anisotropic models is considered. The wing panels are modeled as an orthotropic plate of variable stiffness; the optimal orientation angle of the anisotropy axes corresponding to the largest of the moduli is determined for this plate under the condition of the maximization of either the efficiency of the transverse-control elements or the critical flutter velocity (or divergence). Examples of the choice of the optimal orientation of the anisotropy axes for swept wings are presented. B.J.

A86-14161
THRUST AND DRAG: ITS PREDICTION AND VERIFICATION
E. E. COVERT, ED. (MIT, Cambridge, MA) New York, AIAA (Progress in Astronautics and Aeronautics. Volume 98), 1985, 358 p. No individual items are abstracted in this volume.

A survey and critical review of the state of the art in prediction and verification of thrust and drag of jet-propelled aircraft is presented. The subjects addressed include: thrust-drag accounting methodology, gas turbine engine performance determination, prediction and verification of aerodynamic drag, throttle-dependent forces, and precision and propagation of errors. A brief historic perspective on the estimation and prediction of drag and on the turbojet engine is also provided. C.D.

A86-14245*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POWERED-LIFT TECHNOLOGY ON THE THRESHOLD
W. H. DECKERT and J. A. FRANKLIN (NASA, Ames Research Center, Moffett Field, CA) Aerospace America (ISSN 0740-722X), vol. 23, Nov. 1985, p. 34-38, 40, 42.

A design configuration study and comparative performance evaluation is presented for current and planned V/STOL military aircraft and their powerplant and control systems, with a view to the effect of the operational capabilities uniquely furnished by such aircraft for battlefield tactics. Attention is given to V/STOL naval aircraft and the carrier or ship's deck conditions under which they must be able to operate. Thrust-vectoring and tilt rotor configurations are the most prominent among successful experimental and operational aircraft of this type; cargo aircraft have most often incorporated short/rough airfield operation capabilities rather than full VTOL. A major development thrust has been mounted for a supersonic short takeoff/vertical landing aircraft. O.C.

A86-14356#
THE IN-FLIGHT SIMULATION PROGRAM AT THE NAE FLIGHT RESEARCH LABORATORY
M. SINCLAIR, M. MORGAN, and S. KERELIUK (National Aeronautical Establishment, Ottawa, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, June 1985, p. 116-124. refs

The Canadian National Aeronautical Establishment's In-Flight Simulator is an adaptable flight mechanics facility serving in a wide range of aircraft and flight system research roles relevant to V/STOL systems. Three specially instrumented airborne simulation helicopters are used in this research work, which has recently encompassed the testing of a multimode matrix display, pilot workload studies, the design and performance of multiaxis side-arm controllers, and helicopter instrument flight handling qualities. O.C.

A86-14361
7J7 - BOEING SETS THE PACE
J. MOXON Flight International (ISSN 0015-3710), vol. 128, Oct. 26, 1985, p. 24-28.

Attention is given to novel technologies' incorporation in the B-7J7 150-seat airliner, which is scheduled for delivery in 1992 and will feature the use of contrarotating unducted fan (UDF) powerplants. The UDF is expected to furnish the greater part of the 40-percent fuel efficiency improvement projected for the 7J7. Other advanced technologies will encompass fly-by-wire/fly-by-light controls with a direct optical link between sensors and controllers, a high speed data bus for cockpit, systems and computer communications, and aluminum-lithium alloy and graphite/epoxy primary structures. O.C.

A86-14423
THE 'SUPER ETENDARD' IS ALWAYS OF INTEREST [LE 'SUPER ETENDARD' EST TOUJOURS D'ACTUALITE]
J. MORISSET and R. NAZARETIAN Air et Cosmos (ISSN 0044-6971), vol. 23, Oct. 12, 1985, p. 21, 23, 24, 29. In French.

Plans are under way to produce another upgraded version of the Super Etendard (SE), which is an evolution of an aircraft first manufactured in 1956. The new versions are targeted for the defense of aircraft carriers. The selling points of the new SE are its recent successes as a low-level, maneuverable transonic attack aircraft. The upgrades include the Atar 8K50 engine for Mach 0.8 flight with over 10,000 lb thrust. Coomparisons of the SE with the new AMX show relative equivalence in many aspects. The SE will receive an advanced avionics system with automated navigation accurate to within 1 nm/hr. The cockpit will include HUD and flight phase controls. Other equipment are FLIR, ECM, nd automated target acquisition and tracking. M.S.K.

A86-14436#
AERO/PROPULSION TECHNOLOGY FOR STOL AND MANEUVER
J. F. MELLO and D. R. KOTANSKY (McDonnell Aircraft Co., St. Louis, MO) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 10 p.
(AIAA PAPER 85-4013)

The expected benefits from the two-dimensional thrust vectoring the thrust reversing (TV/TR) nozzles and canards to be used on a F-16 fighter in a STOL and Maneuvering flight test program are delineated. Nozzle deflection furnishes STOL capabilities and roll, pitch and yaw control for the twin-engined F-15. Internal operations are maximized by controlling the exhaust aperture. TR can furnish up to 67 percent full reverse power in landing phases and in-flight. Dihedral canards increase lift in supersonic flight and provide positive trim, while aerodynamically reacting favorably with the wings, which are twice the length of the canards. The tests are hoped to yield effective design options for future fighter aircraft. M.S.K.

A86-14449
THE DEVELOPMENT OF DYNAMIC PERFORMANCE STANDARDS FOR GENERAL AVIATION AIRCRAFT SEATS
S. J. SOLTIS (FAA, Washington, DC) and J. W. OLCOTT (Business and Commercial Aviation, White Plains, NY) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr. 16-19, 1985. 18 p. refs
(SAE PAPER 850853)

Recently, recommendations were furnished to the FAA by the General Aviation Safety Panel (GASP) to encourage the establishment of FAA crash tolerance requirements for new seats for general aviation aircraft carrying less than 10 passengers. The guidelines were based on NASA, FAA and GASP crash test data and mil-spec standards for aircrashworthiness, particularly for the UH-60A helicopter. Analyses were performed of probable causes of accidents, impact velocities and correlations among various types of small aircraft. Impact pulse shapes and durations and survivable limits were quantified. Criteria were defined for the causes of injuries to certain parts of the body to devise standardized testing of new seat designs to determine if the seats offer adequate restraint/protection for passengers. M.S.K.

A86-14458#
STUDIES OF ROTOR-AIRFRAME INTERACTIONS IN FORWARD FLIGHT
N. M. KOMERATH, H. M. MCMAHON, and J. E. HUBBARTT (Georgia Institute of Technology, Atlanta) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 10 p. refs
(Contract DAAG29-82-K-0094)
(AIAA PAPER 85-5015)

The helicopter rotor and airframe cannot be treated in isolation if significant improvements in forward-flight performance are to be achieved; rotor-airframe interaction effects must be understood and predictable. Results from an experimental/analytical study of this interaction problem are presented and discussed. The experimental results include mean and periodic pressures on the surface of a cylindrical airframe and measured mean velocity components in the rotor wake. An existing prediction code is used to calculate mean pressures and velocity components which are compared with the experimental results. The impingement of the rotor wake on the airframe causes significant effects with regard to both the mean and periodic pressures. These mean effects are not adequately predicted by an available fully-coupled interaction code in its present form. A comprehensive prediction code must include unsteady effects. Author

A86-14498#
THE FUNDAMENTALS OF AIRCRAFT COMBAT SURVIVABILITY ANALYSIS AND DESIGN
R. E. BALL (U.S. Naval Postgraduate School, Monterey, CA) New York, AIAA, 1985, 410 p. refs

A comprehensive treatment is presented of military aircraft design problems to which the continuing development of antiaircraft weapons gives rise. The discussion encompasses both fixed wing and rotary wing aircraft; all mission types and combat scenarios are treated, under a general organization which distinguishes among vulnerability (due to the position of critical components), susceptibility (likelihood of detection and destruction in a given enemy threat environment), and survivability (active measures taken to ensure minimum detection and destruction probability, including battle damage repair). An attempt is made to anticipate likely developments in enemy sensor technologies and weapon lethality in the near future, as well as to project potentially fruitful aircraft design optimization solutions. O.C.

A86-14527*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REVIEW OF RECENT RESEARCH ON INTERIOR NOISE OF PROPELLER AIRCRAFT
J. S. MIXSON and C. A. POWELL (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 931-949. Previously cited in issue 01, p. 4, Accession no. A85-10885. refs

A86-14536#
FLUTTER AND DIVERGENCE AEROELASTIC CHARACTERISTICS FOR COMPOSITE FORWARD SWEPT CANTILEVERED WING
I. LOTTATI (Technion - Israel Institute of Technology, Haifa) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 1001-1007. refs

An analytical investigation was conducted to determine the aeroelastic flutter and divergence behavior of a cantilevered, composite, forward swept rectangular wing. The influence due to the variation in the bending-torsion stiffness coupling of the tailored wing on the flutter and divergence critical dynamic pressure is analyzed. The analytical approach utilizes the incompressible two-dimensional unsteady aerodynamic strip theory. Flutter and divergence velocities were obtained by using an optimization procedure that solves exactly the coupled bending-torsion equations for a cantilevered swept wing. The results indicate that

the flutter and divergent of a fixed-root wing involve a compromise, since the bending-torsion stiffness that maximizes the flutter velocity tends to minimize the divergent speed and vice versa.
Author

A86-14822
THE LAMINAR AIRLINER - PROSPECTS AND PROBLEMS
B. R. A. BURNS (British Aerospace, PLC, Preston, England) Air International (ISSN 0306-5634), vol. 29, Nov. 1985, p. 235-239.

A development history and performance improvement evaluation is presented for various active boundary layer control (BLC) laminarization methods that have been applied to modified and experimental aircraft in order to improve their aerodynamic efficiency and reduce their fuel consumption. Boundary layer suction through slots or holes has been the object of primary interest amon BLC techniques, often in conjunction with exotic airfoil profiles and propulsion system integration configurations. The substantial gains predicted for BLC aircraft on theoretical grounds have often, however, gone unrealized because of the inherent, boundary turbulence-generating presence of aircraft surface imperfections and vibrations, rain and ice impacts on the leading edge, and even the effect of insects that are encountered as swarms at low altitudes. O.C.

A86-14975
WING ASPECT RATIO OPTIMIZATION RELATED TO PAYLOAD AND TO FUEL CONSUMPTION OF TRANSPORT PROPELLER AIRPLANES
P. A. GILI and F. B. QUAGLIOTTI (Torino, Politecnico, Turin, Italy) Society of Allied Weight Engineers, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984. 17 p. refs
(SAWE PAPER 1615)

Solutions are obtained relating the range, payload, and fuel consumption of a propeller aircraft as a function of the wing aspect ratio (WAR) and the flight attitude (FA). A simple and reliable formula for predicting the wing weight is proposed and introduced in the flight performance (FP) equations, which express the FP as a function of the WAR only, permitting brief analysis of many design solutions in a large operational field. The analytical results allow drawing of many diagrams for the relations between the payload or fuel consumption and the FA, for optimum values of WAR at different operational ranges. I.S.

A86-15598
4 X S = S(ATF)
J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, Nov. 1985, p. 10-17.

A technology integration and performance forecast is presented for the U.S. Air Force's next-generation Advanced Tactical Fighter (ATF), which will become operational at the turn of the century. The most critical performance improvements envisaged for the ATF are sustained supersonic flight, short field takeoff and landing capabilities, enhanced survivability through the incorporation of stealth features (reducing IR emissions and radar cross section), and enhanced supportability in a combat scenario. Significant acceleration, maneuvering, and thrust reversal (for short landing run) contributions must be made by a 9:1 thrust/weight ratio powerplant that integrally incorporates a thrust vectoring/reversing two-dimensional variable geometry nozzle. O.C.

A86-15999
DOUGLAS PLANS CONTINUING UPGRADES TO MAINTAIN MD-80 COMPETITIVENESS
K. F. MORDOFF Aviation Week and Space Technology (ISSN 0005-2175), vol. 123, Nov. 11, 1985, p. 52, 57, 59, 61, 65.

A projection is made of configurational possibilities and prospective performance improvements obtainable for the MD-80 family of medium size airliners. The two primary variants foreseen are the MD-87, for the 115-130 seat transport class, which will be derived by a shortening of the MD-80 fuselage, and the 160-seat MD-89, derived by stretching the MD-80. In the longer term, attention is to be given to the incorporation of ultrahigh bypass engines which may be of either propfan or unducted fan type. More extensive primary structural use is planned for carbon/epoxy and kevlar/epoxy composites, and novel carbon or glass fiber-reinforcced phenolics will be introduced. O.C.

A86-16000
AIRBUS INDUSTRIE STRESSES TECHNOLOGY, AVAILABILITY OF A320
J. M. LENOROVITZ Aviation Week and Space Technology (ISSN 0005-2175), vol. 123, Nov. 11, 1985, p. 81, 83, 85.

A performance capability and market viability assessment is made for the state-of-the-art technology A320 airliner, whose total orders and options over the course of 1986 are expected to rise to nearly 300 aircraft. Certification for the A320 is scheduled for 1988, using CFM56-5 engines. The airliner will seat 120-179 passengers, depending on cabin configuration, and it incorporates fly-by-wire controls, pilot/copilot sidestick controllers, a centralized maintenance data system, a novel wing design with automatic load alleviation, and extensive use of composite materials in both primary and secondary structures. The manufacturer has begun to survey prospective customers for the requirements of twin-engine (TA-9) and four-engine (TA-11) wide body airliners. O.C.

A86-16095
THE V-22 - PREPARING FOR FULL-SCALE DEVELOPMENT
R. J. TRACY (U.S. Naval Air Systems Command, Washington, DC) Vertiflite (ISSN 0042-4455), vol. 31, Nov.-Dec. 1985, p. 27-29.

The V-22 tilt-rotor aircraft must possess a range of over 2000 mi, have rotors under 38 ft diam, and in shipboard basing weigh less than 25 tons. The V-22 is approaching full-scale development after 6000 hr of wind tunnel tests to characterize the configuration, drag, rotor effects, spin behavior, aeroelstic boundaries, the engine nacelle airflow characteristics and methods validation. Longitudinal instability at a low lift coefficient has been eliminated and the scale model results indicate a flutter-free performance at over 420 kt. Some of the design choices, such as the nacelle tilt in hover, have been validated on the XV-15 aircraft. Full-size tests have been performed on the wing structure, which will sport 1200 lb of composite parts. Particular attention is being given to minimizing weight as the design studies progress. M.S.K.

A86-16097
TOMORROW'S FLEET - THE LIGHT HELICTOPER FAMILY (LHX)
R. K. ANDERSON (U.S. Army, Aviation Systems Command, Washington, DC) Vertiflite (ISSN 0042-4455), vol. 31, Nov.-Dec. 1985, p. 42-46.

The development program for the next generation of light rotorcraft has progressed to contracts for the turboshaft engine and the preparation of the RFP for the LHX air vehicle system. The LHX will have two variants: the scout/attack aircraft (SCAT) and light utility (U). Both will be capable of one-person operation, flight in adverse weather and achieve 40-50 percent cost redutions compared to the current fleet. The avionics will be state of the art digital equipment, driven by VHSIC and accepting voice commands. The total procurement will be 5023 aircraft. The program is in the concept exploration stage, and has defined the gross weight interval as 7500-8500 lb and at $6/4 million each for the SCAT/U vehicles. Innovation has been the guideword in defining the LHX specifications, which will only be 40 pages long.
M.S.K.

A86-16123
FEASIBILITY OF SIMPLIFYING COUPLED LAG-FLAP-TORSIONAL MODELS FOR ROTOR BLADE STABILITY IN FORWARD FLIGHT
G. R. NILAKANTAN (Hindustan Aeronautics, Ltd., Bangalore, India) and G. H. GAONKAR (Florida Atlantic University, Boca Raton) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 3, 1985, p. 241-256. refs

The feasibility of simplifying coupled lag-flap-torsional models is explored for the low-frequency stability of isolated hingeless

rotor blades in forward flight. The nonlinear equations of moderate deflections with appropriate geometric nonlinearities are valid to third order, so are the perturbed linear equations about time dependent equilibrium (trim) positions. Aerodynamic strip theory based on a quasisteady approximation of two-dimensional unsteady airfoil theory is used. Under linear and quasilinear propulsive trim conditions, stability is investigated for four cases: a base-line model with elastic lag bending, flap bending and torsion degrees of freedom, the modified elastic lag-flap model that neglects only torsional dynamic effects, and the rigid blade models with and without quasisteady approximation to torsion. The method of equivalent Lock number and drag coefficient is used for qualitative insights into dynamic inflow effects. The range of validity of the modified elastic lag-flap and rigid lag-flap models is outlined with respect to torsional frequencies for soft (including matched stiffness) and stiff inplane rotors. Author

A86-16124
THE EFFECT OF HIGHER HARMONIC CONTROL (HHC) ON A FOUR-BLADED HINGELESS MODEL ROTOR
G. LEHMANN (DFVLR, Institut fuer Flugmechanik, Brunswick, West Germany) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 3, 1985, p. 273-284. refs

A four-bladed hingeless rotor system was used for application of higher harmonic control (HHC) inputs. With the objective of obtaining a better knowledge of the dynamic behavior of rotor forces and moments theoretical and experimental investigations were conducted. Wind tunnel measurements in the DNW with the DFVLR rotor test rig included different advance ratios and trimmed flight conditions scaled down from the BO-105 helicopter. After a brief description of the test equipment, the sensor arrangement, the data acquisition and data reduction, the evaluation of the reference data will be described. In the second part of this contribution the effect of the 3, 4 and 5/rev control inputs to the vibratory hub and blade loads are demonstrated. The major aspect to be discussed is the extraction of nonlinearities and couplings in the control inputs, which are the amplitudes and phases of the three higher harmonic blade pitch angles. Additionally comparisons of the cost functions, used at simulation runs and the wind tunnel tests, are described. The cost function gives a value for the vibration level on the dedicated rotor system which is an input for most of the common HHC algorithms. Author

A86-16125
EXPERIENCE WITH A NEW APPROACH TO ROTOR AEROELASTICITY
M. H. PATEL and G. T. S. DONE (City University, London, England) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 3, 1985, p. 285-294. Research supported by the Ministry of Defence. refs

Experience with an alternative procedure for computing the aeroelastic stability of a helicopter rotor system is described. The method has already been presented at a previous European Rotorcraft Forum, and is aimed at generating the coefficients of the aeroelastic equations of motion automatically on the computer. The main objective of the current work is to validate the associated computer program using three practical examples provided by Westland Helicopters Ltd. These examples are graded such that different aspects of the program are tested. The validation exercise is completed by comparing the results obtained by the new method with those previously obtained using conventional techniques, and providing explanation for discrepancies where they occur. Author

N86-12217 Department of the Air Force, Washington, D.C.
PNEUMATIC ACTUATOR DEVICE Patent
R. W. GAZZERA, *inventor* (to Air Force) 16 Apr. 1985 7 p
Supersedes AD-D009822
(AD-D011794; US-PATENT-4,510,846;
US-PATENT-CLASS-91-460) Avail: US Patent and Trademark Office CSCL 13K

A closed center four-way poppet actuator control device is incorporated into a pneumatic actuation system for controlling the movement of flight surfaces. The closed center four-way poppet actuator control device has a housing, a pair of two-way poppet valves in the housing, a rocker arm assembly mounted on the housing and connected to the pair of two-way poppet valves, and a diaphragm assembly also mounted in the housing and in contact with the two-way valves. A torque motor-driver assembly connected to the diaphragm assembly actuates the two-way valves as determined by control symbols. The rocker arm causes the two-way valves to function opposite each other: one allows high pressure gas to be input to a lobe motor acutator while the other allows gas to be output from the lobe motor actuator. Each two-way valve has a cylindrical poppet valve for inletting the gas to the actuator and a disk poppet valve for outputting the gas from the actuator to a vent. The actuator causes movement of the flight surfaces through a gearbox. A velocity transducer monitors this movement and transmits this movement to an electronic control unit which sends control signals to drive the torque motor-driver assembly that actuates said actuator control device.
Author (GRA)

N86-12219# Army War Coll., Carlisle Barracks, Pa.
THE C-17: WE NEED IT YESTERDAY
B. R. HOOTEN 25 Apr. 1985 37 p
(AD-A157147) Avail: NTIS HC A03/MF A01 CSCL 01C

This student essay examines the historical development of the C-17, beginning in the 1970's when Tactical Airlift Command was pressing for development of the Advanced Medium Shortfield Takeoff and Landing Transport. An in-depth look is taken at the Congressionally Mandated Mobility Study and at the analyses done by the C-X Task Force that led to the final definition of the C-17. The US Air Force Airlift Master Plan is reviewed to show the importance of the C-17 to the structure of our airlift force of the future. Real world potential applications of the C-17 are projected by examination of two studies of actual airlift operations. AHUAS TARA '83, (a combined operation in Honduras) and URGENT FURY, the US rescue mission to Grenada in October 1983. This essay supports the need to buy the C-17 by showing the detailed, logistical process that led to its design, and by using two recent actual operations to show the airplane's unprecedented airlift capabilities of today and into the foreseeable future. GRA

N86-12450# Joint Publications Research Service, Arlington, Va.
WINGTIP SAILS TESTED ON Y-5 AIRCRAFT
Y. DAXI *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-029) p 49-53 3 Sep. 1985 Transl. into ENGLISH from Guoji Hangkong (Beijing), no. 5, May 1985 p 2-3
Avail: NTIS HC A08/MF A01

In recent years, much attention has been given to the use of wingtip ailerons or wing tip sails to reduce induced drag because for most transport airplanes, the induced drag at cruising speed is approximately 30 percent of the total drag; at lower speeds the ratio is even higher. For the Y-5 biplane, the induced drag to total drag ratio is approximately 55.6 percent, at cruising speed the ratio is approximately 33 percent, and during climb it is 58 percent. Therefore, wing tip ailerons or wing tip sails potentially can be very effective in reducing the overall drag of the aircraft. Since a large number of Y-5 airplanes are used in China for a variety of applications, a research program was initiated in August 1982 to install and test wing tip sails on the Y-5 aircraft. Results show that the use of wing tip sails improved the performance of the Y-5 aircraft. Author

N86-13316*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ABRASION BEHAVIOR OF ALUMINUM AND COMPOSITE SKIN COUPONS, STIFFENED SKINS AND STIFFENED PANELS REPRESENTATIVE OF TRANSPORT AIRPLANE STRUCTURES
K. E. JACKSON Nov. 1985 33 p refs
(Contract DA PROJ. 1L1-61102-AH-45)
(NASA-TP-2520; L-16018; NAS 1.60:2520; AVSCOM-TR-85-B-7)
Avail: NTIS HC A03/MF A01 CSCL 01C

A three-phase investigation was conducted to compare the friction and wear response of aluminum and graphite-epoxy composite materials when subjected to loading conditions similar to those experienced by the skin panels on the underside of a transport airplane during an emergency belly landing on a runway surface. The first phase involved a laboratory test which used a standard belt sander to provide the sliding abrasive surface. Small skin-coupon test specimens were abraded over a range of pressures and velocities to determine the effects of these variables on the coefficient of friction and wear rate. The second phase involved abrading I-beam stiffened skins on actual runway surface over the same range of pressures and velocities used in the first phase. In the third phase, large stiffened panels which most closely resembled transport fuelage skin construction were abraded on a runway surface. This report presents results from each phase of the investigation and shows comparisons between the friction and wear behavior of the aluminum and graphite-epoxy composite materials. Author

N86-13317*# Operations Research, Inc., Rockville, Md.
TRADEOFF ANALYSIS OF TECHNOLOGY NEEDS FOR PUBLIC SERVICE HELICOPTERS
J. S. BAUCHSPIES, W. R. BRYANT, JR., and W. E. SIMPSON Aug. 1985 120 p refs
(Contract NASW-3554)
(NASA-CR-3927; NAS 1.26:3927; ORI-TR-2459) Avail: NTIS HC A06/MF A01 CSCL 01C

The design requirements for a family or type of Public Service Helicopter (PSH) is examined which will satisfy the needs of municipal and state governments in the following mission areas: Emergency Medical Service--Airborne Rescue Squad; Law Enforcement; Search and Rescue; and Environmental Control (Fire Fighting, Pollution, Resource Management). The report compares both design and performance requirements as specified by the PSH user's group against current technological capabilities, RTOPS and US Army LHX design requirements. The study explores various design trade-offs and options available to the aircraft designer/manufacturer in order to meet the several criteria specified by the PSH user's group. In addition, the report includes a brief assessment of the feasibility of employing certain advanced rotorcraft designs to meet the stringent combination of operational capabilities desired by the Public Service Helicopter Users. Author

N86-13318*# National Aeronautics and Space Administration, Washington, D.C.
AIRCRAFT OF THE FUTURE
S. YEGER (OKB Tupolev, USSR) Nov. 1985 9 p Transl. into ENGLISH from Techn.-Oekonomische Inform. der Zivilen Luftfahrt (West Germany), v. 13, no. 2, 1977 p 88-90 Original language document was announced in IAA as A77-39452 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASW-4006)
(NASA-TM-77952; NAS 1.15:77952) Avail: NTIS HC A02/MF A01 CSCL 01C

Some basic problems connected with attempts to increase the size and capacity of transport aircraft are discussed. According to the square-cubic law, the increase in structural weight is proportional to the third power of the increase in the linear dimensions of the aircraft when geomettric similarity is maintained, while the surface area of the aircraft increases according to the second power. A consequence is that the fraction of useful weight will decrease as aircraft increase in size. However, in flying-wing designs in which the whole load on the wing is proportional to the distribution of lifting forces, the total bending moment on the wing will be sharply reduced, enabling lighter construction. Flying wings may have an ultimate capacity of 3000 passengers. DOE

N86-13319*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY REPORT ON IN-FLIGHT MEASUREMENT OF ROTOR HUB DRAG AND LIFT USING THE RSRA
C. W. ACREE, JR. Oct. 1985 28 p refs
(NASA-TM-86764; REPT-85288; NAS 1.15:86764) Avail: NTIS HC A03/MF A01 CSCL 01C

The Rotor Systems Research Aircraft (RSRA) is a compound helicopter that was test flown as a fixed wing aircraft, with the main rotor blades removed and the rotor hub installed. An onboard rotor load measurement system measured the resulting rotor hub drag and lift. Measured hub drag and lift are plotted for comparison to that predicted by full scale and 1/6 scale model wind tunnel tests. The success of the demonstration gives confidence that planned improvements to the RSRA will allow high accuracy hub drag and lift measurements to be made in flight on a routine research basis. Author

N86-13320*# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering/Computer Science.
INTERPRETATION OF F-106B IN-FLIGHT LIGHTNING SIGNATURES
T. F. TROST, M. G. GROTHAUS, and C. T. WEN Aug. 1985 51 p refs
(Contract NAG1-28)
(NASA-CR-176387; NAS 1.26:176387) Avail: NTIS HC A04/MF A01 CSCL 01C

Various characteristics of the electromagnetic data obtained on a NASA F-106B aircraft during direct lightning strikes are presented. Time scales of interest range from 10 ns to 400 microsecond. The following topics are discussed: (1) Lightning current, I, measured directly versus I obtained from computer integration of measured I-dot; (2) A method of compensation for the low frequency cutoff of the current transformer used to measure I; (3) Properties of fast pulses observed in the lightning time-derivative waveforms; (4) The characteristic D-dot signature of the F-106B aircraft; (5) An RC-discharge interpretation for some lightning waveforms; (6) A method for inferring the locations of lightning channel attachment points on the aircraft by using B-dot data; (7) Simple, approximate relationships between D-dot and I-dot and between B and I; and (8) Estimates of energy, charge, voltage, and resistance for a particular lightning event. Author

N86-13321*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GROUND VIBRATION TEST OF THE LAMINAR FLOW CONTROL JSTAR AIRPLANE
M. W. KEHOE (NASA. Ames Research Center), F. W. CAZIER, JR. (NASA. Ames Research Center), and J. F. ELLISON Oct. 1985 61 p
(NASA-TM-86398; L-15949; NAS 1.15:86398) Avail: NTIS HC A04/MF A01 CSCL 01C

A ground vibration test was conducted on a Lockheed JetStar airplane that had been modified for the purpose of conducting laminar flow control experiments. The test was performed prior to initial flight flutter tests. Both sine-dwell and single-point-random excitation methods were used. The data presented include frequency response functions and a comparison of mode frequencies and mode shapes from both methods. Author

N86-13322# Royal Aircraft Establishment, Farnborough (England).
STANDARDISED FATIGUE LOADING SEQUENCES FOR HELICOPTER ROTORS (HELIX AND FELIX). PART 2: FINAL DEFINITION OF HELIX AND FELIX
P. R. EDWARDS and J. DARTS Aug. 1984 124 p
(AD-A156622; RAE-TR-84085; DRIC-BR-95846) Avail: NTIS HC A06/MF A01 CSCL 14B

This report defines two loading standards for the fatigue evaluation of helicopter rotor materials and components. They were developed as a collaborative study between West Germany, the Netherlands and UK. Details of the contributing organizations are given in Appendix A. The new loading standards follow the earlier TWIST (Transport Wing Standard), and FALSTAFF (Fighter Aircraft Loading Standard For Fatigue evaluation). After the tradition of these earlier loading sequences, the new loading standards have been given identifying names. For these the origin of the word helicopter (Helix-spiral, pteronwing from the Greek) has provided a convenient basis. The new standards are called: Helix loading standard for hinged or articulated rotors; Felix loading standard for fixed or semi-rigid rotors. This report defines the final form of the two standards, statistical content according to different counting methods and full details of their method of generation. GRA

N86-13323# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
LIMITED AIRWORTHINESS AND FLIGHT CHARACTERISTICS (A AND FC) TEST OF THE QUICK FIX CONFIGURATION Final Report, 23 May - 27 Jun. 1984
G. L. SKINNER, G. M. BISHOP, E. J. TAVARES, and R. C. MURRELL Oct. 1984 67 p
(AD-A157716; USAAEFA-83-20) Avail: NTIS HC A04/MF A01 CSCL 01C

The US Army Aviation Engineering Flight Activity conducted an evaluation to determine the increase in power required and the change in handling qualities due to the installation of the AN/ALQ-151(V)2 countermeasures system and associated mission equipment on the UH-60A helicopter. Testing conducted between 23 May to 2 June 1984 totaled 12.4 hours. The addition of the Quick Fix System and associated mission equipment created an increase in equivalent flat plate area (F sub e) of 17 sq ft (ft2) for advance ratios (mu) of 0.26 and greater. For mu's less than 0.26, the change in F sub e increased above 17 sq ft as a function of thrust coefficient. Handling qualities of the Quick Fix configured YEH-60A were unchanged from a normal utility configured UH-60A and were determined satisfactory. One deficiency, interference between the main rotor blades and the upper elements of the (no. 3 and no. 4) direction finding dipole antennas during ground taxi and four shortcomings were associated with the Quick Fix configuration. GRA

N86-13324# SRI International Corp., Menlo Park, Calif.
PHYSICAL DISTRIBUTION SYSTEM FOR AIRCRAFT EXTERNAL FUEL TANKS-SURVEY Final Report, 1 Mar. - 31 May 1985
G. B. ANDEEN, R. D. KORNBLUH, T. P. LOW, R. H. MONAHAN, and W. PARK Jun. 1985 96 p
(Contract N00600-82-D-8362)
(AD-A158275; DTNSRDC/CMLD-CR-47-85) Avail: NTIS HC A05/MF A01 CSCL 13D

The general objective of this study was to conduct a survey and analysis of current and planned aircraft external fuel tanks, with emphasis on the disposability and nestability aspects of these fuel tanks. The study focused on design requirements, fabrication and assembly, and physical distribution, with particular attention directed to the use of the robotic equipment for the assembly of nestable fuel tanks aboard the ship. The principal conclusion of this study is that the development of disposable, nestable external aircraft fuel tanks with automated assembly aboard ship, using robotic equipment, is a feasible option for implementation within the next five to ten years. Chapter 1 of the report presents an introduction and summary description of the major results of the survey. Chapter 2 then provides a summary description of the tentative operational requirements established by the Navy for disposable, nestable external aircraft fuel tanks. Chapter 3 presents a discussion of the possible fabrication and assembly techniques and problems for such fuel tanks. Chapter 4 then discusses the physical distribution aspects of external aircraft fuel tanks. Chapter 5 concludes with a listing of the conclusions and recommendations resulting from this analysis. GRA

N86-13325# Hughes Helicopters, Culver City, Calif.
ADVANCED TECHNOLOGY HELICOPTER LANDING GEAR PRELIMINARY DESIGN INVESTIGATION Final Report, Sep. 1983 - Jul. 1984
J. K. SEN, M. W. VOTAW, and D. C. WEBER Jul. 1985 247 p
(Contract DAAK51-83-C-0039; DA PROJ. 1L1-62209-AH-76)
(AD-A158816; HHI-84-284; USAAVSCOM-TR-84-D-20) Avail: NTIS HC A11/MF A01 CSCL 01C

This report describes the preliminary designs of two configurations of helicopter crashworthy landing gears: (1) with the trailing arms of the main gear coupled with a torque, which forces both shock struts to absorb the kinetic energy of an unsymmetrical crash impact, and (2) with the trailing arms uncoupled; i.e., the torque tube is replaced by a cross tube which is incapable of reacting the high torsional load of an unsymmetrical crash impact. Retractable and fixed landing gears of both configurations have been designed, as well as a standard (noncrashworthy) retractable landing gear. All landing gears are of tailwheel designs. The designs apply the systems approach to crashworthiness where the total impact energy absorbed is shared by the landing gear, fuselage and seat. The designs of the crashworthy landing gears were completed after a preliminary investigation of crash impact at sink speeds up to 42 fps, roll angles up to + or - 20 degrees and pitch angles up to -10+20 degrees. The crashworthy evaluations were made with program KRASH. A detailed analysis with KRASH was then conducted for all configurations of landing gears. Based on the weight trend curves and cost analysis, a crashworthy design criterion was recommended. This design criterion was the basis for updating the landing gear design. The designs identify the fabrication methods and processes for the landing gear. Estimates of cost and weight of the updated designs are also presented. GRA

N86-13326# Sikorsky Aircraft, Stratford, Conn.
TRANSMISSION ACOUSTIC VIBRATION TESTING Final Report, Sep. 1982 - Nov. 1983
C. YOERKIE and A. CHORY Jul. 1985 85 p
(Contract DAAK51-82-C-0040; DA PROJ. 1L2-63201-DB-72)
(AD-A159022; USAAVRADCOM-TR-83-D-34) Avail: NTIS HC A05/MF A01 CSCL 01C

Laboratory tests were conducted to determine the individual and combined effects of a high contact ratio (HCR) planetary gearset and a stainless steel housing on the acoustic (high frequency) vibration signature of the BLACK HAWK helicopter main transmission. Vibration levels at the planetary mesh frequency increased significantly with the stainless steel housing, but increased unexpectedly with the HCR planetary. The primary reason for the increased response with the HCR was the reduced gear face widths. GRA

N86-13327# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AIRCREW DOSE AND ENGINE DUST INGESTION FROM NUCLEAR CLOUD PENETRATION M.S. Thesis
S. P. CONNERS Mar. 1985 168 p
(AD-A159246; AFIT/GNE/PH/85M-4) Avail: NTIS HC A08/MF A01 CSCL 01B

This thesis evaluates the threat to aircraft and aircrew from dust and radioactivity in a cloud generated by nuclear surface bursts. A model of the nuclear cloud is generated, using any number and type of weapons and any desire dust size distribution. The cloud is propagated through the atmosphere for a given time, then penetrated by an aircraft. The activity density in the cloud is converted to dose to the crew for a given path through the cloud. Radiation shielding and dust filters are included in the calculations. Alternatively, the cloud dust mass density can be converted to

mass trapped in a filter or the cabin, or to the dust mass that has entered the engine. Methods for determining particle size and altitude distributions are presented. The ionizing dose to the crewmember is computed for both sky-shine and the dust trapped in the cabin during cloud passage. A method of computing the shielding power of the crew compartment against sky-shine is presented. Given the air flow rate into a filter or engine, the mass of ingested dust is found. These nuclear cloud and aircraft models are incorporated in a computer code oriented toward operational use. A significant feature of the code includes the ability to easily change the scenario with menu driven options. GRA

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A86-12683
MISSILE GUIDANCE BASED ON KALMAN FILTER ESTIMATION OF TARGET MANEUVER
Y. M. TANG (Chinese Aeronautical Establishment, Luoyang Dynamic Institute, People's Republic of China) and J. A. BORRIE (Cranfield Institute of Technology, England) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-20, Nov. 1984, p. 736-741. refs

A weakness of conventional proportional navigation for a homing missile is related to a limited effectiveness in coping with evasive maneuvers of the target. The present investigation is concerned with an extended Kalman filter which generates an estimate of target lateral acceleration. This estimate is used together with other information to generate the required lateral missile acceleration, taking into account a precomputed suboptimal control law. Attention is given to a simplified model of target behavior, the design of the extended Kalman filter, system model and missile guidance law design, and a computer simulation. The simulation shows that a substantial improvement in miss distance is achieved. G.R.

A86-13202
AIR FORCE FLIGHT TEST INSTRUMENTATION SYSTEM
M. F. LAMY (SCI Systems, Inc., Huntsville, AL) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 13-19.

The U.S. Air Force's Flight Test Instrumentation System (AFFTIS) is being developed to furnish flight test instrumentation capabilities for aircraft through the 1990s. The AFFTIS System Controller (ASC) orchestrates the functions of the airborne PCM system, which encompasses a central control unit and distributed data acquisition units (DAUs) via high speed serial/response data bus. Each of the remote DAUs includes a memory containing format information. The command from the ASC points to the correct format instruction location within the DAU. All of the PCM format structure is user-definable and programmable. Attention is given to ground and laboratory support equipment. O.C.

A86-13215
A PROGRAMMABLE DATA ACQUISITION SYSTEM WITH INTEGRATED TEST AND CALIBRATION FACILITIES
A. ZACH and R. GANDERT (DFVLR, Institut fuer Flugmechanik, Brunswick, West Germany) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 155-172.

The accurate and testable data acquisition system developed for the Advanced Technologies Testing Aircraft System consists of a distributed modular microprocessor system with signal conditioning units that are located near the system's sensors. Control is exercised by a master unit with integral PCM encoder. Flexible signal conditioning, which features software-controlled parameters and adaptable signal inputs, can be automatically tested via an analog calibration bus that uses switchable signal paths. O.C.

A86-13269
MILITARY AVIONICS
G. WARWICK Flight International (ISSN 0015-3710), vol. 128, Oct. 5, 1985, p. 24-31.

The advanced cockpit displays being developed to exploit the capabilities of state of the art digital avionics are described, along with the avionics systems. Triple and quadruple redundancy is being used to enhance digital systems, and their associated servosystems, to reliability levels offered by part-mechanical systems. The introduction of color-coded CRT graphics displays, voice activated controls and AI into the cockpit alters the pilot role to that of a flight manager. Recent advances in shadow-mask CRT technologies have provided the full-color, adequate brightness/resolution and reliability, i.e., vibration resistance, needed for fighter cockpit applications such as moving map displays. For the on-board computer, multiple pathways augment failure tolerance and allow majority voting, although triply redundant systems must employ more self-checking than quadruply redundant systems. Acceptable totally fly-by-wire systems permit active, automated control of dynamically unstable aircraft configurations such as the X-29. M.S.K.

A86-13548
ALTIMETERS TO MEET MILITARY LOW LEVEL NEEDS
B. WANSTALL Interavia (ISSN 0020-5168), vol. 40, Oct. 1985, p. 1127, 1128.

Military requirements for greater trajectory accuracy at low altitudes, and lighter and more compact equipment, are being addressed by a new generation of CW and pulsed radio altimeter equipment technologies. Attention is presently given to the Spectrum Leading Edge Detection technique, which overcomes limitations associated with conventional FM/CW systems, a German FM/CW radio altimeter for military helicopters which incorporates two antennas and weighs 1 kg, and pulsed J-band radio altimeters that are smaller, lighter and cheaper than the conventional devices. O.C.

A86-14220
ICING WIND TUNNEL TESTS ON THE CSIRO LIQUID WATER PROBE
W. D. KING (CSIRO, Cloud Physics Laboratory, Sydney, Australia), J. E. DYE, J. W. STRAPP (National Center for Atmospheric Research, Boulder, CO), D. BAUMGARDNER (Department of the Environment, Atmospheric Environment Service, Downsview, Canada), and D. HUFFMAN (Particle Measuring Systems, Inc., Boulder, CO) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 2, Sept. 1985, p. 340-352. refs

The CSIRO probe for airborne measurements of liquid water content (LWC) is currently used by many research organizations. It was felt that a series of icing wind tunnel comparisons and calibrations of the type performed on the Johnson-Williams (JW) probe by Strapp and Schemenauer (1982) would help to evaluate the performance of the probe. The present paper provides a description of such tests. Aspects of tunnel calibration awe discussed along with the tunnel profiles, details regarding the employed probes, and the analysis of the probe data. Attention is given to the effect of varying yaw angle, the effects of varying the operating temperature, the effect of airspeed, the effect of ambient temperature, the replacement heads, the effects of power supply voltage, the offset voltage and its effect on damping, long-term stability, inoperative slave wires and inconsistencies. G.R.

A86-14223
EVALUATION OF METEOROLOGICAL AIRBORNE DOPPLER RADAR. I DUAL-DOPPLER ANALYSES OF AIR MOTIONS. II - TRIPLE-DOPPLER ANALYSES OF AIR MOTIONS
P. H. HILDEBRAND and C. K. MUELLER (National Center for Atmospheric Research, Boulder, CO) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 2, Sept. 1985, p. 362-392. refs

A number of studies have shown that ground-based Doppler radars are valuable tools for atmospheric sciences research. However, ground-based Doppler observations are limited to measurements of phenomena which occur within the area covered by the radars. Some of the problems of ground-based radars can be overcome by making use of airborne Doppler radars. During the past two years, the potential value of practical airborne Doppler radar systems has been demonstrated in tests of a 3-cm Doppler radar aboard the NOAA P3 aircraft. In the present paper, observations are presented of a convective storm by airborne and ground-based Doppler radars, taking into account also the subsequent comparative analyses of the storm structure. G.R.

A86-14433#
AUTOMATION AND INTEGRATION ON AFTI/F-16
A. F. BARFIELD and F. R. SWORTZEL (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 8 p.
(AIAA PAPER 85-3089)

The techniques being pursued in the Advanced Fighter Technology Integration (AFTI/F-16) program to provide enhanced automation, effectiveness and reliability in fighter aircraft are surveyed. The goal is to furnish increased lethality and deliverability of weapons systems and augmented maneuverability while keeping the pilot workload at manageable levels. Triply-redundant computers provide for fully digital mechanization for multimode flight control. Each flight phase is decoupled from others and automated wherever possible, in addition to simplifed vertical and sideways manual translation control. Enhanced control is achieved with blended surfaces control, with control modes selected as one-button options. Automation also covers trajectory control for bombing, air-to-air gunnery, collision avoidance and integrated systems operation. M.S.K.

A86-15314
RADIOMETRIC CHARACTERIZATION METHODS FOR INFRARED COUNTERMEASURES SYSTEMS
J. L. GRANGAARD (USAF, Infrared and Laser Standards Laboratory, Newark Air Force Station, OH), C. LINK (Northrop Corp., Defense Systems Div., Rolling Meadows, IL), G. SPADE (Sanders Associates, Inc., Nashua, NH), and W. RAMSEY (Loral Electro-Optical Systems, Inc., Pasadena, CA) IN: Optical radiation measurements; Proceedings of the Meeting, San Diego, CA, August 21, 22, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1985, p. 39-46.

For the purpose of jamming an infrared tracker, Infrared Countermeasures Systems (IRCM) produce a complicated pulsed pattern of infrared radiation. The produced radiation varies rapidly with time, direction, and wavelength. Large simulation facilities are employed to test the effect which these systems produce on the tracking ability of an infrared seeker. A number of measurement facilities have been designed for the evaluation of IRCM systems. The present paper provides a detailed description of the measurement system used at Newark Air Force Station. Attention is given to the radiometer measurement equation, the relative spectral output measurement, spectral scaling factor measurement, an estimate of measurement error, methods of measuring radiant intensity, and an intercomparison of techniques. G.R.

A86-15342
FIBER OPTIC AIRCRAFT SYSTEMS ELECTROMAGNETIC PULSE (EMP) SURVIVABILITY
B. GAGE, R. GREENWELL, M. SUMMERLIN, and B. ZETLEN (Science and Engineering Associates, Inc., Seattle, WA) IN: Fiber optics in adverse environments II; Proceedings of the Meeting, San Diego, CA, August 22-24, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 109-115. refs

It is pointed out that a single eletromagnetic pulse (EMP) event can disrupt or destroy vital military electronics and aircraft avionics which operate in an area as large as the entire continental United States. This paper is concerned with the application of fiber optic technology for aircraft systems EMP survivability optic technology. In the case of the present methodology of data and signal transfer in aircraft, complex electromagnetic protection techniques are needed to protect aircraft avionics from lightning, EMP, and electromagnetic interference. The EMP problem is further enhanced by the increased use of new nonmetallic composite aircraft structural materials which diminish outer layer topological shielding. Fiber optic technology, in connection with its inherent dielectric nature, provides the most cost-effective alternative to conventional shielded transmission paths. G.R.

A86-15378
INFRARED FLIGHT SIMULATION USING COMPUTER GENERATED IMAGERY
M. R. WEATHERSBY and W. M. FINLAY (Georgia Institute of Technology, Atlanta) IN: Infrared technology X; Proceedings of the Meeting, San Diego, CA, August 23, 24, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1985, p. 89-93. Army-sponsored research. refs

A deterministic, interactive software model has been developed for the computer generation of three-dimensionally projected IR scenes, on the basis of either self-emission or near-IR reflectance, and allowing for generation of flight paths through a data base that consists of both feature and topography. The three-dimensional IR background clutter model furnishes an evaluation tool for the assessment of system performance in clutter, and for deepening current understanding of the clutter phenomenon itself. Applications include sensor operator training with dynamic imagery, and the evaluation of automatic target recognition algorithms. O.C.

A86-15599
LANTIRN - TURNING NIGHT INTO DAY
J. H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 5, Nov. 1985, p. 18-22.

The low altitude navigational targeting IR night (LANTIRN) system is an autonomous, pod-mounted fire-control system for tactical aircraft that is linked to a cockpit HUD, facilitating nocturnal missions in adverse weather conditions against low latitude targets. LANTIRN will be installed on 392 F-15E, 200 F-16, and 100 A-10 aircraft. Attention is presently given to the subcomponent configuration of the system and its functions on typical bombing runs. O.C.

N86-12220*# Dayton Univ., Ohio.
PERFORMANCE OF AN ALPHA-VANE AND PITOT TUBE IN SIMULATED HEAVY RAIN ENVIRONMENT Final Report
J. K. LUERS and I. B. FISCUS Oct. 1985 32 p refs
(Contract NAG1-522)
(NASA-CR-176353; NAS 1.26:176353; UDR-TR-85-131) Avail: NTIS HC A03/MF A01 CSCL 01D

Experimental tests were conducted in the UDRI Environmental Wind/Rain Tunnel to establish the performance of an alpha-vane, that measures angle of attack, in a simulated heavy rain environment. The tests consisted of emersing the alpha-vane in an airstream with a concurrent water spray penetrating vertically through the airstream. The direction of the spray was varied to make an angle of 5.8 to 18 deg with the airstream direction in order to simulate the conditions that occur when an aircraft lands in a heavy rain environment. Rainrates simulated varied from 1000 to 1200 mm/hr which are the most severe ever expected to be

encountered by an aircraft over even a 30 second period. Tunnel airspeeds ranged from 85 to 125 miles per hour. The results showed that even the most severe rainrates produced a misalignment in the alpha-vane of only 1 deg away from the airstream direction. Thus for normal rain conditions experienced by landing aircraft no significant deterioration in alpha-vane performance is expected. B.W.

N86-12221# Air Force Flight Test Center, Edwards AFB, Calif.
T-33 (SILVER STAR MK 3) PITOT-STATIC SYSTEM CALIBRATION Final Report, 17 Apr. - 15 May 1985
T. R. WOODFORD and E. P. HANSEN Jun. 1985 34 p
(AD-A157854; AFFTC-TR-85-19) Avail: NTIS HC A03/MF A01 CSCL 01D

This report presents the results of pitot-static system calibration tests performed on T-33 (Silver Star MK 3), civil registration number N83TB. The T-33 pitot-static system was calibrated in order to use the T-33 as a pacer for the T-46A pitot-static system calibration tests to be performed during the T-46A Development Test and Evaluation Program. Although the test aircraft will perform satisfactorily as a pacer, periodic checks on the pitot-static system's accuracy should be performed. GRA

N86-12222# Sanders Associates, Inc., Nashua, N. H.
ADVANCED AVIONICS COMPUTER ARCHITECTURE. VOLUME 1. EXECUTIVE SUMMARY Final Report, May 1980 - Nov. 1984
L. GREENSPAN and R. SINGLETARY May 1985 19 p
(Contract F33615-79-C-1935)
(AD-A158119; AFWAL-TR-85-1041-VOL-1) Avail: NTIS HC A02/MF A01 CSCL 09B

This exploratory development program was originally aimed at developing a computer with features to specifically support the JOVIAL (J73) programming language with considerations to Ada. Later, the program was redirected to modify the instruction set architecture (ISA) to more fully support Ada and increase performance. The new ISA supports most of the standard functions found in most ISA, but gives additional supports in: the Ada package concept, processing arrays and records, unconstrained arrays, dynamic storage allocation, detecting dangling references, detecting undefined variables, Ada-like exception handling, case instructions, for-loop instructions, Ada-like parameter passing, Ada-like tasking instructions and IEEE-standard floating point data types. GRA

N86-12223# Sanders Associates, Inc., Nashua, N. H.
ADVANCED AVIONICS COMPUTER ARCHITECTURE. VOLUME 2. INSTRUCTION SET ARCHITECTURE SPECIFICATION Final Report, May 1980 - Nov. 1984
L. GREENSPAN and R. SINGLETARY May 1985 305 p 2 Vol.
(Contract F33615-79-C-1935)
(AD-A158120; AFWAL-TR-85-1041-VOL-2) Avail: NTIS HC A14/MF A01 CSCL 09B

This exploratory development program was originally aimed at developing a computer with features to specifically support the JOVIAL (J73) programming language with considerations to Ada. Later, the program was redirected to modify the instruction set architecture (ISA) to more fully support Ada and increase performance. The new ISA supports most of the standard functions found in most ISA, but gives additional supports in: the Ada package concept, processing arrays and records, unconstrained arrays, dynamic storage allocation, detecting dangling reference, detecting undefined variables, Ada-like exception handling, case instructions, for-loop instructions, Ada-like parameter passing, Ada-like tasking instructions and IEEE-standard floating point data types. GRA

N86-12224# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
NAVY SHOULD JOIN THE AIR FORCE AND ARMY PROGRAM TO DEVELOP AN ADVANCED INTEGRATED AVIONICS SYSTEM
17 Jun. 1985 17 p
(PB85-222503; GAO/NSIAD-85-94; B-215379) Avail: NTIS HC A02/MF A01 CSCL 01D

Modern technology should soon enable separate avionics systems in an aircraft to be consolidated into a single package to conserve space, save weight, and reduce costs. The report points out the potential benefits of avionics consolidation and recommends the Navy join in a demonstration program now being conducted by the Air Force and Army to exploit such benefits. 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.

A86-13051#
DERIVATIVE ENGINES VERSUS NEW ENGINES - WHAT DETERMINES THE CHOICE?
D. M. DIX and D. A. GISSENDANNER (DOD, Office of the Under Secretary of Defense, Washington, DC) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 808-814.
(ASME PAPER 85-GT-190)

Attention is given to the objective factors to be considered in choosing between a new and a derivative engine for existing or new aircraft, in view of recent and current engine choice cases. An examination of the numerous factors implicit in performance capabilities, costs, and risks, leads to the identification of 12 objective factors; many of these are noted to have been previously overlooked in rational engine choice analyses. Attention is given to the cases of F-15 and F-16 reengining, powerplant selection for the Advanced Joint Services Vertical Lift Aircraft, and derivative engines for the U.S. Navy's A-6. O.C.

A86-13053#
EXPERIMENTAL EVALUATION OF HEAVY FAN-HIGH-PRESSURE COMPRESSOR INTERACTION IN A THREE-SHAFT ENGINE. I - EXPERIMENTAL SETUP AND RESULTS
A. SCHAEFFLER (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, West Germany) and D. C. MIATT (Rolls-Royce, Ltd., Bristol, England) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 828-832.
(ASME PAPER 85-GT-173)

Severe aerodynamic interaction between the fan core stream section and the high-pressure compressor of a three-shaft, low bypass ratio engine is described. At high fan running lines, a heavy single-cell rotating stall was found in the fan core stream even at high aerodynamic speeds of between 90-98 percent. The rotating circumferential distortion with 180-200 deg sector angle is swallowed by the intermediate pressure compressor, but erodes the high pressure compressor surge margin by about 22 percent, leading to steady-state surges. A remotely mounted transducer in a specific arrangement was used successfully for measurements in the hot environment behind intermediate and high pressure compressor using a 'long-line' system with a closed end at the downstream pipe. Author

A86-13054*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIBER OPTICS FOR PROPULSION CONTROL SYSTEMS
R. J. BAUMBICK (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 851-855. Previously announced in STAR as N84-14111.
(ASME PAPER 84-GT-97)

In aircraft systems with digital controls, fiberoptics has advantages over wire systems because of its inherent immunity to electromagnetic noise (EMI) and electromagnetic pulses (EMP). It also offers a weight benefit when metallic conductors are replaced by optical fibers. To take full advantage of the benefits of optical waveguides, passive optical sensors are also being developed to eliminate the need for electrical power to the sensor. Fiberoptics may also be used for controlling actuators on engine and airframe. In this application, the optical fibers, connectors, etc. will be subjected to high temperature and vibrations. This paper discussed the use of fiberoptics in aircraft propulsion systems together with the optical sensors and optically controlled actuators being developed to take full advantage of the benefits which fiberoptics offers. The requirements for sensors and actuators in advanced propulsion systems are identified. The benefits of using fiberoptics in place of conventional wire systems are discussed as well as the environmental conditions under which the optical components must operate. B.W.

A86-13058#
THE DESIGN, PERFORMANCE AND ANALYSIS OF A HIGH WORK CAPACITY TRANSONIC TURBINE
J. D. BRYCE, M. R. LITCHFIELD, and N. P. LEVERSUCH (Royal Aircraft Establishment, Farnborough, England) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 931-937. refs
(ASME PAPER 85-GT-15)

This paper describes the design and testing of a high work capacity single-stage transonic turbine of aerodynamic duty tailored to the requirements of driving the high-pressure core of a lowcost turbofan engine. Aerodynamic loading was high for this duty, and a major objective in the design was the control of the resulting transonic flow to achieve good turbine performance. Practical and coolable blading was a design requirement. At the design point (pressure ratio = 4.48), a turbine total-to-total efficiency of 87.0 percent was measured, based on measured shaft power and a tip clearance of 1.4 percent of blade height. In addition, the turbine was comprehensively instrumented to allow measurement of aerofoil surface static pressures on both stator and rotor; the latter being expedited via a rotating 'scanivalve' system. Downstream area traverses were also conducted. Analysis of these measurements indicates that the turbine operates at overall reaction levels lower than design, but the rotor blade performs efficiently. Author

A86-13173
MATERIALS AND MANUFACTURING PROCESSES FOR ADVANCED JET ENGINES
R. E. SCHAFRIK (USAF, Systems Command, Andrews AFB, MD) and R. WILLIAMS (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1424-1429. refs

This paper will discuss requirements and developments in materials performance, manufacturing quality, and life cycle cost for future jet engines. Advances in powered flight have always required improvements in engine technology which, in turn, has oftentimes been paced by progress in materials and manufacturing technology. In addition, man-rated aircraft demand the ultimate in propulsion system reliability. As a result, assuring quality of aeronautical engine parts and assemblies has become as important as the material properties used by the design engineer. And since the cost of owning and operating aircraft has become a key factor in selecting a system and determining the quantity to be purchased, factors such as engine durability, ease of repair, and in-service inspectability now have equal status to material performance and manufacturing quality. The impact of these three elements is playing a significant role in determining future directions for military jet aircraft engines. Author

A86-13408
CRITICAL VALUES OF THE MACH NUMBER OF A RADIAL AIRFOIL CASCADE [O KRITICHESKIKH ZNACHENIIAKH CHISLA M RADIAL'NOI RESHETKI PROFILEI]
V. A. GALAEV, N. A. ERMOLAEVA, and IU. A. ZABELIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 110-114. In Russian.

The efficiency of a turboprop engine is largely determined by the critical Mach number of the system propeller-spinner-intake. Here, the real system is replaced by a schematic radial airfoil cascade, and a numerical solution is obtained for the velocity potential describing the mean axisymmetric flow past the cascade. The solution yields an expression relating the critical Mach number to the cascade density. V.L.

A86-13444
CALCULATION OF UNSTEADY FLOW IN A TWO-STAGE GAS TURBINE ENGINE [RASCHET NESTATSIONARNOGO TECHENIIA V DVUKHKONTURNOM GAZOTURBINNOM DVIGATELE]
V. F. PAVLENKO, IU. A. SKVORTSOV, and A. S. TUTUSHKIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 114-119. In Russian. refs

The paper presents a mathematical model of a two-stage turbojet engine with an afterburner operating in a one-dimensional unsteady flow. The model, based on integral equations of gas dynamics, makes it possible to investigate gas-dynamic stability problems in such engines. Unsteady-flow parameters in the case of abrupt changes of fuel consumption in the main combustion chamber are calculated. B.J.

A86-13447
DESIGN OF THE FLOW PATH OF AIRCRAFT GAS-TURBINE ENGINES [PROEKTIROVANIE PROTOCHNOI CHASTI TURBIN AVIATSIONNYKH DVIGATELEI]
S. Z. KOPELEV Moscow, Izdatel'stvo Mashinostroenie, 1984, 224 p. In Russian. refs

The fundamentals of the theory and design of axial-flow gas turbines are presented. Attention is given to the rational selection of a particular flow-path scheme during the design of an aircraft gas-turbine engine and its gasdynamic analysis as a function of the specified parameters. The effect of the structural components of the turbine flow path on the efficiency of the turbine is demonstrated. Analytical profiling techniques using Bernoulli lemniscates are presented. V.L.

A86-13599
CUMULATIVE-DAMAGE MODELING OF FATIGUE CRACK GROWTH IN TURBINE ENGINE MATERIALS
J. M. LARSEN and T. NICHOLAS (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 22, no. 4, 1985, p. 713-730. refs
(Contract AF PROJECT 2307P102)

Life predictions of turbine engine structural components utilize fracture mechanics principles to determine fatigue crack growth rates. Fatigue cracks grow under conditions of variable temperature, frequency, hold time, stress ratio and stress level. At elevated temperatures, time-dependent material behavior can play a significant role in the material behavior. Cumulative-damage models must account for all these variables as well as interaction effects. The earliest modeling involved interaction schemes and, primarily, time-independent material behavior. More recent work has focused on time-dependence and creep-fatigue interaction effects. A review of current modeling concepts is presented. Author

A86-14226*# *National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.*
SENSOR FAILURE DETECTION FOR JET ENGINES USING ANALYTICAL REDUNDANCY
W. C. MERRILL (NASA, Lewis Research Center, Cleveland, OH) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Nov.-Dec. 1985, p. 673-682. Previously cited in issue 05, p. 553, Accession no. A85-16097. refs

A86-14244#
RESERVE GENERATOR FOR OVER-OCEAN TWINS
R. DEMEIS Aerospace America (ISSN 0740-722X), vol. 23, Nov. 1985, p. 26, 28.

Attention is given to the design features, performance, and operational functions of a reserve generator that has been installed in the twin-engine, transoceanic range 767-300 airliner. This generator, which serves as a second backup to engine-driven generators, is driven by a constant speed, variable-displacement servocontrolled hydraulic motor. The self-excited generator and hydraulic motor are installed in the wheel well of the aircraft. O.C.

A86-14338* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION ANALYSIS OF ROTATING TURBOMACHINERY BLADES BY AN IMPROVED FINITE DIFFERENCE METHOD
K. B. SUBRAHMANYAM and K. R. V. KAZA (NASA, Lewis Research Center, Cleveland, OH) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 21, Oct. 1985, p. 1871-1886. refs

The problem of calculating the natural frequencies and mode shapes of rotating blades is solved by an improved finite difference procedure based on second-order central differences. Lead-lag, flapping and coupled bending-torsional vibration cases of untwisted blades are considered. Results obtained by using the present improved theory have been observed to be close lower bound solutions. The convergence has been found to be rapid in comparison with the classical first-order finite difference method. While the computational space and time required by the present approach is observed to be almost the same as that required by the first-order theory for a given mesh size, accuracies of practical interest can be obtained by using the improved finite difference procedure with a relatively smaller matrix size, in contrast to the classical finite difference procedure which requires either a larger matrix or an extrapolation procedure for improvement in accuracy. Author

A86-14358#
DEVELOPMENT OF MODERN TURBOPROP ENGINES
H. I. H. SARAVANAMUTTOO (Carleton University, Ottawa, Canada) (NATO, AGARD, Specialist Meeting on Aerodynamics and Acoustics of Propellers, Toronto, Canada, Oct. 1984) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, June 1985, p. 131-139. NSERC-supported research. refs

An evaluation is made of configurational possibilities and technology readiness considerations relevant to the design of turboprop powerplants suitable for 'propfan' propulsion of airliners, with attention to engine core performance advancements made since turboprops were last used in airliners (the late 1950s) and the critical upgrading of transmissions for the higher power levels envisaged. The technical risks foreseen suggest a channeling of initial efforts toward engines of moderate, 10,000-12,000 shp output; the goal of Mach 0.8 cruise speeds for such power plants, as set by NASA, may be overly ambitious. O.C.

A86-14430*# *Army Propulsion Lab., Cleveland, Ohio.*
DEAN - A PROGRAM FOR DYNAMIC ENGINE ANALYSIS
G. G. SADLER (U.S. Army, Propulsion Laboratory, Cleveland, OH) and K. J. MELCHER (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 17 p. Previously announced in STAR as N85-28945. refs
(AIAA PAPER 85-1354)

The Dynamic Engine Analysis Program, DEAN, is a FORTRAN code implemented on the IBM/370 mainframe at NASA Lewis Research Center for digital simulation of turbofan engine dynamics. DEAN is an interactive program which allows the user to simulate engine subsystems as well as full engine systems with relative ease. The nonlinear first order ordinary differential equations which define the engine model may be solved by one of four integration schemes, a second order Runge-Kutta, a fourth order Runge-Kutta, an Adams Predictor-Corrector, or Gear's method for still systems. The numerical data generated by the model equations are displayed at specified intervals between which the user may choose to modify various parameters affecting the model equations and transient execution. Following the transient run, versatile graphics capabilities allow close examination of the data. DEAN's modeling procedure and capabilities are demonstrated by generating a model of simple compressor rig. Author

A86-14528*# General Electric Co., Cincinnati, Ohio.
SUBSCALE-MODEL AND FULL-SCALE ENGINE MIXED-FLOW EXHAUST SYSTEM PERFORMANCE COMPARISON
A. P. KUCHAR (General Electric Co., Advanced Engineering Technologies Dept., Cincinnati, OH) and R. CHAMBERLIN (NASA, Lewis Research Center, Cleveland, OH) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 950-955. Previously cited in issue 06, p. 723, Accession no. A84-17997. refs

A86-14562#
SOLID FUEL RAMJET SIMULATOR RESULTS - EXPERIMENT AND ANALYSIS IN COLD FLOW
J. RICHARDSON, W. A. DE GROOT, J. I. JAGODA, R. E. WALTERICK, J. E. HUBBARTT (Georgia Institute of Technology, Atlanta) et al. Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 488-493. Previously cited in issue 07, p. 856, Accession no. A85-19671. refs
(Contract AF-AFOSR-83-0356)

A86-15225* Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
RIBBON-BURNER SIMULATION OF T-700 TURBINE SHROUD FOR CERAMIC-LINED SEALS RESEARCH
J. K. LITTLE (USAF, Arnold Air Force Station, TN), G. P. ALLEN, G. MCDONALD, and R. C. HENDRICKS (NASA, Lewis Research Center, Cleveland, OH) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 6, July-Aug. 1985, p. 849-861. Previously announced in STAR as N85-19364. refs

Experimental and analytical studies were conducted to determine the acceptability of a ribbon-burner simulation of engine conditions for testing ceramic-lined turbine tip shrouds. The calculated values reveal that the ribbon burner establishes at least as harsh a thermal environment as is present at any time within the turbine shroud. Comparisons were made with ceramic components in a turboshaft engine. Author

A86-15410
TEST OF JET ENGINE TURBINE BLADES BY THERMOGRAPHY
K. DING (MTU Motoren- und Turbinen-Union Muenchen GmbH, Munich, West Germany) IN: International Conference on Thermal Infrared Sensing for Diagnostics and Control (Thermosense VII), Cambridge, MA, November 5-8, 1984, Proceedings . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1985, p. 52-58. refs

Two applications of thermography for testing and development of turbomachinery components are described. Fabrication defects in the cooling system of internally cooled turbine blades are

detected by transient heating of the blade and measuring its surface temperature distribution by an infrared imaging system. Defects like blocking, narrowing, widening, and mispositioning of cooling channels can clearly be identified by the disturbance of the transient surface temperature distribution of the blade. To improve the cooling configuration of turbine blades, the cooling effectiveness over the total blade surface must be determined under test conditions similar to those in the turbomachine. The infrared measurement of blade surface temperature distributions in a hot air cascade and the method for correcting the infrared intensities for radiation reflected at the measuring surface are illustrated in an example. Author

N86-12225 Department of the Air Force, Washington, D.C.
COMPARTMENTED, FILAMENT WOUND, ONE-PIECE AIRCRAFT FUEL TANKS Patent
E. J. MORRISEY, inventor (to Air Force) 16 Apr. 1985 6 p
(AD-D011793; US-PATENT-4,511,105;
US-PATENT-CLASS-244-135) Avail: US Patent and Trademark Office CSCL 01C

An external aircraft fuel tank is provided which comprises a filament-reinforced fuel cell assembled with aerodynamic end shapes having a plurality of layers of adhesive resin-impregnated filament wrappings over the assembly. Also provided is a method for making the fuel tank. Author (GRA)

N86-12227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLUID MACHINES: EXPANDING THE LIMITS, PAST AND FUTURE
M. J. HARTMANN and D. M. SANDERCOCK 1985 46 p refs Presented at the Winter Ann. Meeting of the Am. Soc. of Mech. Eng., Miami Beach, Fla., 17-22 Nov. 1985
(NASA-TM-87161; E-2793; NAS 1.15:87161) Avail: NTIS HC A03/MF A01 CSCL 21E

During the 40 yr period from 1940 to 1980, the capabilities and operating limits of fluid machines were greatly extended. This was due to a research program, carried out to meet the needs of aerospace programs. Some of the events are reviewed. Overall advancements of all machinery components are discussed followed by a detailed examination of technology advancements in axial compressors and pumps. Future technology needs are suggested. E.A.K.

N86-12228# Department of the Air Force, Washington, D.C.
IMPROVED TEMPERATURE DETECTION SYSTEM FOR USE ON FILM COOLED TURBINE AIRFOILS Patent Application
R. FREDERICK, inventor (to Air Force) 1 May 1985 13 p
(AD-D011762; US-PATENT-APPL-SN-729388) Avail: NTIS HC A02/MF A01 CSCL 21E

This patent application discloses an improved temperature detection system for use on film cooled turbine airfoils having a showerhead assembly with a series of parallel slots defined in the leading edge of an airfoil, each slot having a multiplicity of film flow ports exiting therefrom. A plurality of sensor assemblies are affixed to the airfoil showerhead and are couplable via electrodes to electronic sensing equipment for establishing the gas flow temperature. GRA

N86-12229# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
COMPRESSOR RESEARCH FACILITY F100 HIGH PRESSURE COMPRESSOR INLET TOTAL PRESSURE AND SWIRL PROFILE SIMULATION Final Report, Dec. 1980 - Nov. 1983
W. W. COPENHAVER Oct. 1984 287 p
(Contract AF PROJ. 3066)
(AD-A157108; AFWAL-TR-84-2030) Avail: NTIS HC A13/MF A01 CSCL 21E

The F100 gas turbine engine currently powers the Air Force F-15 and F-16 aircraft. The compression section of this engine consists of a three-stage fan followed by a ten-stage High Pressure Compressor (HPC). A component test of the F100 HPC will be performed in the Compressor Research Facility (CRF) of the Aero Propulsion Laboratory (APL) at Wright-Patterson Air Force Base, to investigate its stall and post stall characteristics. This testing will require that the high pressure compressor entrance profiles be simulated to obtain results which correspond to actual engine operation. Since these entrance profiles had never been measured, a program was designed to experimentally measure the total and static pressure, temperature and flow angle profiles at the HPC entrance of an F100 Series 3 engine (F100 (3)), (S/NP072). The measured profile data were then used as design data for a set of inlet screens and vanes. These vanes and screens will simulate the engine fan discharge profiles for the HPC test. The manufactured screens and vanes were tested in Room 24 of Building 18 of the Air Force Wright Aeronautical Laboratories to verify their simulation capabilities. Five separate test periods were necessary to achieve the program goals. These tests are described in Sections 2 thru VI. The program discussion and conclusions are presented in Section 7 and 8. GRA

N86-12230# Battelle Columbus Labs., Ohio.
COMPOSITION AND PHOTOCHEMICAL REACTIVITY OF TURBINE ENGINE EXHAUST Final Report, Mar. 1983 - Sep. 1984
C. W. SPICER, M. W. HOLDREN, F. F. LYON, and R. M. RIGGIN Jun. 1985 52 p
(Contract F08635-82-C-0131)
(AD-A157643; AFESC/ESL-TR-84-61) Avail: NTIS HC A04/MF A01 CSCL 21B

This study was carried out to augment the results of an earlier investigation of turbine engine emissions. Experiments were conducted to investigate the photochemical reactivity and biological activity of exhaust from a full-scale 60 deg. sector combustor from a TF-39 turbine engine. All experiments were carried out at idle power setting. The study utilized exhaust from two conventional petroleum fuels (JP-4 and JP-5) and a shale fuel meeting JP-4 specifications. Photochemical reactivity was studied with two large (8 cum 3)n Teflon outdoor environmental chambers. Photochemical reactivity is defined for purposes of this study as the maximum ozone concentration produced during a one day irradiation in natural sunlight. Experiments were undertaken with a TF-39 combustor operating on JP-4 and JP-5 fuels, for comparison with pervious studies of a full-scale TF-39 engine. The combustor exhaust was more effective than exhaust from the full-scale engine, regardless of which fuel was burned. The combustor exhaust was 60 percent more reactive than engine exhaust for JP-5 fuel, and between 30 and 100 percent more reactive for JP-4 fuel. The photochemical reactivity of exhaust generated from a shale oil-derived fuel meeting JP-4 specifications was studied. Exhaust from the shale fuel was no more reactive than exhaust from petroleum fuels, and under some circumstances was actually less reactive. The shale fuel exhaust also generated less secondary aerosol than exhaust from the petroleum fuels. GRA

N86-12231# Naval Weapons Center, China Lake, Calif.
ANALYSIS OF PARTICULATES IN THE EXHAUST PLUME OF A J52-P3 TURBOJET ENGINE AT MILITARY POWER Interim Report, Oct. 1983 - Sep. 1984
J. H. JOHNSON, E. D. ERICKSON, and D. J. KNIGHT Mar. 1985 27 p
(AD-A157840; AD-E900455; NWC-TP-6618) Avail: NTIS HC A03/MF A01 CSCL 21E

This report presents particulate concentration, emission index, and size distribution data in the exhaust plume of a J52-P3 turbojet engine, run at military power in the open air. Recommendations are listed for future tests. GRA

N86-12232# Department of the Air Force, Washington, D.C.
LENGTH ADJUSTABLE STRUT LINK WITH LOW AERODYNAMIC DRAG Patent Application
D. NASH, inventor (to Air Force) 10 Jul. 1985 25 p
(AD-D011851; US-PATENT-APPL-SN-753462) Avail: NTIS HC A02/MF A01 CSCL 13E

This patent application discloses a low aerodynamic drag structural link suitable for use within the housing of a turbofan jet

engine. The link includes length adjustment capability, pivotal end mounting provision, maintained airstream orientation capability, low mass and jam nut length and orientation locking. Several variations in link construction including a single ball and socket arrangement, varying link cross-section along its longitudinal length and the use of fairing nose and tail inserts are disclosed. GRA

N86-13328*# Teledyne Continental Motors, Muskegon, Mich.
LIGHTWEIGHT TWO-STROKE CYCLE AIRCRAFT DIESEL ENGINE TECHNOLOGY ENABLEMENT PROGRAM, VOLUME 1 Final Report, Dec. 1979 - Aug. 1985
P. D. FREEN, S. G. BERENYI, A. P. BROUWERS, and M. E. MOYNIHAN Aug. 1985 116 p
(Contract NAS3-22218)
(NASA-CR-174923-VOL-1; NAS 1.26:174923-VOL-1) Avail: NTIS HC A06/MF A01 CSCL 21G

An experimental Single Cylinder Test Engine Program is conducted to confirm the analytically projected performance of a two-stroke cycle diesel engine for aircraft applications. The test engine delivered 78kW indicated power from 1007cc displacement, operating at 3500 RPM on Schnuerle loop scavenged two-stroke cycle. Testing confirms the ability of a proposed 4-cylinder version of such an engine to reach the target power at altitude, in a highly turbocharged configuration. The experimental program defines all necessary parameters to permit design of a multicylinder engine for eventual flight applications; including injection system requirement, turbocharging, heat rejection, breathing, scavenging, and structural requirements. The multicylinder engine concept is configured to operate with an augmented turbocharger, but with no primary scavenge blower. The test program is oriented to provide a balanced turbocharger compressor to turbine power balance without an auxiliary scavenging system. Engine cylinder heat rejection to the ambient air has been significantly reduced and the minimum overall turbocharger efficiency required is within the range of commercially available turbochargers. Analytical studies and finite element modeling is made of insulated configurations of the engines - including both ceramic and metallic versions. A second generation test engine is designed based on current test results. Author

N86-13329*# Teledyne Continental Motors, Muskegon, Mich.
LIGHTWEIGHT TWO-STROKE CYCLE AIRCRAFT DIESEL ENGINE TECHNOLOGY ENABLEMENT PROGRAM, VOLUME 2 Final Report, Dec. 1979 - Aug. 1985
P. D. FREEN, S. G. BERENYI, A. P. BROUWERS, and M. E. MOYNIHAN Aug. 1985 150 p refs
(Contract NAS3-22218)
(NASA-CR-174923-VOL-2; NAS 1.26:174923-VOL-2) Avail: NTIS HC A07/MF A01 CSCL 21G

An experimental Single Cylinder Test Engine Program is conducted to confirm the analytically projected performance of a two-stroke cycle diesel engine for aircraft applications. Testing confirms the ability of a proposed 4-cylinder version of such an engine to reach the target power at altitude in a highly turbocharged configuration. The experimental program defines all necessary parameters to permit a design of a multicylinder engine for eventual flight applications. Author

N86-13330*# Teledyne Continental Motors, Muskegon, Mich.
LIGHTWEIGHT TWO-STROKE CYCLE AIRCRAFT DIESEL ENGINE TECHNOLOGY ENABLEMENT PROGRAM, VOLUME 3 Final Report, Dec. 1979 - Aug. 1985
P. D. FREEN, S. G. BERENYI, A. P. BROUWERS, and M. E. MOYNIHAN Aug. 1985 282 p
(Contract NAS3-22218)
(NASA-CR-174923-VOL-3; NAS 1.26:174923-VOL-3) Avail: NTIS HC A13/MF A01 CSCL 21G

An experimental Single Cylinder Test Engine Program is conducted to confirm the analytically projected performance of a two-stroke cycle diesel engine for aircraft applications. Testing confirms the ability of a proposed 4-cylinder version of such an engine to reach the target power at altitude in a highly turbocharged configuration. The experimental program defines all necessary parameters to permit design of a multicylinder engine for eventual flight applications. Author

N86-13331# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
HUB EFFECTS IN PROPELLER DESIGN AND ANALYSIS
M. H. WANG Jul. 1985 183 p
(Contract N00014-82-K-0198)
(AD-A158853; OE-85-14) Avail: NTIS HC A09/MF A01 CSCL 20D

A numerical model is established for the design of propeller blade shape for a prescribed circulation and a given hub geometry. The vortex lattice approach is adapted for blades and their wakes. The hub is represented by a distribution of dipoles which ends at the hub apex. It is shown that consideration of the hub results in a lower pitch and lower camber at the inner radii. An iterative method is developed for analyzing the interference between the blades and the hub. It is shown that the circulation at the root of a propeller with a hub is larger than the circulation at the root of a propeller without a hub. Two examples show that the increase in thrust due to hub effects has the same order of magnitude as the drag force effects on the hub for propellers which are moderately loaded at the hub. Experiments are carried out for comparison with the numerical results. Excellent agreement is obtained in the circulation distribution for a conventional propeller, and fair agreement for a controllable pitch propeller. Experimental results show what the circulation is, roughly speaking, conserved. A method for estimating the drag force of the hub due to the hub vortex is established by assuming that the circulation is conserved. GRA

08

AIRCRAFT STABILITY AND CONTROL

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

A86-13355
ESTIMATION OF THE PROBABILITY OF A FLIGHT PARAMETER EXCEEDING A SPECIFIED VALUE UNDER CONDITIONS OF ATMOSPHERIC TURBULENCE [OTSENKA VEROIATNOSTI PREVYSHENIIA PARAMETROM POLETA ZADANNOGO ZNACHENIIA PRI DEISTVII ATMOSFERNOI TURBULENTNOSTI]
I. N. TITOVSKII and I. G. KHVOSTOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 74-81. In Russian. refs

The problem of the estimation of the probability of a flight parameter exceeding a specified value due to atmospheric turbulence is solved in the linear approximation using a continuous turbulence model and the stochastic process overshoot theory. A method is proposed for determining the probability of a parameter exceeding a specified value at least once during one hour of flight or per flight path unit length. The method also makes it possible to determine the average number of such overshooots per flight. V.L.

A86-13365
ESTIMATION OF THE DEVIATION LIMITS OF THE AIRCRAFT PATH PARAMETERS DURING AUTOMATIC LANDING [OTSENKA PREDEL'NYKH OTKLONENII PARAMETROV TRAEKTORII SAMOLETA PRI AVTOMATICHESKOI POSADKE]
V. P. KUZMIN and V. A. IAROSHEVSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 43-56. In Russian.

A method is proposed for specifying the worst-case longitudinal wind parameters during the automatic leveling-out of aircraft in order to estimate the deviation limits of the aircraft path parameters (the vertical velocity and the flight range) at the moment of touchdown corresponding to a low specified probability level (10

to the -5th - 10 to the -7th). The method proposed here is used to study the automatic landing of typical passenger aircraft. V.L.

A86-13370
A STUDY OF FLUTTER ON THE BASIS OF FREQUENCY TESTS AT SUBCRITICAL REGIMES [ISSLEDOVANIE FLATTERA NA OSNOVE CHASTOTNYKH ISPYTANII PRI DOKRITICHESKIKH REZHIMAKH]
B. D. BRIANTSEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 100-108. In Russian. refs

Algorithms are presented for deriving equations describing the vibrations of an elastic flight vehicle in air flow and for estimating the flutter characteristics from frequency tests at flow velocities that are substantially less than the critical flutter velocity. Analytical and experimental data are then presented to illustrate the possibilities afforded by the algorithms proposed here and their advantages over other methods of critical flutter velocity estimation. V.L.

A86-13394
CERTAIN CRITERIA AND FORMULAS FOR THE ANALYSIS OF FLEXURAL-TORSIONAL FLUTTER [NEKOTORYE KRITERII I FORMULY DLIA ANALIZA IZGIBNO-KRUTIL'NOGO FLATTERA]
G. A. BULYCHEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 143-150. In Russian.

Criteria and formulas are derived for the parametric investigation of flexural-torsional flutter on the basis of an analysis of the modes and frequencies of the natural vibrations. The usefulness of the expressions obtained is demonstrated by using them to evaluate the flutter characteristics of a large-aspect-ratio straight wing. Results are presented in graphical form. V.L.

A86-13417
MINIMIZATION OF AIRCRAFT FLIGHT TIME FOR A GIVEN DISTANCE WITH RETURN TO THE ORIGINAL POINT [MINIMIZATSIIA VREMENI POLETA SAMOLETA NA ZADANNUIU DAL'NOST' S VOZVRASHCHENIEM V ISKHODNUIU TOCHKU]
V. F. ILLARIONOV and V. T. PASHINTSEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 54-67. In Russian. refs

An approximate approach is used to consider the problem of minimizing the flight time of an aircraft with a fixed fuel supply for a given distance with return to the original point. The optimal flight profile is constructed on the basis of the standard energy method with variation of only one parameter having a physical significance. A description is given of a method for determining the saddle points of a family of extrema corresponding either to steady-state flight regimes or to singular thrust-control regimes. A numerical example concerning flight at a constant altitude is given. B.J.

A86-13435
METHOD FOR CALCULATING THE EQUILIBRIUM SPIN OF AN AIRCRAFT [METOD RASCHETA USTANOVIVSHEGOSIA DVIZHENIIA SAMOLETA PO SPIRALI]
V. K. SVIATODUKH TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 51-62. In Russian. refs

Equations for the equilibrium spin of an aircraft are obtained in a form containing the angle of attack alpha, the sideslip angle beta, the direction cosines of the vertical, and the parameter (omega) (V)/g, where omega is the angular velocity and V is the modulus of the center-of-mass velocity. The direction cosines of the vertical are determined as explicit functions of alpha, beta, and (omega)(V)/g in the case when the aerodynamic forces do not depend on the angular velocities of the aircraft. In this case the complete equations of equilibrium motion are reduced to three moment equations depending on the above three variables. A method for the approximate determination of the dependence of the aerodynamic forces on the angular velocities of the aircraft is proposed. B.J.

A86-13436
CALCULATION OF EQUILIBRIUM TURN [RASCHET USTANOVIVSHEGOSIA VIRAZHA]
A. A. SHILOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 63-70. In Russian.

A method is developed for calculating the characteristics of such motions of an aircraft as equilibrium turn, descending turn, and equilibrium spin. Particular attention is given to the structure of the kinematic and dynamic equations used to solve the problem for arbitrary aerodynamic characteristics of the aircraft. B.J.

A86-13931
DYNAMICS OF NON-AUTONOMOUS SPATIAL MOTION OF AN AEROPLANE WITH DEFORMABLE CONTROL SYSTEMS
Z. DZYGADLO and A. KRZYZANOWSKI Journal of Technical Physics (ISSN 0324-8313), vol. 25, no. 1, 1984, p. 53-77. refs

The dynamics of nonautonomous spatial motion of an aircraft with deformable control systems and moving ponderable control surfaces is analyzed. A complete nonlinear set of equations of spatial motion is derived, introducing time-dependent external forces and taking into account the elasticity and damping in the control systems and the unbalance of the ailerons, the elevator, and the rudder. A program for the numerical integration of the equations by the Runge-Kutta-Gill method is used. The effect of external forces on the dynamics of the aircraft's spatial motion is studied. The influence of stiffness and damping in the controls is investigated with a numerical resonance analysis of the oscillating control surface. C.D.

A86-14235#
LONGITUDINAL STABILITY OF A HOVERING, TETHERED ROTORCRAFT
D. C. RYE (Sydney, University, Australia) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Nov.-Dec. 1985, p. 743-752. refs

Linearized equations describing the perturbed longitudinal motion of a tethered rotorcraft are presented. The tethering cable is assumed to be straight and inextensible. This permits development of two degree-of-freedom equations which admit cable tension variations. Routh's criteria are applied to a simplified stability quartic for hovering flight in an analytic search for stable configurations. The cable length, equilibrium tension, and point of attachment strongly influence the stability of perturbed motion. If the cable is short, the machines considered may be inherently stable. This does not appear to be possible for hovering flight on very long cables. Numerical solutions to the complete stability quartic show good agreement with approximate Routh's-criteria predictions. Author

A86-14236*# Princeton Univ., N. J.
STABILITY AND CONTROL OF VTOL CAPABLE AIRSHIPS IN HOVERING FLIGHT
H. C. CURTISS, JR. (Princeton University, NJ) and V. SUMANTRAN Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Nov.-Dec. 1985, p. 753-760. refs
(Contract NAG2-98)

The stability and control characteristics of an airship equipped with lifting rotors to provide a modest VTOL capability are discussed. The rotors are used for control and maneuvering in near-hovering flight. Configurations with two, three, and four lifting rotors are examined and compared with respect to control capabilities and dynamic response characteristics. Linearized models of the dynamics are employed for this study. A new approach to the prediction of rotor derivatives for operation near zero thrust in hover is presented. It is found that all three configurations have similar control and response characteristics. The responses are characterized by long time constants and low levels of angular damping. Author

A86-14243#
A SELF-REPAIRING AIRCRAFT?
E. J. LERNER Aerospace America (ISSN 0740-722X), vol. 23, Nov. 1985, p. 22, 24.

Attention is given to a computer program which will allow future control-configured fighter aircraft to automatically compensate for the loss of a control surface due to combat damage, in order to maintain stability. Such a system, if successfully implemented, would also be able to compensate for electronic and hydraulic system failures, effectively obviating the presently critical requirement for four-fold redundancy in such systems. This would reduce cost and complexity, while increasing MTBF. The reliable detection of system failures is identified as a major problem in implementation. O.C.

A86-14530*# California Univ., Los Angeles.
AEROMECHANICAL STABILITY ANALYSIS OF A HYBRID HEAVY LIFT MULTIROTOR VEHICLE IN HOVER
C. VENKATESAN and P. P. FRIEDMANN (California, University, Los Angeles) (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, p. 251-265) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 965-972. Previously cited in issue 13, p. 1836, Accession no. A84-31712. refs
(Contract NAG2-116)

A86-14531*# Flight Systems, Inc., Newport Beach, Calif.
IMPACT OF FLYING QUALITIES ON MISSION EFFECTIVENESS FOR HELICOPTER AIR COMBAT
T. M. HARRIS, D. A. BEERMAN (Flight Systems, Inc., Newport Beach, CA), and C. C. BIVENS (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 973-978. Previously cited in issue 20, p. 2855, Accession no. A84-42354. refs
(Contract NAS2-11178)

A86-14533#
FREE-FALLING AUTOROTATING PLATE - A COUPLED FLUID AND FLIGHT MECHANICS PROBLEM
C. R. GALLAWAY and W. L. HANKEY (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 983-987. Previously cited in issue 20, p. 2854, Accession no. A84-42336. refs

A86-14534#
THE NUMERICAL COMPUTATION OF AIRCRAFT RESPONSE TO ARBITRARY VERTICAL GUST DISTRIBUTIONS
J. AN (Chinese Aerodynamic Research and Development Centre, Mianyang, People's Republic of China), Z. YAN, W. ZHOU (Jiaotong University, Shanghai, People's Republic of China), and C. QIU (Shanghai Aircraft Co., People's Republic of China) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 988-992. Previously cited in issue 20, p. 2854, Accession no. A84-42331. refs

N86-12233*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
INTERACTIVE AIRCRAFT FLIGHT CONTROL AND AEROELASTIC STABILIZATION Semiannual Report, 1 May - 31 Oct. 1985
T. A. WEISSHAAR Nov. 1985 48 p refs
(Contract NAG1-157)
(NASA-CR-176323; NAS 1.26:176323) Avail: NTIS HC A03/MF A01 CSCL 01C

Aeroservoelastic optimization techniques were studied to determine a methodology for maximization of the stable flight envelope of an idealized, actively controlled, flexible airfoil. The equations of motion for the airfoil were developed in state-space form to include time-domain representations of aerodynamic forces and active control. The development of an optimization scheme to stabilize the aeroelastic system over a range of airspeeds, including the design airspeed is outlined. The solution approach was divided in two levels: (1) the airfoil structure, with a design variable represented by the shear center position; and (2) the control system. An objective was stated in mathematical form and a search was conducted with the restriction that each subsystem be constrained to be optimal in some sense. Analytical expressions are developed to compute the changes in the eigenvalues of the closed-loop, actively controlled system. A stability index is constructed to ensure that stability is present at the design speed and at other airspeeds away from the design speed. E.A.K.

N86-12234# Aeronautical Research Labs., Melbourne (Australia).
FLUTTER CLEARANCE TESTS ON A TRANSAVIA PL-12/T-400 SKYFARMER
A. GOLDMAN and S. GALEA Mar. 1985 66 p
(AD-A157212; ARL/STRUC-TM-400) Avail: NTIS HC A04/MF A01 CSCL 20D

The Transavia T-400 Skyfarmer is the latest version of the twin-boom agricultural aircraft and incorporates several changes from the T-300 model previously tested. Changes which could affect the flutter characteristics are: (1) Change of engine from 6 cylinder 300 horsepower to 8 cylinder 400 horsepower; (2) Increase in length of tail booms by 750 mm; (3) Increase in stub-wing span by 900 mm; (4) Removal of the spring-tab from the elevators; and (5) Addition of a dorsal stabilizer fin along each tail boom. A ground resonance test and subsequent flight tests were conducted on a Transavia T-400 Skyfarmer. The natural modes and frequencies of vibration were measured in the ground tests, and monitored during flight tests in which attempts were made to induce flutter. The results of these tests are presented. GRA

N86-12235# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
POST STALL MANEUVERS AND THRUST VECTORING PERFORMANCE ANALYSIS Final Technical Report, Aug. 1983 - Jul. 1984
L. E. MILLER Jul. 1984 77 p
(Contract AF PROJ. 2404)
(AD-A158100; AFWAL-TR-84-3109) Avail: NTIS HC A05/MF A01 CSCL 01B

The purpose of this effort was to determine whether or not there are any apparent performance improvements through post stall maneuvers (PSM) or thrust vectoring. The PSM is a result of high angles of attack, greater than the stall value. Two different problems were addressed. The first examined instantaneous turning performance. The second focused on minimum time turn problems. The impact of both vectored and nonvectored thrust was considered. It was proven that minimum time turns fall in the vertical plane. For maximum instantaneous turning rate and nonvectored thrust high angle of attack results if the speed is less than the critical speed which is approximately Mach 0.2. The optimal angle of attack approaches 90 deg as the speed approaches zero. For vectored thrust, the stall angle of attack is optimum and the thrust vector angle is the complement of the angle of attack. The PSM is not optimal if thrust vectoring is available. For minimum time turning performance, maximum thrust is optimal. At the end of the trajectory, the optimal angle of attack equals that for maximum instantaneous performance. The PSM is optimal. As the thrust to weight ratio increases, the maximum angle of attack increases. GRA

N86-12236# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AN APPLICATION OF ADAPTIVE LEARNING TO MALFUNCTION RECOVERY M.S. Thesis
R. E. CRUZ 1985 51 p
(AD-A158129; AFIT/CI/NR-85-85T) Avail: NTIS HC A04/MF A01 CSCL 01D

A self-organizing controller was developed for a simplified two-dimensional aircraft model. The controller learns how to pilot the aircraft through a navigational mission without exceeding pre-established position and velocity limits. The controller pilots the aircraft by activating one of eight directional actuators at all

times. By continually monitoring the aircraft's position and velocity with respect to the mission, the controller progressively modifies its decision rules to improve the aircraft's performance. When the controller has learned how to pilot the aircraft, two actuators fail permanently. Despite this malfunction, the controller regains proficiency at its original task. The experimental results reported show the controller's capabilities for self-organizing control, learning, and malfunction recovery. GRA

N86-12405# Joint Publications Research Service, Arlington, Va.
JAPANESE REPORT ON CHINA'S F-8 FIGHTER
Y. YUEBO *In its* China Rept.: Sci. and Technol. (JPRS-CST-85-035) p 70-72 17 Oct. 1985 Transl. into ENGLISH from Hangkong Zhishi (Beijing), no. 7, Jul. 1985 p 22-23
Avail: NTIS HC A08/MF A01

A new Chinese-built fighter aircraft has been unveiled. This aircraft, which is named the F-8, has a delta wing and a horizontal tail; it probably has two engines, and its maximum speed is estimated to be greater than Mach2. According to the article 1983-1984 Military Balance, approximately thirty F-8 aircraft are currently in service in the Chinese Air Force. G.L.C.

N86-13332*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PRELIMINARY EVALUATION OF THE GENERALIZED LIKELIHOOD RATIO FOR DETECTING AND IDENTIFYING CONTROL ELEMENT FAILURES IN A TRANSPORT AIRCRAFT
W. T. BUNDICK Sep. 1985 94 p refs
(NASA-TM-87620; NAS 1.15:87620) Avail: NTIS HC A05/MF A01 CSCL 01C

The application of the Generalized Likelihood Ratio technique to the detection and identification of aircraft control element failures has been evaluated in a linear digital simulation of the longitudinal dynamics of a B-737 aircraft. Simulation results show that the technique has potential but that the effects of wind turbulence and Kalman filter model errors are problems which must be overcome. Author

N86-13334# Air Force Academy, Colo.
PITCH RATE VERSUS G COMMAND AS THE LONGITUDINAL FLIGHT CONTROL SYSTEM DESIGN STRATEGY FOR A STATISTICALLY UNSTABLE FIGHTER TYPE AIRCRAFT WITH TWO CONTROL SURFACES
T. P. WEBB 2 Jul. 1985 32 p
(AD-A158803; USAFA-TN-85-8) Avail: NTIS HC A03/MF A01 CSCL 01D

Pitch rate command and normal G command longitudinal flight control systems were designed using linear optimal control theory for a statically unstable, two control surface, fighter-type aircraft at both a power approach and an up-and-away flight condition. The closed-loop systems were then evaluated in man-in-the-loop simulations with pilots attempting random altitude tracking and pitch tracking tasks. The evaluation results indicated that in the power approach flight condition, normal G command was more suitable for altitude tracking and pitch rate command was preferred for pitch tracking. Results for the up-and-away flight condition were inconclusive. GRA

N86-13335# Southwest Research Inst., San Antonio, Tex.
DIGITAL SERVOCONTROLLER SYSTEM. VOLUME 4. RESULTS AND CONCLUSIONS Final Report, Jul. 1983 - Nov. 1984
J. LOPEZ and K. MILLER Feb. 1985 31 p
(AD-A159068; SWRI-14-7676-VOL-4; AFWAL-TR-84-3117-VOL-4)
Avail: NTIS HC A03/MF A01 CSCL 09B

This final report describes an exploratory development effort for the design and fabrication of a digital servocontroller system for load control in full-scale air-frame fatigue tests. Each digital controller replaces four analog controllers. The LSI-11/23 microcomputer in the digital controller executes a PI algorithm to implement direct digital control. It may operate in a stand-alone mode or as a slave processor to a master computer via fiber optic link. Other programmable features specify loop parameters, building load profiles, adjusting control system gains and monitoring alarm and abort conditions. GRA

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RESEARCH AND SUPPORT FACILITIES (AIR)

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

A86-13214
GRUMMAN'S AUTOMATED TEST SYSTEMS
C. SCHIANO (Grumman Data Systems Corp., Calverton, NY) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 147-154.

Attention is given to the features and functions of a proprietary Automated Test System (ATS) that has been successfully used to support aircraft test data processing. The ATS consists of a complement of hardware and software subsystems which, when combined with a central processor, yield the integrated system capabilities required for real time/on-line test analyses. Interactive data processing of telemetered, range-acquired, and data base-generated test data furnishes real time answers to development engineer's questions. Development histories are given for the initial (1970-1983) and current (1983-1986) configurations of the ATS, as well as projected features for the 1987-1990s time frame. O.C.

A86-13248
CANADIAN FORCES PCM TELEMETRY PROCESSING AND DISPLAY SYSTEM
L. B. GLENESK and J. L. MARRIOTT (Aerospace Engineering Test Establishment, Medley, Canada) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 593-602.

The Canadian Forces Flight Test Facilities are described, and planned enhancements are examined. The facilities consist of the Aerospace Engineering Test Establishment (AETE) which includes the 200 square mile Primrose Lake Evaluation Range, 300 km east-northeast of Edmonton, Alberta. The facilities at PLER include nine phototheodolites, a telemetry tracking and receiving station, a meteorological station, command and control centers, and microwave and L-Band telemetry link to the main AETE facilities 50 km to the south. A new ground-based PCM telemetry processing and display system is described. D.H.

A86-13400
DIFFUSER PARAMETER OPTIMIZATION FOR LOW REYNOLDS NUMBERS USING EXPERIMENTAL DATA [OPTIMIZATSIIA PARAMETROV DIFFUZOROV PRI MALYKH CHISLAKH REINOL'DSA S ISPOL'ZOVANIIEM EKSPERIMENTAL'NYKH DANNYKH]
A. P. FILATOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 38-45. In Russian. refs

Pressure recovery in the diffuser of a wind tunnel has been investigated for Mach 4.4-8.5 and Re = 1300-7600 without models and with spherical models with model-to-nozzle cross-section ratios of 0.004-0.062. Semiempirical expressins are obtained which relate the optimum geometrical parameters of the diffuser throat, pressure recovery coefficients, and optimum diffuser efficiency to the Mach number at the nozzle exit section, and the relative cross-sectional area of the model. V.L.

A86-13405
USING SUCTION FOR INCREASING MACH NUMBERS IN A PERFORATED TEST SECTION WITH A SUBSONIC NOZZLE [ISPOL'ZOVANIE OTSOSA DLIA UVELICHENIIA CHISEL M V PERFORIROVANNOI RABOCHEI CHASTI S DOZVUKOVYM SOPLOM]
S. IU. BORISOV and Z. G. PASOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 93-98. In Russian.

It is shown that in the transonic perforated test section of a wind tunnel with a subsonic nozzle, Mach numbers up to 1.5 can be achieved by installing the panels of the test section at an angle of 1 deg 40 min and using suction. The suction coefficient does not exceed 8-10 percent, and there is practically no longitudinal pressure gradient in the vicinity of the model. V.L.

A86-13428
INFLUENCE OF UNSTEADY FLOW EFFECTS ON THE LENGTH OF OPERATION OF A HYPERSONIC SHOCK TUNNEL [VLIIANIE NESTATSIONARNYKH EFFEKTOV TECHENIIA NA PRODOLZHITEL'NOST' RABOTY GIPERZVUKOVOI UDARNOI TRUBY]
V. L. GRIGORENKO, A. M. NAUMOV, and N. I. KHVOSTOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 149-155. In Russian. refs

Unsteady flow processes are considered in a hypersonic shock wind tunnel where Mach numbers of 5-20 are achieved. This flow is analyzed numerically for a wide range of governing parameters in a quasi-one-dimensional framework using a mobile variable-step computational grid with identification of the main discontinuities and high-gradient regions of gas parameters. An algorithm is developed for considering the effect of unsteady flow processes in the nozzle on the length of operation of a shock wind tunnel. B.J.

A86-13443
SUBSONIC THERMAL WIND TUNNEL WITH AN EIFFEL CHAMBER [DOZVUKOVAIA TEPLOVAIA AERODINAMICHESKAIA TRUBA S KAMEROI EIFELIA]
A. M. BESPALOV, L. A. VNUKOVA, A. S. KROKHIN, and A. G. MIKHALCHENKO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 110-113. In Russian.

The paper gives a description of an ejector-type subsonic thermal wind tunnel with an Eiffel chamber. The wind tunnel is intended for measurements of friction distribution and viscous-flow structure on models using laser-knife, paint-drop-dispersion, and thermal-coating techniques. B.J.

A86-13848
THE RIGHT COMBINATION UNLOCKS AEROSPACE EMC
O. B. M. PIETERSEN (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) Microwaves & RF (ISSN 0745-2993), vol. 24, Oct. 1985, p. 73-78. refs

It is pointed out that aerospace vehicles present a difficult challenge for the designer concerned with electromagnetic compatibility (EMC). The requirement to keep electromagnetic interference (EMI) at acceptable levels makes it necessary to utilize a combination of empirical and computer-aided techniques. Generally, one of two basic approaches is used to ensure EMC. The specification-based approach relies on compliance with EMI specifications for each subsystem, while in the computer-aided approach, the designer predicts undesirable situations by calculations. A number of specifications are available to provide procedures for EMC testing of aerospace electronics systems and subsystems. Attention is given to transducers for EMI measurements, the major aerospace EMI specifications, EMI testing of large equipment, and the sample compatibility matrix. G.R.

A86-14246*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION WORLD MOVES UP TO V/STOL
A. M. COOK (NASA, Ames Research Center, Moffett Field, CA) Aerospace America (ISSN 0740-722X), vol. 23, Nov. 1985, p. 46-48.

NASA-Ames' Vertical Motion Simulator (VMS) is a large motion amplitude manned simulator designed for investigation of landing, takeoff, and general handling qualities and control system development for STOL and VTOL aircraft. The VMS incorporates six degrees of freedom, a four-window computer-generated imagery (CGI) system, and interchangeable cabs. The CGI generates day and night scenes that can include moving objects on the ground and in flight. A project is now underway to upgrade the VMS for research on rotorcraft engaged in nap-of-the-earth flight missions. O.C.

A86-14480#
ENGINE SIMULATOR TECHNIQUES FOR SCALED TEST CELL STUDIES
J. D. LEE and R. J. FREULER (Ohio State University, Columbus) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-11, 1985. 7 p. Research supported by the General Electric Co. refs
(AIAA PAPER 85-1282)

Research studies with scale model engine test cells for studying test cell aerodynamics, acoustics, and cell flow characteristics affecting engine performance have required the simulation of a variety of jet engines in accurate detail. Simulators of turboshaft engines (without propellers), low-bypass afterburning turbojets, and high-bypass turbofans were designed, fabricated and successfully operated using high-pressure air ejector systems for the motive power. The peculiar problems associated with such engine simulators and the methods used to attack these problems are described. This paper also outlines the specific designs used for four engine simulators. Author

A86-14532#
IMPROVED DRAG ELEMENT FOR WIND TUNNEL STING BALANCES
M. RINGEL and D. LEVIN (Technion - Israel Institute of Technology, Haifa) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 979-982. refs

The adverse relation between sensitivity and stiffness in wind tunnel internal sting balance design leads to solutions with high nonlinear interactions. Attention is presently given to a solution in which these interactions are minimized, and for which calibration results indicate an order-of-magnitude improvement in normal force interaction linearity as well as a 60 (or more) percent improvement in moment of interaction linearity. The novel sting balance design obtained on the basis of this method allows a higher sensitivity level of the drag output, with increased overall stiffness, to be obtained. O.C.

A86-15526
RADIO FREQUENCY CHAMBER IMPROVES LAMPS MK III TESTING
J. B. SCHULTZ Defense Electronics (ISSN 0278-3479), vol. 17, Nov. 1985, p. 53, 54, 56.

Attention is given to the design features, performance capabilities, and prospective applications of an RF test chamber which allows ground facility-based acceptance trials of military helicopter avionics to be conducted prior to flight testing in a highly controlled (indoor) environment. Tests encompass electromagnetic environment response and security and cryptological measures, with round-the-clock operations requiring minimum preparation time and fast recuperation from operational failures. The LAMPS Mk III antisubmarine warfare helicopter is currently undergoing tests; future testing is anticipated to involve the U.S. Navy V-22 tilt-rotor and U.S. Army LHX helicopter programs. O.C.

N86-12237*# College of William and Mary, Williamsburg, Va. Dept. of Computer Science.
USER'S GUIDE TO STIPPAN: A PANEL METHOD PROGRAM FOR SLOTTED TUNNEL INTERFERENCE PREDICTION Report, 16 Mar. - 15 Jun. 1985
W. B. KEMP, JR. 5 Nov. 1985 33 p refs
(Contract NCC1-69)
(NASA-CR-178003; NAS 1.26:178003) Avail: NTIS HC A03/MF A01 CSCL 14B

Guidelines are presented for use of the computer program STIPPAN to simulate the subsonic flow in a slotted wind tunnel test section with a known model disturbance. Input data requirements are defined in detail and other aspects of the program usage are discussed in more general terms. The program is written for use in a CDC CYBER 200 class vector processing system.
Author

N86-12238*# Vigyan Research Associates, Inc., Hampton, Va. Dept. of Aeronautics and Astronautics.
INTRODUCTION TO CRYOGENIC WIND TUNNELS
M. J. GOODYER (Southampton Univ.) Sep. 1985 14 p refs
(Contract NAS1-17919)
(NASA-CR-177966; NAS 1.26:177966; AGARD-722-PAPER-1)
Avail: NTIS HC A02/MF A01 CSCL 14B

The background to the evolution of the cryogenic wind tunnel is outlined, with particular reference to the late 60's/early 70's when efforts were begun to re-equip with larger wind tunnels. The problems of providing full scale Reynolds numbers in transonic testing were proving particularly intractible, when the notion of satisfying the needs with the cryogenic tunnel was proposed, and then adopted. The principles and advantages of the cryogenic tunnel are outlined, along with guidance on the coolant needs when this is liquid nitrogen, and with a note on energy recovery. Operational features of the tunnels are introduced with reference to a small low speed tunnel. Finally the outstanding contributions are highlighted of the 0.3-Meter Transonic Cryogenic Tunnel (TCT) at NASA Langley Research Center, and its personnel, to the furtherance of knowledge and confidence in the concept. Author

N86-12239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TUNNEL TURNING VANES OF MODERN DESIGN
T. F. GELDER, R. D. MOORE, J. M. SANZ, and E. R. MCFARLAND 1985 23 p refs Proposed for presentation at the 24th Aerospace Sci. Meeting, Reno, Nev., 6-8 Jan. 1986; sponsored by AIAA
(NASA-TM-87146; E-2775; NAS 1.15:87146; AIAA-86-0044)
Avail: NTIS HC A02/MF A01 CSCL 14B

Rehabilitation of the Altitude Wind Tunnel includes the need for new corner turning vanes to match its upgraded performance. The design and experimental performance results from a 0.1-full scale model of the highest speed corner (M = 0.35) are presented and discussed along with some two dimensional inviscid analyses of two vaned corners. With a vane designed by an inverse two dimensional technique, the overall corner loss was about 12% of the inlet dynamic pressure of which about 4% was caused by vane skin friction. Comparable values with a conventionally designed circular arc vane were about 14% overall with about 7% due to skin friction. E.A.K.

N86-12240*# College of William and Mary, Williamsburg, Va.
WALL-INTERFERENCE ASSESSMENT IN THREE-DIMENSIONAL SLOTTED-WALL WIND TUNNELS Final Technical Report, 16 Jun. 1982 - 15 Oct. 1985
W. B. KEMP, JR. Oct. 1985 11 p refs
(Contract NCC1-69)
(NASA-CR-176320; NAS 1.26:176320) Avail: NTIS HC A02/MF A01 CSCL 14B

The development of the slotted tunnel simulator code and lessons learned from its use are summarized. The high order panel method was selected as the basic procedure for aerodynamic computations. The panel singularities are supplemented by line sources to represent discrete wall slots. G.L.C.

N86-12241# Federal Aviation Administration, Washington, D.C. Associate Administrator for Airports.
REPORT OF ACCOMPLISHMENTS UNDER THE AIRPORT IMPROVEMENT PROGRAM Annual Report, period ending 30 Sep. 1984
V. J. MARTIN 30 Sep. 1984 125 p
(AD-A156834; AD-E301723; FAA-ARP-85-1; FAA-ARP-11; AR-3)
Avail: NTIS HC A06/MF A01 CSCL 01E

Section 521 of the Airport and Airway Improvement Act of 1982 (Public Law 97-248) requires that the Secretary of Transportation submit an annual report to Congress describing the accomplishments of the airport grant program. This report covers activities for the fiscal year ending September 30, 1984.
Author (GRA)

N86-12242# Florida Univ., Gainesville. Dept. of Civil Engineering.
CBR (CALIFORNIA BEARING RATIO) DESIGN OF FLEXIBLE AIRFIELD PAVEMENTS WITH CASE STUDY M.S. Thesis
T. M. DESTAFNEY 1985 94 p
(Contract N66314-72-A-3029)
(AD-A158101) Avail: NTIS HC A05/MF A01 CSCL 13B

It is the purpose of this paper to state the fundamentals involved in the design of flexible airfield pavements utilizing the U.S. Army Corps of Engineers CBR (California Bearing Ratio) design method. This paper also discusses concepts that are considered to be prerequisites to any discussion of the subject, including basic pavement theory, aircraft loading effects, subgrade strength, and aircraft characteristics related to design. The CBR method of design is outlined, and an actual design performed in order to more clearly illustrate this method of designing flexible airfield pavements.
GRA

N86-13337# Aeronautical Research Labs., Melbourne (Australia).
ALGORITHMS FOR THE REDUCTION OF WIND-TUNNEL DATA DERIVED FROM STRAIN GAUGE FORCE BALANCES
B. D. FAIRLIE 1985 49 p refs
(ARL/AERO-R-164; AR-004-017) Avail: NTIS HC A03/MF A01

Algorithms and procedures are presented for the reduction of force and moment data derived from wind-tunnel models supported by internal strain-gauge balances. The algorithms are developed in their most general forms, suitable for implementation on the new generation of powerful minicomputers currently being included in wind-tunnel data acquisition systems. Although the emphasis is on the treatment of data derived from sting mounted strain gauge force balances, the analysis is applicable, with only minor modifications, to data derived from modern load-cell based external force balances. Author

N86-13339# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
A DURABLE AIRFIELD MARKING SYSTEM Final Report, 23 Jun. 1980 - 30 Sep. 1984
T. NOVINSON Jun. 1985 52 p
(Contract AF PROJ. 2054)
(AD-A157953; AFESC/ESL-TR-84-59) Avail: NTIS HC A04/MF A01 CSCL 01E

This report describes a 4-year work unit on the selection, development, and testing of a novel airfield marking system on ceramic-coated aluminized steel (CAS) tiles. The CAS tiles were developed to replace painted center marking lines that are obliterated by rubber streaks from jet tires from landing aircraft. The tiles are recessed or set into the pavement by grinding out 50- by 30-foot sections (1/8 inch deep) and bonding the tiles with epoxy/polyamide adhesive (2,000- to 5,000-psi tensile strength). The tiles can be easily cleaned by spraying with aqueous detergent and wiping off the rubber residue. The tiles are flexible, weather-resistant, chemically resistant, and highly reflective in day or evening, without retroreflective glass spheres. At $2.00 to $5.00 sq. ft., the CAS tiles are much more expensive than Federal Specification TT-P-1952 latex paint (about $0.10 sq. ft.), but the high initial cost can be offset in 1 year by lower maintenance

costs. Although these CAS tiles are still being tested for Air Force use, the life cycle might be 5 to 10 years before replacement.
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.

A86-13386
ESTIMATION OF THE FLUCTUATION AMPLITUDE OF THE ANGLE OF ATTACK OF A FLIGHT VEHICLE WITH NONLINEAR DAMPING CHARACTERISTICS IN THE PRESENCE OF ATMOSPHERIC TURBULENCE [OTSENKA AMPLITUDY KOLEBANII UGLA ATAKI LETATEL'NOGO APPARATA S NELINEINYMI KHARAKTERISTIKAMI DEMPFIROVANIIA PRI NALICHII ATMOSFERNOI TURBULENTNOSTI]
A. S. NEMYKIN and V. A. IAROSHEVSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 85-98. In Russian. refs

The plane motion of a flight vehicle with nonlinear damping characteristics relative to its center of mass is analyzed. For the amplitude-phase variables, equations of motion are written using the Van der Pol transformation. The corresponding Fokker-Planck-Kholmogorov equations are averaged in phase, which makes it possible to determine the steady-state amplitude distribution and to solve the problem of the probability of the threshold amplitude being exceeded. Approximate analytical formulas are presented, and the results are compared with the numerical calculations. V.L.

11

CHEMISTRY AND MATERIALS

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

A86-12761
FRACTURE TOUGHNESS CHARACTERIZATION OF LIGHT ALLOYS FOR AERONAUTICAL USE
G. P. CAMMAROTA, G. GARAGNANI, P. BARIANI (Bologna, Universita, Italy), M. CIPRANDI, G. DONZELLI (Costruzioni Aeronautiche Giovanni Agusta S.p.A., Laboratorio Tecnologie Sperimentali, Gallarate, Italy) et al. International Journal of Fracture (ISSN 0376-9429), vol. 29, Sept. 1985, p. 47-55. refs

The fracture resistance properties of a rod and a plate, both made of 2024 aluminum alloy, are evaluated according to standard and non-standard methods. The materials are tested after heat treatments involving material microstructures different especially as to size and dispersion of the hardening precipitates. The sensitivity of various fracture-toughness parameters to microstructure conditions, specimen geometry, as well as their interactions is analyzed. Correlations established between standard and non-standard parameters confirm that alternative testing procedures are adequate to evaluate the fracture toughness of this alloy. Author

A86-12925* California Univ., Berkeley.
DYNAMIC FEATURES OF COMBUSTION
A. K. OPPENHEIM (California, University; California, University, Lawrence Berkeley Laboratory, Berkeley) Royal Society (London) Philosophical Transactions, Series A (ISSN 0080-4614), vol. 315, no. 1534, Sept. 26, 1985, p. 471-508. refs
(Contract DE-AC03-76SF-00098; NSF CPE-83-02232; NAG3-131; NAG3-137)

The dynamic features of combustion are discussed for four important cases: ignition, inflammation, explosion, and detonation. Ignition, the initiation of a self-sustained exothermic process, is considered in the simplest case of a closed thermodynamic system and its stochastic distribution. Inflammation, the initiation and propagation of self-sustained flames, is presented for turbulent flow. Explosion, the dynamic effects caused by the deposition of exothermic energy in a compressible medium, is illustrated by self-similar blast waves with energy deposition at the front and the adiabatic non-self-similar wave. Detonation, the most comprehensive illustration of all the dynamic effects of combustion, is discussed with a phenomenological account of the development and structure of the wave. C.D.

A86-12989
ATOM-PROBE MICROANALYSIS OF A NICKEL-BASE SUPERALLOY
D. BLAVETTE, A. BOSTEL, and J. M. SARRAU (Rouen-Haute Normandie, Universite, Mont-Saint-Aignan, France) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 16A, Oct. 1985, p. 1703-1711. refs

A field ion microscope (FIM) atom-probe has been used to investigate the phase compositions in a Nb-Mo bearing nickel-based superalloy. The composition of gamma-prime precipitates in fully heat-treated conditions was found to vary with their mean sizes. The matrix analyses revealed the presence of fine secondary precipitates (30 to 100 A) which occupy 10 percent of the overall volume of the material. The high spatial resolution of the atom-probe allowed the gamma-gamma-prime interface characterization. Composition profiles show that the transition between the phases occurs within one interplanar spacing. Finally, a long range order study of the ordered gamma-prime phase has been performed. The analysis of the L1(2) type (Ni, X)3 (Al, Y) precipitates, made on an atomic plane-by-plane basis, shows how alloying elements substitute for Ni and Al in the gamma-prime sublattice. The observed results, expressed in terms of occupancy probabilities for both types of sites, indicate that Ti, Nb, and Mo preferentially occupy Al sites while Cr and Co substitute for Ni.
Author

A86-13005
PROTECTING GAS TURBINE COMPONENTS - THE RELATIVE DURABILITY OF A CONVENTIONAL AND A PLATINUM-MODIFIED ALUMINIDE COATING
J. L. COCKING, G. R. JOHNSTON, and P. G. RICHARDS (Department of Defence, Materials Research Laboratories, Maribyrnong, Australia) Materials and Design (ISSN 0261-3069), vol. 6, Oct.-Nov. 1985, p. 224-229. refs

Platinum-modified aluminide coating for high pressure turbine blades and vanes was investigated by the Australian DOD. Conventional aluminide coating degradation research showed that the platinum-modified aluminide is superior. After 750 hours of operation, marked corrosive attack of the leading edge of the blades and concave side of the airfoil and corrosion pits along the center of the concave side were evident in the conventional aluminide coated engine. The 750 hours of operation of the platinum-modified aluminide coated engine retained 50 percent of the coating thickness in the areas of greatest attack such as the leading edge blades and the concave side; however, wide shallow pits occurred in the concave mid-chord region. Therefore, it was determined that platinum-modified aluminide coated blades are fit for re-use after 750 hours and even at full overhaul of 1000 hours of operation. F.J.

A86-13076
NATIONAL SAMPE SYMPOSIUM AND EXHIBITION, 30TH, ANAHEIM, CA, MARCH 19-21, 1985, PROCEEDINGS
Symposium and Exhibition sponsored by the Society for the Advancement of Material and Process Engineering. Covina, CA, Society for the Advancement of Material and Process Engineering (Science of Advanced Materials and Process Engineering Series. Volume 30), 1985, 1698 p. For individual items see A86-13077 to A86-13093, A86-13095 to A86-13102, A86-13104 to A86-13157, A86-13159 to A86-13164, A86-13166 to A86-13181.

Among the topics discussed are novel biomedical materials, high temperature polyimides, structures and materials for space structures, pressure sensitive adhesives, materials for advanced electronics, fiber/matrix-interface technologies, composite materials' testing and analysis techniques, thermoplastic matrices, recent advancements in automated and robotic manufacturing methods, and novel polymeric materials. Also covered are surface mount assembly technology, metallic materials for automated and robotic systems, novel matrix resin technologies, surface preparation and adhesive bonding methods, spacecraft and missile material design, the application of computers to materials engineering, advancements in filament winding techniques, advanced composites' design and manufacture, and environmental management. O.C.

A86-13082
A LOW TEMPERATURE CURING, QUICK REPAIR, FUEL RESISTANT AIRCRAFT SEALANT
L. MORRIS (Products Research and Chemical Corp., Glendale, CA) and C. NADLER (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 102-110.

The application times and cure rates of two commercial rapid curing Thiokol polysulfide based sealants of MIL-S-8802 and MIL-S-83318 (USAF) types are compared with the results observed with mercaptan terminated polythioether based sealants cured with epoxy resins. A tentative specification requiring more rapid low temperature conversions, MIL-S-85420 (AS), was used as the performance standard. The application and aging characteristics of the products equal or exceed the standards. A long application life, quick curing polythioether is also compared with current MIL-S-8802 qualified material and found to have advantages. Author

A86-13101
ADHESIVE SYSTEM FOR HIGH TEMPERATURE DESTRUCTIVE TESTING OF COMPOSITE STRUCTURES
C. M. GOOLSBAY (Vought Corp., Aero Products Div., Dallas, TX) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 399-405.

An adhesive test program has been conducted in order to develop an adhesive rubber tension pad system that would retain acceptable mechanical properties in a 400 F environment, such as that of the Navy S-3A aircraft's engine nacelle door. Mosite 14124 silicone rubber and 14206 film adhesive proved to be a system with performance far exceeding engine nacelle door test requirements. O.C.

A86-13103
COMPOSITE REPAIRS
H. BROWN, ED. (Society for the Advancement of Materials and Process Engineering, Azusa, CA) Covina, CA, Society for the Advancement of Materials and Process Engineering (SAMPE Monograph, No. 1), 1985. 232 p. No individual items are abstracted in this volume.

A comprehensive account is given of the advanced laminate composite repair methods that have been developed to date in the aerospace field, largely for fiber-reinforced polymer matrix composite aircraft primary structures. Attention is given to repair procedures for commercial transport aircraft graphite/epoxy structures, the acoustoultrasonic evaluation of impact-damaged graphite/epoxy, field level equipment for repair operations, depot level repair techniques, and intermediate/high temperature composite repair methods. Also discussed are the specialized methodologies for thermoplastic matrix composites and boron/epoxy composites, the repair of a stability-critical structure, and the effect of manufacturing defects on the strength of aircraft composite structures. O.C.

A86-13118
CONFORMAL COATING FOR SURFACE MOUNT ASSEMBLY
R. W. MALARIK (Lear Siegler, Inc., Instrument Div., Grand Rapids, MI) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 755-759.

Conformal coating of electronic assemblies with surface mounted devices represents a unique problem particularly related to the close spacing between the device and the board surface. Paraxylylene, a logical-choice, proved not to be satisfactory with a ceramic substrate. An acrylic resin was selected and a process established which satisfactorily sealed the device from the environment. Author

A86-13170
ELECTRICALLY CONDUCTIVE STRUCTURAL ADHESIVE
M. G. BILLIAS and M. E. BORDERS (Lockheed-Georgia Co., Marietta, GA) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1397-1407.

The electrically conductive structural adhesive developed for the C-5A military cargo aircraft can sustain the high currents of lightning strike without bond failure, and has passed all requirements of MIL-B-5087(B) in simulated lightning strike tests. It is now being used to bond static dischargers to the extremities of the C-5B variant. The adhesive incorporates aluminum particles in place of the previously employed silver, eliminating the galvanic corrosion potential that had been established with the aircraft structure. The static dischargers also withstand lightning strike currents. MIL-S-9129(B) is also successfully passed. O.C.

A86-13172
AIRCRAFT FIELD REPAIR
D. J. ZALUCHA (Lord Corp., Industrial Adhesives Div., Erie, PA) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1419-1423.

One approach to field repair of aircraft structures is the use of low energy cure adhesives to either bond patches and doubler plates in place or to serve as matrices for the fabrication of in situ composites. Advances in adhesive chemistry have in recent years led to the formulation of both epoxy and acrylic adhesives suitable for such field repairs, which can be conveniently packaged as kits for that purpose. While the epoxy systems can be cured with portable induction heaters, the acrylic ones may in addition take the form of two-element systems that can cure rapidly without additional energy input. O.C.

A86-13174
CONSTANT TEMPERATURE HEATERS FOR THE REPAIR OF COMPOSITE STRUCTURES
R. J. WALTY (Deposition Technology, Inc., San Diego, CA) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1441-1451.

The self-regulating heaters that have been developed to facilitate field repairs of composite aircraft structures heat to a specific temperature which is required by the resin system in question and permit careful temperature control over large areas,

using unregulated ac and dc power supplies. Tests have confirmed the superiority of these heaters to the constant wattage heaters currently in use, in light of thermal contour heat distribution analyses of both types of systems. O.C.

A86-14474#
METALS ANAD PLASTICS - STATE OF THE ART AND PERSPECTIVES [METAUX ET PLASTIQUES - ETAT ACTUEL ET PERSPECTIVES]
J. BRANDT, H. KELLERER, and P. WINKLER (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Association Aeronautique et Astronautique de France, Journee des Pionniers Europeens, Paris, France, Apr. 25, 1985, Paper. 35 p. In French.
(MBB-Z-49-85-OE)

Progress and expected advances in metals and plastics for aerospace usage, especially aircraft primary structures, are discussed. Metals, mostly Al and Ti alloys, are still the preferred materials, and are expected to be enhanced to have lower densities and display greater fracture resistance in the future. The advances will be achieved with new additives to the alloys, powder metallurgy, and superplastic forming. Metal matrix composites are also under investigation, as are fiber-reinforced plastics (FRPs), the latter being more developed and cheaper to produce than the metal counterparts. Kevlar and carbon fiber reinforcements are the most promising reinforcements; however, matrix materials have yet to reach reliability levels which would permit flight-certification of FRPs for primary structures. M.S.K.

A86-14566#
COMBUSTION RELATED TO SOLID-FUEL RAMJETS
B. N. RAGHUNANDAN, A. G. MARATHE (Indian Institute of Science, Bangalore, India), and E. R. RAVICHANDRAN Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 502-504. refs

Experiments conducted on a solid fuel ramjet-configuration apparatus have indicated that, at low inlet air temperatures, smoother ignition and sustained combustion are achievable through the dispersion of a small percentage of a solid oxidizer in the fuel matrix. Both the pressure index and the regression rate dependence on the transfer number encourage further examination and exploitation of this mode of combustion. O.C.

A86-15220* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHARACTERIZATION OF THE THERMAL CONDUCTIVITY FOR FIBROUS REFRACTORY COMPOSITE INSULATIONS
D. A. STEWART and D. B. LEISER (NASA, Ames Research Center, Moffett Field, CA) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 6, July-Aug. 1985, p. 769-792. refs

Thermal conductivity for a family of fibrous, refractory composite insulations are characterized through the use of an engineering model and arc-jet data. The model defines the composite as a uniform pore material using measured physical and mechanical properties. Efficiency parameters assigned to the solid and radiation conduction terms in the thermal conductivity equation were found to be dependent only on solid volume fraction and porosity. Author

A86-16100
MEASUREMENT OF PREFERENTIAL MOISTURE INGRESS IN COMPOSITE WING/SPAR JOINTS
J. B. WHITESIDE, R. J. DELASI, and R. L. SCHULTE (Grumman Corporate Research Center, Bethpage, NY) (International Symposium on Composites: Materials and Engineering, University of Delaware, Newark, Sept. 24-28, 1984) Composites Science and Technology (ISSN 0266-3538), vol. 24, no. 2, 1985, p. 123-145. Research supported by Grumman Aerospace Corp. refs
(Contract F33615-78-C-3209)

The distribution of absorbed moisture was measured in three integral composite skin-to-spar joint concepts. The graphite/epoxy joint specimens were dried, exposed to heavy water vapor environment and sectioned. The method of nuclear reaction analysis was used to measure the distribution of absorbed moisture in the sectioned specimens. Two of the joint concepts had periodic fibrous reinforcement penetrating the skin: Kevlar stitches in one case and graphite tows in the other. In both cases the interior moisture concentrations in and around these stitches and tows were increased considerably above the corresponding interior moisture concentrations in areas remote from the stitches or tows. Measurements of absorbed moisture across the remote sections showed good agreement with Fickian diffusion distributions. The increased interior moisture level around the stitches is consistent with an interlaminar failure obtained in a previous hot-wet skin-spar shear test. Author

N86-12259*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF MEASURED MATERIAL PROPERTIES ON THE FINITE ELEMENT ANALYSIS OF AN OH-58 COMPOSITE TAIL BOOM
L. M. BOWMAN Oct. 1985 28 p refs
(Contract DA PROJ. 1L1-61102-AH-45)
(NASA-TM-86430; L-15969; NAS 1.15:86430;
AVSCOM-TR-85-B-5) Avail: NTIS HC A03/MF A01 CSCL 11D

A static and dynamic finite element analysis is conducted on a U.S. Army OH-58 composite tail boom and compared with test data. The tail boom is a filament-wound graphite/epoxy monocoque structure. The structural design of the composite tail boom skin is based on 50-percent graphite fiber volume. However, material tests on representative samples of the tail boom skin reveal that the graphite fiber-volume fraction varied from 44.6 to 49.3 percent. To determine the effect of using measured material properties, static and dynamic finite element analyses are conducted for three fiber-volume conditions of 45, 48, and 50 percent. The static and dynamic model with the 45-percent fiber-volume graphite skins gives the closest agreement with test data. Author

N86-12271# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF THE COMBUSTION OF GAS-AIR MIXTURES IN A CHANNEL AND THE DIFFUSION COMBUSTION IN A SLIPSTREAM AT HIGH VELOCITIES
V. K. BAYEV, P. K. TRETYAKOV, and V. A. YASAKOV 16 Jul. 1985 49 p Transl. into ENGLISH from mono. "Sovremennoye Sostoyaniye i Teoriya Sgoraniya Kondensirovannykh Sistem" Moscow, 1972 p 357-360, 386-391, 416-420, 421-425
(AD-A157495; FTD-ID(RS)T-1323-84) Avail: NTIS HC A03/MF A01 CSCL 21B

This translation contains three additional papers by other authors. Their titles are: Ignition and Interruption of Combustion in the Stagnation Zone During Flow Around a Flatstep or Indentation by a Supersonic Flow of Combustible Mixture; Combustion of Rich Kerosine-Air Mixture in Tunnel Type Chamber; and Mechanism of the Process of Combustion After the Front Devices and in the Zone of the Inflow of the Jets of Secondary Air in the Chambers of Gas-Turbine Engine. GRA

N86-12272# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
METHOD TO DETECT ETHYLENE GLYCOL IN GASEOUS MIXTURES Final Report, 1 Oct. 1982 - 30 Sep. 1983
R. E. WILLIS Aug. 1985 53 p Prepared in cooperation with Sverdrup Technology, Inc., Arnold AFS, TN
(AD-A158109; AEDC-TR-85-39) Avail: NTIS HC A04/MF A01 CSCL 07D

Ethylene glycol is used as a refrigerant for the intake air during simulated altitude testing. There have been some problems during these tests because of the ethylene glycol accidentally leaking into the inlet airstream. Since ethylene glycol has at times been suspected of interfering with the test article, its early detection would be greatly beneficial so that testing could be stopped before damage occurs. Because a detection scheme must indicate the presence of ethylene glycol as soon as it appears in the inlet airstream, a spectroscopic technique is preferred over other methods of gas analysis such as sampling and subsequent

laboratory analysis. A study was conducted to determine if microwave spectroscopy techniques could be used to monitor the level of ethylene glycol in the inlet airstream to the Engine Test Facility (ETF) test cells during simulated altitude testing. The theory of microwave spectroscopy and the spectra of ethylene glycol are reviewed. Three separate designs of microwave spectrometers are presented which should be capable of monitoring ethylene glycol in the inlet airstreams with a sensitivity of at least 10 ppm. GRA

N86-13407*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POLYMER, METAL AND CERAMIC MATRIX COMPOSITES FOR ADVANCED AIRCRAFT ENGINE APPLICATIONS
D. L. MCDANELS, T. T. SERAFINI, and J. A. DICARLO 1985 26 p refs Presented at the Advanced Composites Conference, Detroit, 3-4 Dec. 1985; sponsored by ASME
(NASA-TM-87132; E-2746; NAS 1.15:87132) Avail: NTIS HC A03/MF A01 CSCL 11F

Advanced aircraft engine research within NASA Lewis is being focused on propulsion systems for subsonic, supersonic, and hypersonic aircraft. Each of these flight regimes requires different types of engines, but all require advanced materials to meet their goals of performance, thrust-to-weight ratio, and fuel efficiency. The high strength/weight and stiffness/weight properties of resin, metal, and ceramic matrix composites will play an increasingly key role in meeting these performance requirements. At NASA Lewis, research is ongoing to apply graphite/polyimide composites to engine components and to develop polymer matrices with higher operating temperature capabilities. Metal matrix composites, using magnesium, aluminum, titanium, and superalloy matrices, are being developed for application to static and rotating engine components, as well as for space applications, over a broad temperature range. Ceramic matrix composites are also being examined to increase the toughness and reliability of ceramics for application to high-temperature engine structures and components. 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.

A86-13011
METHODS OF CONSTRUCTING R-CURVES AND APPLICATION OF THESE CURVES FOR EVALUATION OF MATERIALS (REVIEW)
G. S. NESHPOR, G. D. KUDRIAVTSEVA, and A. A. ARMIAGOV (Zavodskaia Laboratoriia, vol. 51, Jan. 1985, p. 64-73) Industrial Laboratory (ISSN 0019-8447), vol. 51, no. 1, July 1985, p. 74-85. Translation. refs

The theoretical background and methods for deriving the R-curve, i.e., the resistance of a material to stable crack growth, is reviewed, along with techniques for applying it to test materials. The R-curve is based on the assumption that the energy released during unstable crack growth is constant, although in some wide specimens plastic deformation at the crack tip will cause the rate of energy release to vary from that expected. The R-curve values are a function of the stress and the effective crack length. The stress value is determined for materials by tensile testing a center-cracked flat specimen, a side-cracked compact specimen and a specimen undergoing wedge loading along the crack line to derive load-displacement data. Sample calculations are carried out for sheets of a steel alloy. M.S.K.

A86-13059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-TEMPERATURE THERMOCOUPLE AND HEAT FLUX GAUGE USING A UNIQUE THIN FILM-HARDWARE HOT JUNCTION
C. H. LIEBERT, R. HOLANDA, S. A. HIPPENSTEELE, and C. A. ANDRACCHIO (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 938-944. Previously announced in STAR as N85-16096. refs
(ASME PAPER 85-GT-18)

A special thin film-hardware material thermocouple (TC) and heat flux gauge concept for a reasonably high temperature and high flux flat plate heat transfer experiment was fabricated and tested to gauge temperatures of 911 K. This concept was developed for minimal disturbance of boundary layer temperature and flow over the plates and minimal disturbance of heat flux through the plates. Comparison of special heat flux gauge Stanton number output at steady-state conditions with benchmark literature data was good and agreement was within a calculated uncertainty of the measurement system. Also, good agreement of special TC and standard TC outputs was obtained and the results are encouraging. Oxidation of thin film thermoelements was a primary failure mode after about 5 of operation. Author

A86-13061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOCAL HEAT-TRANSFER MEASUREMENTS ON A LARGE SCALE-MODEL TURBINE BLADE AIRFOIL USING A COMPOSITE OF A HEATER ELEMENT AND LIQUID CRYSTALS
S. A. HIPPENSTEELE, L. M. RUSSELL, and F. J. TORRES (NASA, Lewis Research Center, Cleveland, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0022-0825), vol. 107, Oct. 1985, p. 953-960. Previously announced in STAR as N85-33435. refs
(ASME PAPER 85-GT-59)

Local heat transfer coefficients were experimentally mapped along the midchord of a five-time-size turbine blade airfoil in a static cascade operated at room temperature over a range of Reynolds numbers. The test surface consisted of a composite of commercially available materials: a mylar sheet with a layer of cholesteric liquid crystals, that change color with temperature, and a heater sheet made of a carbon-impregnated paper, that produces uniform heat flux. After the initial selection and calibration of the composite sheet, accurate, quantitative, and continuous heat transfer coefficients were mapped over the airfoil surface. The local heat transfer coefficients are presented for Reynolds numbers from 2.8 x 10 to the 5th power to 7.6 x 10 to the 5th power. Comparisons are made with analytical values of heat transfer coefficients obtained from the STANS boundary layer code. Also, a leading edge separation bubble was revealed by thermal and flow visualization. Author

A86-13111
F/A 18 COMPOSITE WING AUTOMATED DRILLING SYSTEM
E. L. BOHANAN, JR. (McDonnell Aircraft Co., St. Louis, MO) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 579-585.

The key factors influencing the configuration and subsystems of the F/A-18 aircraft wing assembly Automated Drilling System (ADS) were the wide variety of fastener hole sizes generated in the composite/metallic material and the improved machining control parameters demanded by these advanced materials. Better cutters and more precise spindles than had been available with pneumatic drilling motors were also called for. ADS production implementation has furnished a cost-effective way of meeting present requirements without resort to hard tooling concepts. O.C.

A86-13135
AGE CREEP FORMING IN AN AUTOCLAVE
D. M. HAMBRICK (Avco Corp., Avco Aerostructure Div., Nashville, TN) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering,. 1985, p. 971-981.

Development of the autoclave forming aluminum process has advanced current technology of age forming. Using an autoclave for application of aging heat and forming pressure, the process has been used to form 50 feet long, 2124 and 2419 aluminum wing skins containing integrally machined stiffeners and varying in thickness from 0.1 to 2.5 inches with thick pads in the middle of thin sections. The process produces smooth contours with no visible signs of abrupt changes in thickness. The skins are believed to be the largest and most complex parts ever to be age creep formed in the history of the aircraft industry. Author

A86-13147
NONDESTRUCTIVE TEST METHODS FOR COMPOSITE STRUCTURES
K. L. REIFSNIDER (Virginia Polytechnic Institute and State University, Blacksburg) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1131-1142. refs

A comparative assessment is made among the three available structural NDT&E methods that are currently available for the response characteristics of missile airframe and space structure assemblies. In vibrothermography, a carefully chosen frequency is used to excite specific structural defects until a heat-pattern of dissipated energy is formed for imaging; structural discontinuities are thereby revealed. Stiffness changes can reflect material integrity and mechanical (especially vibratory) response. C-scan and acoustoultrasonic methods constitute the third family of methods considered. O.C.

A86-13171
PREDICTION AND MEASUREMENT OF DAMPING OF VIBRATIONS OF STRUCTURES BY ADHESIVES
R. A. ELY and K. B. SANGHA (LTV Aerospace and Defense Co., Dallas, TX) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1408-1418. refs

Attention is given to a method for the mathematical selection of adhesives to yield large vibration damping levels in structures, with emphasis on the major influences exerted by ambient temperature and mechanical excitation frequency on the selection of such adhesive damping treatments. In addition to laboratory tests and computer calculations aiding the development of adhesively damped components for aircraft structures, two examples of fighter aircraft components employing constrained adhesive layers are presented: a flap and a spoiler, which were chronically subject to pressure fluctuations. O.C.

A86-13180
BOEING MILITARY AIRPLANE COMPANY'S ROBOTIC ULTRASONIC INSPECTION SYSTEM
B. W. VON ASPE, K. C. STEWART, and K. E. GRAEBNER (Boeing Military Airplane Co., Wichita, KS) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 1655-1664.

Attention is given to a proprietary robotic system for the ultrasonic inspection of composite structures with compound curvatures which rapidly follows these contours while maintaining the geometric normality of the ultrasonic sensors to the surface of the structure. Since the robot must know the contours well, a digitizing scan is initially performed to determine and store structural shapes. The systems inspects the structure for internal voids, delaminations and unbounds. O.C.

A86-13221
A MICROPROCESSOR-BASED DIGITAL VOICE NETWORK
J. MOSES and R. SKLAR (Hughes Aircraft Co., Microelectronic Systems Div., Irvine, CA) IN: ITC/USA/'84; Proceedings of the International Telemetering Conference, Las Vegas, NV, October 22-25, 1984 . Research Triangle Park, NC, Instrument Society of America, 1984, p. 299-306.

An internal research and development program is described that is intended to advance the state of the art in digital voice technology and demonstrate digital voice transmission using advanced microprocessor technology and token-passing bus network architecture. The design architecture, terminal design and implementation, and future plans to satisfy digital voice requirements in a military environment are examined. D.H.

A86-13336#
NEW METHODS OF MEASURING STRAIN AND TEMPERATURE IN A TURBINE ENGINE
W. A. STANGE (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, OH) IN: International Congress on Experimental Mechanics, 5th, Montreal, Canada, June 10-15, 1984, Proceedings . Brookfield Center, CT, SESA, 1984, p. 565-570.

This paper presents an overview of current research efforts aimed at improving turbine engine structural instrumentation capabilities. Emphasis is placed on high temperature applications and improved sensor reliability. Technologies to be described include blade tip deflection sensors to determine dynamic stress, acoustic guided wave sensors to measure steady state strain, and double core fiber optics to measure both metal temperature and steady state strain. Advantages of the various systems, potential problems and limitations, as well as an assessment as to when the various technologies are likely to be ready for actual engine test usage are presented. Author

A86-13338#
EXPERIMENTAL/ANALYTIC COMPARISONS CONSIDERING COMPOSITE PANELS WITH A CUTOUT
A. N. PALAZOTTO, M. SABOTA (USAF, Institute of Technology, Wright-Patterson AFB, OH), and T. JANISSE (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: International Congress on Experimental Mechanics, 5th, Montreal, Canada, June 10-15, 1984, Proceedings . Brookfield Center, CT, SESA, 1984, p. 628-633.

The nonlinear finite element (STAGSC-1) program was used to calculate the values of radial displacement (RD) in a composite graphite/epoxy panel with a symmetrically positioned square cutout that is subjected to buckling loads of 2000, 2500, and 3300 lb. These RD values were compared with experimental measurements obtained under the defined conditions. The comparison shows the sensitivity of the panel to varying boundary conditions produced by the restraints associated with the experimental panel. A description of the techniques used for fabrication of composite cylindrical panels and application of the compressive load, and of the boundary conditions, as well as the STAGSC computer code, is included. I.S.

A86-13342#
APPLICATION OF COMPUTERIZED DATA ACQUISITION AND DATA PROCESSING TO THE SURFACE CONTOURING OF LARGE STRUCTURES
T. M. MILLY and A. HUNTER (Lockheed Research Laboratories, Palo Alto, CA) IN: International Congress on Experimental Mechanics, 5th, Montreal, Canada, June 10-15, 1984, Proceedings . Brookfield Center, CT, SESA, 1984, p. 795-799.

This paper deals with techniques and procedures for contouring relatively large surfaces using shadow and projection moire. The Experimental Strain Analysis Processing System (ESAPS), developed at LMSC, is then applied to these techniques to increase speed and efficiency of processing. In addition, the capability has been developed which provides for the examination of the overall contours of large areas as well as detailed localized contours. With systematically obtained contour data, interactive processing

procedures provide for correlation analysis and accurate interpretation of incoming data. Author

A86-13357
PANEL DESIGN FOR OPTIMUM STRENGTH AND STABILITY WITH ALLOWANCE FOR THE NONUNIFORMITY OF HEATING [PROEKTIROVANIE PANELEI PO USLOVIIAM PROCHNOSTI I USTOICHIVOSTI S UCHETOM NERAVNOMERNOGO NAGREVA]
G. P. GROSHEV and E. K. LIPIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 95-103. In Russian.

The problem of optimizing the design of a reinforced panel with respect to strength and stability is solved with allowance for the interaction of the panel with the flanges of the spars and wing ribs under conditions of nonuniform heating. It is shown that in the case of high total compressive forces in the root section of the wing, sections with heavy spar flanges can be used without a significant increase in weight in comparison with the wing sections having thermocompensated panels. V.L.

A86-13362
AN ALGORITHM FOR CALCULATING THE COUPLING BETWEEN MATRICES OF ELASTIC INFLUENCE COEFFICIENTS FOR TWO SYSTEMS OF COMPUTATIONAL POINTS [ALGORITHM VYCHISLENIIA SVIAZI MATRITS UPRUGIKH KOEFFITSIENTOV VLIIANIIA V DVUKH RASCHETNYKH SISTEMAKH TOCHEK]
S. V. EFIMENKO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 1, 1984, p. 133-136. In Russian.

The interpolation of a function of two variables by spline surfaces is used to calculate the elastic influence coefficients in a system of computational points on an elastic surface from the influence coefficients of a different system of points. To illustrate the approach proposed here, calculations are carried out for a cantilever plate. V.L.

A86-13367
CONSIDERATION OF THE MULTIPLICITY OF CRITICAL SPOTS IN A STRUCTURE IN ESTIMATING THE DURABILITY AND THE SERVICE LIFE [UCHET MNOZHESTVENNOSTI KRITICHESKIKH MEST KONSTRUKTSII PRI OTSENKE GOLGOVECHNOSTI I RESURSA]
V. L. RAIKHER, A. F. SELIKHOV, and I. G. KHLEBNIKOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 2, 1984, p. 72-81. In Russian. refs

An aircraft structure is treated as a system containing a large number of individual elements (stress raisers), and it is shown that, under certain assumptions, this approach makes it possible to obtain a statistical model for the service life of a structure. Such a model is proposed here for the case where the durabilities of individual elements can be considered to be independent and for the case where the individual durabilities are related in a certain manner. The validity of this approach is verified experimentally using several examples. The possible versions of the durability distribution function of an individual component are examined. V.L.

A86-13382
AN EXPERIMENTAL STUDY OF A VACUUM WATER-AIR EJECTOR WITH A MULTICHANNEL LIQUID-SUPPLY NOZZLE ENSURING JET-PAIR COLLISION [EKSPERIMENTAL'NOE ISSLEDOVANIE VAKUUMNOGO VODOVOZDUSHNOGO EZHEKTORA S MNOGOSTVOL'NYM SOPLOM DLIA PODACHI ZHIDKOSTI, OBESPECHIVAIUSHCHIM POPARNOE SOUDARENIE STRUI]
IU. N. VASILEV, E. P. GLADKOV, and G. A. GORSHKOVA TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 45-54. In Russian.

Experimental results are reported for a vacuum water-air ejector with a cylindrical mixing chamber and a multichannel water-supply nozzle in which the axes of the adjacent channels are inclined relative to each other at a small angle, resulting in pair collisions of the jets in the mixing chamber and a more intense jet fractionation. A comparison with results obtained for an ejector using a water-supply nozzle with parallel channels shows that the collision of jets significantly increases the efficiency of the ejector. V.L.

A86-13387
A PROPERTY OF THE ELASTIC VIBRATIONS OF NEARLY SYMMETRIC SYSTEMS [OB ODNOI OSOBENNOSTI UPRUGIKH KOLEBANII 'POCHTI SIMMETRICHNYKH' SISTEM]
IA. M. PARKHOMOVSKII TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 99-106. In Russian.

It is shown that a slight asymmetry of the mass and stiffness characteristics of an aircraft relative to a vertical plane intersecting the longitudinal axis of the aircraft can sometimes cause essentially asymmetric vibrational modes. In particulaiar, this is true of the torsional modes of the wings. The mechanism of this phenemenon is illustrated by a model problem. V.L.

A86-13388
A MODEL FOR THE LIFE VARIANCE OF A STRUCTURAL ELEMENT UNDER IRREGULAR LOADING [MODEL' RASSEIANIIA DOLGOVECHNOSTI ELEMENTA KONSTRUKTSII PRI NEREGULIARNOM NAGRUZHENII]
A. F. SELIKHOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 3, 1984, p. 107-120. In Russian. refs

A life variance model developed in an earlier study (Selikhov, 1984) for regular loading is extended to the case of irregular loading. By using the formalism of individual fatigue damage curves for true stresses at the highest-load point, an expression for the life variance is obtained for the case where the relative cycle number based on nominal stresses is not equal to unity. The model proposed here explains certain characteristics of life variance under conditions of irregular loading. V.L.

A86-13410
USING ISOPERIMETRIC INEQUALITIES FOR THE TWO-SIDED ESTIMATION OF THE TORSIONAL STIFFNESS OF A PRISMATIC BAR [PRIMENENIE IZOPERIMETRICHESKIKH NERAVENSTV DLIA DVUKHSTORONNEI OTSENKI ZHESTKOSTI KRUCHENIIA PRIZMATICHESKOGO STERZHNIA]
V. V. EGOROV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 120-123. In Russian.

A formula is proposed which makes it possible to obtain the upper and lower bounds for the torsional stiffness of a prismatic bar from two geometrical parameters of its cross-section, the perimeter and the area. This formula can be used to determine the trend of the change of the cross-sectional torsional stiffness for any change in the shape of the cross-section (e.g., in the case of cross-section reinforcement or replacement of one cross-section by another). V.L.

A86-13419
ALLOWANCE FOR INITIAL CONDITIONS IN STATIC AND DYNAMIC CALCULATIONS OF STRUCTURES BY THE FINITE ELEMENT METHOD [UCHET NACHAL'NYKH USILII V STATICHESKIKH I DINAMICHESKIKH RASCHETAKH KONSTRUKTSII METODOM KONECHNYKH ELEMENTOV]
V. P. AGAPOV, V. D. ILICHEV, V. A. KOROTKOV, and A. V. STRELIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 79-89. In Russian. refs

The influence of initial conditions on the stiffness characteristics of aircraft structures in static and dynamic calculations is examined. A method for including initial conditions in the finite element method is described, with particular attention given to a procedure for obtaining the initial-stress matrix for a plane triangular element. The accuracy of the method is illustrated by model problems, and calculation results for the natural vibrations of a propeller are compared with experimental data. B.J.

A86-13424
CERTAIN PROBLEMS OF FLUID FLOW NEAR THE CORE OF A SPIRAL DISCONTINUITY [NEKOTORYE ZADACHI O TECHENII ZHIDKOSTI V OKRESTNOSTI IADRA SPIRAL'NOGO RAZRYVA]
A. M. GAIFULLIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 125-131. In Russian. refs

The structure of the core of a vortex sheet is analyzed in flows that are only slightly different from self-similar ones; on a low-aspect-ratio delta wing this corresponds to a slight curvature of the vortex-sheet axis. Also investigated is the structure of the core of a vortex sheet and a free boundary in axisymmetric self-similar flows. A comparison is made with the two-dimensional case. B.J.

A86-13430
SEPARATED FLOW PAST A SHARP EDGE ACCORDING TO A REVERSE-JET SCHEME [OTRYVNOE OBTEKANIE OSTROI KROMKI PO SKHEME S VOZVRATNOI STRUIKOI]
L. A. KOZHURO TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 6, 1984, p. 10-18. In Russian. refs

A solution is obtained to the problem of separated incompressible inviscid flow past a sharp edge according to Efros' scheme in the limiting case of an infinite velocity at the free streamline. The rate of change in reverse-jet momentum remains finite and is equal to the suction force acting on the sharp edge in the case of nonseparated flow. A finite concentrated force acts on the edge in a direction perpendicular to the action of the suction force. Attention is given to the limit state for flow past a plate at angle of attack with separation at the leading edge, when the velocity at the free streamline tends to infinity. B.J.

A86-13463
CUTOUTS IN LOAD-BEARING STRUCTURES [VYREZY V NESUSHCHIKH KONSTRUKTSIIAKH]
I. N. PREOBRAZHENSKII and I. A. TSURPAL Moscow, Izdatel'stvo Mashinostroenie, 1984, 112 p. In Russian. refs

Data are presented on the stability, natural frequencies, and stress distributions of the critical parts of machines and structural elements near holes, cavities, and other types of abrupt changes in the cross-section. The effect of various factors on stress concentration is estimated for different types of structures and materials. In particular, attention is given to the effect of reinforcing elements, the effect of material anisotropy, dynamic problems, the effect of the viscoelastic properties of materials on stress distribution near holes, and nonlinear problems of stress concentration. V.L.

A86-13671
THE DRAG OF A THERMALLY INSULATED PLATE IN A STREAM OF A COMPRESSIBLE GAS UNDER MIXED FLOW CONDITIONS [SOPROTIVLENIE TEPLOIZOLIROVANNOI PLASTINY V SZHIMAEMOM POTOKE GAZA PRI SMESHANNOM OBTEKANII]
L. F. KOZLOV (AN USSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 7, no. 4, 1985, p. 17-20. In Russian. refs

A formula is obtained for calculating the aerodynamic drag of a thermally insulated plate in a high-velocity compressible-gas stream with a mixed boundary layer. The formula proposed here allows for the finite length of the transition region and is reduced to the known solutions for the cases of a fully laminar and a fully turbulent boundary layer. V.L.

A86-13673
THE EFFECT OF THE DEFLECTOR TYPE ON INTERNAL HEAT TRANSFER IN BLADES WITH TRANSVERSE COOLANT FLOW [VLIIANIE TIPA DEFLEKTORA NA VNUTRENNII TEPLOOBMEN V LOPATKAKH S POPERECHNYM TECHENIEM OKHLADITELIA]
A. N. BOIKO, M. N. GALKIN, S. Z. KOPELEV, and I. V. SHEVCHENKO (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) Promyshlennaia Teplotekhnika (ISSN 0204-3602), vol. 7, no. 4, 1985, p. 42-46. In Russian.

The internal heat transfer characteristics of a deflector blade are determined by liquid-metal thermostat calorimetry. The coefficients of heat transfer to the cooling air are obtained for the mean blade cross-sectional area for three types of deflectors. It is found that in deflector plates with slots or round nozzles, the cooling intensity of the inlet edge is a factor of 1.6-1.9 higher than in blades with transverse cuts. V.L.

A86-13690
DYNAMIC STRENGTH PROBLEMS IN AEROSPACE EQUIPMENT [O PROBLEMAKH DINAMICHESKOI PROCHNOSTI V AVIATSIONNO-KOSMICHESKOI TEKHNIKE]
I. F. OBRAZTSOV Raschety na Prochnost', no. 25, 1984, p. 3-11. In Russian. refs

The paper is concerned with a wide range of problems arising during the manufacture and operation of the structural elements of aerospace equipment due to increased velocity, power, dimensions, and other flight vehicle parameters. Particular attention is given to the dynamic strength of structures, which in many cases determines the durability and performance of flight vehicle structures. Several dynamic strength problems are analyzed, aand some problems that have yet to be solved are mentioned. V.L.

A86-13983
QUASI-SOLUTIONS OF AN INVERSE BOUNDARY VALUE PROBLEM OF HYDROAERODYNAMICS [KVAZIRESHENIIA OBRATNOI KRAEVOI ZADACHI GIDROAERODINAMIKI]
A. M. ELIZAROV, N. B. ILINSKII, and A. V. POTASHEV (Kazanskii Gosudarstvennyi Universitet, Kazan, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 284, no. 2, 1985, p. 319-322. In Russian. refs

The following inverse boundary value problem is considered: to determine the form of a closed wing profile in the two-dimensional potential steady flow of an ideal incompressible fluid according to a specified velocity distribution on the profile surface. Examples of numerical calculations based on the method of quasi-solutions are given. B.J.

A86-14157#
COMPUTATION OF AERONAUTICAL STRUCTURES [CALCULUL STRUCTURILOR DE AVIATIE]
A. PETRE Bucharest, Editura Tehnica, 1984, 368 p. In Romanian. refs

The book presents both the classical and modern computational methods of aircraft structures. After a brief historical review of aviation, the general design and stress-strain problems are exposed. Aerodynamic principles, loads, shell structures, buckling, reliability, post-buckling behavior and plates and bars are covered in detail. A section on optimization problems ends the classical study. The modern section starts with the matrix methods, discusses the finite element method and concludes with a structural synthesis and optimization theory. The book is of interest to the academic world as well as to engineers and designers working in the aeronautical field. N.D.

A86-14348
WEIGHT OPTIMIZATION OF STIFFENED CYLINDERS UNDER AXIAL COMPRESSION
R. QIU Computers and Structures (ISSN 0045-7949), vol. 21, no. 5, 1985, p. 945-952. refs

A procedure is developed for the design of a stiffened cylinder under a given uniform axial compression with minimum weight. The approach allows the consideration of various shapes of

stiffening members. The effective stiffness of the skin in its post-buckled state is taken into account in the basic analysis. The buckling analyses are accomplished as a minimum problem in the buckling mode shape parameters space using the variable metric method. A mixed procedure which combines the exterior penalty function concept and random search is used to minimize the weight of the stiffened cylinders. The design examples demonstrate the validity of the present approach. Author

A86-14355#
'BUT NOT WITH THE GREATEST OF EASE' - A FEASIBILITY STUDY OF A HUMAN-POWERED ACV
H. S. FOWLER (National Research Council of Canada, Ottawa) (Canadian Air Cushion Technology Society, International Conference on Air Cushion Technology, Vancouver, Canada, Sept. 26, 1984) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 31, June 1985, p. 107-115. refs

An assessment is made of the propulsion efficiency-related difficulties that are ineluctably encountered in attempts to design human-powered air cushion vehicles (ACVs). After defining an arbitrary human-powered ACV, a terrain representative of the kind that such a vehicle should be able to traverse is selected to evaluate the feasibility of the design within current engineering and human performance capabilities. An ACV capable of 1 hour of sustained operation over a flat, smooth course of approximately 10 km is foreseen. O.C.

A86-14424
FORGING IN THE AEROSPACE INDUSTRY [LE FORGEAGE DANS L'INDUSTRIE AEROSPATIALE]
N. BEAUCLAIR Air et Cosmos (ISSN 0044-6971), vol. 23, Oct. 19, 1985, p. 19-21, 23-27, 29. In French.

The recent recession slowed the rate at which foundaries could afford to invest in plant modernization. Modernization, i.e. CAD/CAM and net-shape forming of metals, is a necessity in order to control the costs of delivered products, which for aerospace applications usually require a high degree of precision in the stamping and forging processes. The new manufacturing techniques are currently applied in working with specialty steels, Ni, Ti and Al alloys, and will necessarily be extended to cover superalloys. Some relief is being experienced by the subcontractors due to the demand for the delivery of eight Airbus aircraft per month, along with a number of Mirage 2000 aircraft. Production of the Airbus has not, thus far, surpassed 4.5 per month. M.S.K.

A86-14538#
PRODUCTIVITY IMPROVEMENTS THROUGH THE USE OF CAD/CAM
M. D. WEHRMAN (Boeing Commercial Airplane Co., Seattle, WA) (International Council of the Aeronautical Sciences, Congress, 14th, Toulouse, France, September 9-14, 1984, Proceedings. Volume 2, p. 1079-1084) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 1013-1017. Previously cited in issue 22, p. 3222, Accession no. A84-45048.

A86-14539#
EVALUATION OF LOW REYNOLDS NUMBER TURBULENCE MODELS FOR ATTACHED AND SEPARATED FLOWS
A. SUGAVANAM (Lockheed-Georgia Co., Marietta, GA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Nov. 1985, p. 1018-1020. Previously cited in issue 07, p. 898, Accession no. A85-19706. refs

A86-14554#
COUNTERROTATING INTERSHAFT SEALS FOR ADVANCED ENGINES
W. L. GAMBLE (United Technologies Corp., Pratt and Whitney, West Palm Beach, FL) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Nov.-Dec. 1985, p. 437-440. Previously cited in issue 16, p. 2343, Accession no. A84-35135.

A86-14680
THE PERFORMANCE OF COMPOSITE STRUCTURES [RABOTOSPOSOBNOST' KONSTRUKTSII IZ KOMPOZITSIONNYKH MATERIALOV]
N. D. KUZNETSOV and N. D. STEPANENKO (Kuibyshevskii Aviatsionnyi Institut, Kuibyshev, USSR) Problemy Prochnosti (ISSN 0556-171X), Oct. 1985, p. 12-19. In Russian. refs

An approach to the design and development of a process for the manufacture of turbine blades of composite materials is presented which ensures the high performance of the blades. Particular attention is given to resonance methods for part and material quality control. With reference to test results obtained for a composite reinforced with glass and carbon fibers it is shown how the volume fraction of the reinforcement material affects the fatigue strength of the composite structure. V.L.

A86-14973
PRECISION CASTING AT ROLLS-ROYCE
R. J. SOUTHGATE Metals and Materials (ISSN 0266-7185), vol. 1, Oct. 1985, p. 602-604, 606.

A development history and status account is presented for near-net shape, high precision aircraft engine component casting methods employed by a major manufacturer of high bypass turbofans for commercial aircraft. The complexity of such components as gas turbine blades is so great that an elaborate assembly of small and fragile ceramic cores must be inserted in the pattern die before closure and wax injection. Molds used for single crystal or directionally solidified superalloy castings differ from conventional types in that openings must be provided for the fitting of a chill plate. Ceramic shell molding techniques are also used for high temperature engine components. Attention is given to the industrial apparatus, including process and quality control elements, that have been developed by the manufacturer. O.C.

A86-15227* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF CERAMIC-COATED TIP SEALS FOR TURBOJET ENGINES
T. J. BIESIADNY, G. MCDONALD, R. C. HENDRICKS (NASA, Lewis Research Center, Cleveland, OH), G. A. KLANN (U.S. Army, Propulsion Laboratory, Cleveland, OH), E. S. LASSOW (Howmet Turbine Components Corp., Whitehall, MI) et al. Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 6, July-Aug. 1985, p. 880-895. Previously announced in STAR as N85-19363. refs

Ceramic gas-path seals were fabricated and successfully operated over 1000 cycles from flight idle to maximum power in a small turboshaft engine. The seals were fabricated by plasma spraying zirconia over a NiCoCrAlX bond coat on the Haynes 25 substrate. Coolant-side substrate temperatures and related engine parameters were recorded. Post-test inspection revealed mudflat surface cracking with penetration to the ceramic bond-coat interface. Author

A86-15528
PORTABLE COMPUTERIZED TESTER IMPROVES FLIGHT-LINE MAINTENANCE
Y. GRINBERG (RADA Electronic Industries, Ltd., Herzliya and Beth Shean, Israel) Defense Electronics (ISSN 0278-3479), vol. 17, Nov. 1985, p. 67, 68, 70, 71.

The present general purpose and portable Computerized Organizational Level Tester (COLT) for the flight-line maintenance of advanced weapons systems is in effect a fully functioning replica of contemporary automated test equipment architectures previously available only in laboratory test installations. The COLT's automated equipment architecture has been scaled down to a ruggedized, portable, suitcase-sized field tester for both analog and digital equipment. Tester software is designed to minimize programming effort, and possesses a real time executive kernel which transparently interfaces high level user commands with tester hardware. Automatic software-generation tools are incorporated. O.C.

A86-15584
OPTICAL COMMUNICATION BETWEEN AIRCRAFT IN LOW-VISIBILITY ATMOSPHERE USING DIODE LASERS
A. K. MAJUMDAR (Lockheed-California Co., Kelly Johnson Research and Development Center, Burbank, CA) Applied Optics (ISSN 0003-6935), vol. 24, Nov. 1, 1985, p. 3659-3665. Research supported by the Lockheed-California Co. refs

The performance of an atmospheric optical communication link using multiple-forward-scattered (MFS) radiation is examined theoretically and experimentally. In particular, results of a laboratory-simulation experiment are used to estimate beam spread/angular spread angle in terms of channel coherence length, rms forward scatter angle, and forward-scattering efficiency, with a GaAlAs laser diode (0.8486 micron) used as a source. A pulse-position-modulation format is then considered, and the minimum field of view which optimizes the system margin for given data rate, low-visibility atmospheric parameter, and background condition is determined. The feasibility of acquisition and high-rate-data transfer between aircraft through low-visibility atmosphere is shown to be feasible. This can provide a relatively covert system with high immunity to jamming. V.L.

A86-16032#
DYNAMIC RESPONSE OF A LAMINATED PLATE WITH FRICTION DAMPING
S. Z. HAN (Chinese Academy of Sciences, Institute of Mechanics, Beijing, People's Republic of China) ASME, Transactions, Journal of Vibration, Acoustics, Stress, and Reliability in Design (ISSN 0739-3717), vol. 107, Oct. 1985, p. 375-377.
(ASME PAPER 85-DET-16)

A sandwich-type plate with metal facings and felt core, fastened by bolts, was studied using both test and finite-element analysis. This type of plate is cheap, light, damping-effective and without pollution; therefore, it is widely used in astronautical engineering. The tests were conducted for different felt thicknesses, bolt numbers, and fastening forces. The results show that the damping depends on friction between the plates and the felt. As compared with an identical stiffness solid plate, the damping of laminated plates can be increased up to 30 times. A mesh with rectangular elements was adopted in the finite-element analysis. In accordance with the slipping mechanism, a rectangular plate clamped on one edge was analyzed with the foregoing elements to determine the resonant frequency and the damping. The difference between the calculated and tested results was within 5 percent for the resonant frequency. Author

A86-16040#
ROTOR DYNAMICS EQUATIONS IN COMPLEX FORM
H. D. NELSON (Arizona State University, Tempe) ASME, Transactions, Journal of Vibration, Acoustics, Stress, and Reliability in Design (ISSN 0739-3717), vol. 107, Oct. 1985, p. 460, 461. refs

For a number of years, the finite element method of modeling rotor dynamic systems has been employed extensively. A presentation of rotor system equations in a complex form is convenient for some applications. The present note has the objective to provide the complex form of the rigid disk, finite rotating shaft element, and general linear bearing equations of motion. Order reduction by static condensation, assembly of the system equations, and analysis procedures, are carried out in the same manner as described by Ruhl and Booker (1972), Nordman (1974), and Nelson and McVaugh (1976). G.R.

A86-16090
APPLICATION OF PULSED REFLECTION HOLOGRAPHY TO MATERIAL TESTING
R. L. VAN RENESSE and J. W. BURGMEIJER (Centrale Organisatie voor Toegepast-Naturwetenschappelijk Onderzoek, Delft, Netherlands) Optical Engineering (ISSN 0091-3286), vol. 24, Nov.-Dec. 1985, p. 1086-1092. Research supported by Rijksverdedigingsorganisatie voor Toegepast-Naturwetenschappelijk Onderzoek. refs

A processing technique resulting in high quality reflection holograms is described. The pulse reflection holograms produced may be analyzed by microscope up to interference fringe densities of about 30 fringes/mm. An experimental study using the holographic technique for the detection of fatigue crack growth in a critical aircraft structure is discussed. Low-noise high-efficiency Denisyuk (1963) phase reflection holograms can be produced by the technique. Holograms of a quality sufficient for the convenient interferometric evaluation of low-diffuse reflectance objects are obtained. In addition, the technique provides a low emulsion shrinkage, making possible shrinkage manipulation and thus reconstructed-color manipulation. Rigid-body motion problems are readily solved if the plate holder is fixed to the object. Finally, sensitivity to in-plane as well as out-of-plane deformation is obtained through the observation of different angles of the objects. F.J.

N86-12399# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
17 Oct. 1985 154 p refs Transl. into ENGLISH from various Chinese articles
(JPRS-CST-85-035) Avail: NTIS HC A08/MF A01

Advances in science and technology by the Peoples Republic of China are reported. Topics of discussion include; (1) national development; (2) physical sciences; (3) applied sciences; (4) astronautics; (5) chemistry; (6) computers; (7) cryogenics; (8) electronics; (9) engineering; (10) mathematics; (11) physics; (12) semiconductors; and (13) solar energy.

N86-12446# Joint Publications Research Service, Arlington, Va.
CHINA REPORT: SCIENCE AND TECHNOLOGY
3 Sep. 1985 171 p refs Transl. into ENGLISH from various Chinese articles
(JPRS-CST-85-029) Avail: NTIS HC A08/MF A01

Numerous topics related to science and technology in China are discussed. The progess of inertial confinement research, a programmer for a single chip microprocessor, digital voltmeter technology acquisition wing tip sails on the Y-5 aircraft are among the topics discussed.

N86-12495# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO-ABSORBING MATERIALS
Y. A. SHNEYDERMAN 16 Jul. 1985 64 p Transl. into ENGLISH from Zarubezhneya Radioelektron. (USSR), no. 4, 1965 p 115-135
(AD-A157496; FTD-ID(RS)T-1326-84) Avail: NTIS HC A04/MF A01 CSCL 17D

Recently abroad in connection with rapid development of radar technology methods and means of antiradar protection of flight vehicles, which facilitate breach/inrush of aircraft and rockets through lines of air defense intensively are developed/processed. On the intensification of works in this direction it is possible to judge a sharp increase in the expenditures of USAF (United States Air Force) for the development of the combat means with radar - with 35.5 million dollars in 1962 to 119 million dollars in 1963 and 155 million dollars each in 1964. Utilization of radio-absorbing materials, which ensure decrease of effective surface of scattering of aircraft and rockets, is one of effective combat means with radar. GRA

N86-12552# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean engineering.
NUMERICAL AND EXPERIMENTAL STUDIES OF 3-D AND UNSTEADY TURBULENT BODY/APPENDAGE/PROPELLER FLOWS Annual Report, No. 2, 15 May 1984 - 14 May 1985
J. A. SCHETZ and R. L. SIMPSON 15 Jun. 1985 56 p
(Contract N00014-83-K-0372)
(AD-A157078) Avail: NTIS HC A04/MF A01 CSCL 20D

The 3-D, turbulent flowfield produced by a propeller operating in the wake of a variable mesh disk has been studied with numerical solutions of the Reynolds-averaged, Navier-Stokes equations and by detailed experiments in a wind tunnel. The mesh variations of the upstream disk were chosen to produce a simulation of the wake of a streamlined, axisymmetric body with a single, streamlined appendage. Comparisons of measurements and preliminary numerical predictions show good agreement for the velocity profiles behind the propeller. The 3-D flow in the junction between a cylindrical appendage and a hull can produce separation of the trailing portion of the appendage and produces a momentum deficient 3-D boundary layer that is more prone to detachment than the 2-D regions away from the appendage. Detailed measurements of the zero-pressure-gradient boundary layer upstream of an appendage of interest have been made. A procedure has been developed for reducing blockage effects in the test wind tunnel. GRA

N86-12580*# Spectron Development Labs., Inc., Costa Mesa, Calif.
OPTICAL TECHNIQUE TO STUDY THE IMPACT OF HEAVY RAIN ON AIRCRAFT PERFORMANCE Final Report
C. F. HESS and F. LI Oct. 1985 43 p refs
(Contract NAS1-17932)
(NASA-CR-177989; NAS 1.26:177989; SDL-85-2424-1F) Avail: NTIS HC A03/MF A01 CSCL 01C

A laser based technique was investigated and shown to have the potential to obtain measurements of the size and velocity of water droplets used in a wind tunnel to simulate rain. A theoretical model was developed which included some simple effects due to droplet nonsphericity. Parametric studies included the variation of collection distance (up to 4 m), angle of collection, effect of beam interference by the spray, and droplet shape. Accurate measurements were obtained under extremely high liquid water content and spray interference. The technique finds applications in the characterization of two phase flows where the size and velocity of particles are needed. Author

N86-12585# Department of the Air Force, Washington, D.C.
TRANSIENT TEST OF SUSPENSION ELECTRONICS FOR GYROSCOPE Patent Application
P. H. ITO, inventor (to Air Force) 8 Jul. 1985 48 p
(AD-D011853; US-PATENT-APPL-SN-752767) Avail: NTIS HC A03/MF A01 CSCL 17G

The rotor suspension electronics of an electrostatic gyro suspension system is required to perform flawlessly to sustain the life of the gyro. Transient abnormalities as short as one millisecond duration will cause the spinning rotor to come in contact with the surrounding electrodes and result in destruction of the gyro. Thus, not infrequently after a catastrophic dropped rotor incident no trace of the fault is evident upon ensuing check of the system. To remedy this problem a built in test (BIT) system is used to provide fault isolation. The test circuitry is built into the navigation system electronics and integrated with the system program. The fault isolation electronics comprise sensor circuits to monitor functional subdivisions of the electronic suspension system for signal abnormality and a processing circuit which receives the sensor circuit outputs and identifies the primary source of the fault. The faults are detected and the source is flagged at the time of occurrance. The output of the fault isolation electronics is a latched coded readout which is fed to the navigation computer for memory storage and any appropriate follow-up system action, such as power shutdown. After initialization by the computer, the fault isolation function is an automatic operation by the electronic circuitry.
Author (GRA)

N86-12595# Sandia National Labs., Albuquerque, N. Mex.
NEW PASSIVE HELICOPTER DETECTOR
G. R. ELLIOTT 1985 7 p Presented at the 26th Ann. Meeting of the Inst. of Nucl. Mater. Management, Albuquerque, N. Mex., 21; Jul. 1985
(Contract DE-AC04-76DP-00789)
(DE85-015160; SAND-85-1670C; CONF-850765-9) Avail: NTIS HC A02/MF A01

Sandia has developed a new helicopter detector. The device relies on the correlation between the acoustic wave from the helicopter and the resulting coupled seismic wave. A significant feature of this approach is that the detector is completely passive; there is no radio frequency radiation. Intended for deployment as a perimeter sensor around a site, the unit offers a low nuisance/false alarm rate and a high probability of detection for a wide range of helicopters. Reliable detection occurs when the target is at high altitude and also very near the earth's surface. Detection ranges start at one kilometer for the small, four-place, civilian helicopter and approach five kilometers for heavier, military types. The system has two parts: a transducer package containing a micrphone and a geophone and a digital processor. Development is underway for a model which will be AC powered and well suited to permanent facilities. A prototype unit using a lightweight, battery powered processor is being constructed for rapid-deployment applications. DOE

N86-12620# Materials Research Labs., Ascot Vale (Australia).
DEVELOPMENT AND EVALUATION OF A MICROBURST TEST APPARATUS FOR USE AS A MINIMUM DESTRUCTIVE TEST FOR PARACHUTE MATERIAL
G. T. EGGLESTONE, N. M. BROWNE, and M. TAYLOR Apr. 1985 33 p
(AD-A158110; MRL-R-959) Avail: NTIS HC A03/MF A01 CSCL 11E

Conventional testing of parachute canopy materials to identify the extent of polymer degradation requires large amounts of material resulting in extensive repairs if the material is found to be sound. A microburst test apparatus designed and built at the Materials Research Labs is capable of testing the canopy in-situ, with a degree of damage confined to a 3.2 mm diameter hole. This does not require repair and fits between a ripstop repeat on canopy material from modern day T-1 0 parachutes. The microburst unit gives a digital readout for maximum pressure to burst and pressure to burst/time integral. Correlations between these results and those from conventional tensile and Mullens burst tests showed the microburst test results to more closely resemble those from accepted tensile test methods. GRA

N86-13616# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY
8 Nov. 1985 49 p Repr. from various West European articles Transl. into ENGLISH from various West European articles
(JPRS-WST-85-031) Avail: NTIS HC A03/MF A01

The FBIS West Europe Report (Science and Technology) of 8 November 1985 includes items in the following categories: Advanced Materials, the European Automobile Industry, Biotechnology, Civil Aviation, Computers, Microelectronics, and Scientific and Industrial Policy. Of special interest in this issue are articles on the Franco-Italian ATR-42 aircraft, new CMOS gate arrays produced at Thomson Semiconductors in France, the use of organo-metallic epitaxy to produce chips, and custom chips produced by European Silicon Structures.

N86-13677*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER AND PRESSURE DROP PERFORMANCE OF A FINNED-TUBE HEAT EXCHANGER PROPOSED FOR USE IN THE NASA LEWIS ALTITUDE WIND TUNNEL
G. J. VANFOSSEN Nov. 1985 27 p refs
(NASA-TM-87151; E-2623; NAS 1.15:87151) Avail: NTIS HC A03/MF A01 CSCL 20D

A segment of the heat exchanger proposed for use in the NASA Lewis Altitude Wind Tunnel (AWT) facility has been tested

under dry and icing conditions. The heat exchanger has the largest pressure drop of any component in the AWT loop. It is therefore critical that its performance be known at all conditions before the final design of the AWT is complete. The heat exchanger segment is tested in the NASA Lewis Icing Research Tunnel (IRT) in order to provide an icing cloud environment similar to what will be encountered in the AWT. Dry heat transfer and pressure drop data are obtained and compared to correlations available in the literature. The effects of icing sprays on heat transfer and pressure drop are also investigated. Author

N86-13704# Argonne National Lab., Ill.
FLUID FORCES ON TWO CIRCULAR CYLINDERS IN CROSSFLOW
J. A. JENDRZEJCZYK and S. S. CHEN Jun. 1985 60 p
(Contract W-31-109-ENG-38)
(DE85-014294; ANL-85-35) Avail: NTIS HC A04/MF A01

Fluid excitation forces are measured in a water loop for two circular cylinders arranged in tandem and normal to flow. The Strouhal number and fluctuating drag and lift coefficients for both cylinders are presented for various spacings and incoming flow conditions. Results show the effects of Reynolds number, pitch ratio, and upstream turbulence on the fluid excitation forces. DOE

N86-13756# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
CRUSHING STRENGTH OF ALUMINUM OXIDE AGGLOMERATES Final Report, Apr. 1983 - Sep. 1984
R. A. GAMBLE Jul. 1985 40 p Prepared in cooperation with Sverdrup Technology, Inc., Arnold AFS, TN
(AD-A158051; AEDC-TR-85-16) Avail: NTIS HC A03/MF A01
CSCL 20K

Aluminum oxide, which is formed during combustion of aluminum-based solid propellants, condenses and solidifies in the exhaust flow to form sub-micron-size particles, which may then adhere together to form agglomerates. Particle sampling, which is required for motor performance or environmental impact investigations, is usually done using a probe placed in the supersonic exhaust flow field. The bow shock at the sample probe inlet will decelerate the gas flow which introduces a large velocity differential between the gas and particulate. This differential will result in a sudden increase on the aerodynamic drag on the agglomerates which may cause them to shear apart, thus altering the sample size distribution. In this effort, aluminum oxide agglomerates were formed and then crushed in order to estimate the magnitude of the interparticle forces binding the agglomerate together. The agglomerates were formed by tumbling commercially available aluminum oxide powder in a container, and strength was determined by measuring the load required to crush the agglomerate between two flat plates. Analysis indicated that through, uniformly-shaped particles formed the strongest agglomerates. The experimentally-derived particle bonding forces were in agreement with values predicted by the van der Waal force equation for closely-spaced spheres. Rocket exhaust particulates collected from a test facility exhaust processing system proved to be unstable because of impurities. GRA

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GEOSCIENCES

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

A86-13467
ENVIRONMENT PROTECTION IN CONNECTION WITH AIR TRANSPORTATION [ZASHCHITA OKRUZHAIUSHCHEI SREDY PRI AVIATRANSPORTNYKH PROTSESSAKH]
V. G. ENENKOV, P. M. ZHELTOV, B. N. MELNIKOV, V. G. LUCHNIKOV, G. E. LAGUTINA et al. Moscow, Izdatel'stvo Transport, 1984, 200 p. In Russian. refs

The physical, organizational and legal aspects of environment protection in connection with air transportation are reviewed. In particular, attention is given to the pollution control of atmospheric air, soil, and water; noise pollution control; and emission control of aviation engines. The discussion also covers the control of sonic boom and the control of radio- and infrasonic-frequency electromagnetic fields. V.L.

A86-13535
WAVES DUE TO A STEADILY MOVING SOURCE ON A FLOATING ICE PLATE
J. W. DAVYS, R. J. HOSKING, and A. D. SNEYD (Waikato, University, Hamilton, New Zealand) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 158, Sept. 1985, p. 269-287. refs

The propagation of flexural waves in floating ice plates is governed by two restoring forces - elastic bending of the plate, and the tendency of gravity to make the upper surface of the supporting water horizontal. This paper studies steady wave patterns generated by a steadily moving source on a water-ice system that is assumed to be homogeneous and of infinite horizontal extent, using asymptotic Fourier analysis to give a simple description of the wave pattern far from the source. Short-wavelength elastic waves propagate ahead, while the long gravity waves appear behind; and, depending on the system parameters, one, two, or no caustics may appear. Wavecrest patterns are shown, and the amplitude variation with direction from the source is given. Where the two caustics just merge together, a special mathematical function analogous to the Airy function is introduced to describe wave amplitudes. These waves can be detectd by a strainmeter embedded in the ice, and its theoretical response is compared with some experimental measurements. Author

A86-14816
MICROBURSTS - A HAZARD FOR AIRCRAFT
P. F. LINDEN and J. E. SIMPSON (Cambridge University, England) Nature (ISSN 0028-0836), vol. 317, Oct. 17, 1985, p. 601, 602. refs

Laboratory experiments are reported which show that when a descending column of dense fluid reaches the ground and begins to spread out horizontally, an intense vortex with a horizontal axis forms at the leading edge of the outflowing air. The intensity of this vortex results from the increase in vorticity due to the rapid stretching of the length of the leading edge. The properties of such a horizontal vortex with its associated updrafts and downdrafts are consistent with those found in microbursts, which are a severe hazard to aircraft when taking off or landing. C.D.

A86-15886#
WIND SHEAR INDUCED BY SOLITARY WAVES IN THE LOWER ATMOSPHERE
L. C. CHIEN (Academia Sinica, Institute of Physics, Taipei, Republic of China), Y. L. LEE (China Airlines, Flight Operation Div., Taipei, Republic of China), and C. Y. LEE (Feng Chia University, Taichung, Republic of China) IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 8 p. refs
(IAF PAPER 85-410)

The present solitary wave theory of wind shears responsible for aircraft accidents is not easily verified by the existing meteorological record, which lacks the requisite resolution and sensitivity to indicate the presence of such waves at the time of an accident. Nevertheless, lower atmosphere solitary waves have been surveyed at Warramunger, Australia, since 1976, over scales ranging from some tens of meters to more than 10 km. Recommendations are made for further study. O.C.

N86-12680# Joint Publications Research Service, Arlington, Va.
GRAVIMETRIC SURVEYING WITH MI-8 HELICOPTERS Abstract Only
V. SOPOLEV *In its* USSR Rept.: Earth Sci. (JPRS-UES-85-006) p 52 19 Jun. 1985 Transl. into ENGLISH from Vozdushnyy Transport (Moscow), 18 Apr. 1985 p 4
Avail: NTIS HC A05/MF A01

A new type of geophysical operation--gravimetric surveying from MI-8 helicopters with the aid of suspended gravimeters--has been mastered for the first time in the country by Far East helicopter crews. In this method, all work is performed by an operator inside a helicopter carrying a gravimeter on an outside sling. The gravimeter is equipped with a stabilizing device. Work with the suspended gravimeter requires considerable flying skill and highly precise piloting during approaches and hovering. Author

N86-12744# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
DATA ANALYSIS OF AIRBORNE ELECTROMAGNETIC BATHYMETRY Final Report
R. ZOLLINGER, A. BECKER, and F. MORRISON Apr. 1985 21 p
(AD-A157132; NORDA-93) Avail: NTIS HC A02/MF A01 CSCL 08J

This report describes an experimental evaluation of the concept of airborne electromagnetic bathymetry. The airborne electromagnetic data that forms the basis of this project was acquired with the Mark VI INPUT system along a 17-mile-long flight path off Cape Breton Island in the province of Nova Scotia. The water depth beneath the flight path ranged from 0 to more than 40 m. Author (GRA)

N86-12915# Meteorological Satellite Center, Tokyo (Japan).
INTRODUCTION TO OPERATIONAL ASDAR SYSTEM
M. HITANI *In its* Meteorol. Satellite Center Tech. Note, No. 11, 1985 p 55-60 Mar. 1985 refs In JAPANESE; ENGLISH summary
Avail: NTIS HC A06/MF A01

ASDAR (Aircraft to Satellite Data Relay) is the meteorological avionics systems which automatically sample, record and transmit meteorological observations. The operational ASDAR unit transmits additional information compared with the prototype unit which has continued to function still in service. The initial deliveries of the new flight units are expected dy mid-1985. The data collection system will be revised to process the new ASDAR data. Author

N86-13832# Westinghouse Electric Corp., Lima, Ohio. Electrical Systems Div.
TWO-HUNDRED TO 300 KVA CONDITIONED POWER SYSTEM - DEVELOPMENT, PHASE 1 Final Report, Sep. 1982 - Mar. 1984
W. E. HYVARINEN Mar. 1985 409 p
(Contract F33615-82-C-2234)
(AD-A158820; REPT-1383R; AFWAL-TR-84-2065) Avail: NTIS HC A18/MF A01 CSCL 10B

Future large AF electrical generator channels will be required to operate in parallel to supply single large loads. These channels will be required to use a minimum number of conversion stages to maintain the highest possible efficiency. The EW or other large loads will use power converted directly from the variable speed generator, and only that power required to be 400-Hz will be converted by the V.S.C.F. unit. Redundancy for one generator out condition will be required. The protection and control of the parallel bus will require more sophistication and complexity than the systems presently available. Large rating generators, contactors, and distribution systems will require design effort and test. This report covers a design study to meet the requirements of advanced high power EW systems for aircraft. This report covers the design of a 50 kVA, six-phase generator which is spray oil cooled. The output ratings are 60 kVA at 53% speed, 120 kVA at 60% speed and 410 kVA above 83% speed. The generator maximum design speed is 15,000 rpm. GRA

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LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

A86-13944#
CHANGES OF FLYING SKILLS DURING NON-FLIGHT PERIODS
Z. KATOH, A. KADOO, Y. NAGASAWA, T. OBATA, and N. IGUCHI Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 26, June 1985, p. 81-104. In Japanese, with abstract In English. refs

Flight data from 28 training pilots were analyzed with respect to changes in flying skill during non-flight periods. On board flight data recordings and questionnaries concerning the self-estimation of pilot skill were evaluated with respect to three maneuvers: vertical S-Alpha (VSA); a steep turn (STP); and a horizontal turn (HRZ). A brief summary of the results is provided. I.H.

N86-12968# Air Command and Staff Coll., Maxwell AFB, Ala.
THE HELICOPTER TO FIXED WING CONVERSION PROGRAM: A CRITICAL REVIEW
L. T. MASSEY Apr. 1985 39 p
(AD-A156820; ACSC-85-1750) Avail: NTIS HC A03/MF A01 CSCL 05I

USAF helicopter pilots are initially trained by the U.S. Army through their undergraduate helicopter pilot training program. Four to seven years later, some of these pilots have the opportunity to convert to fixed wing aircraft via the fixed wing conversion program currently conducted by sending selected helicopter pilots through Air Force undergraduate pilot training. This study reviews these programs and assesses the impact this training philosophy has on career opportunities for helicopter pilots, both for those who convert to fixed wing systems, as well as for those who remain in helicopters. Two alternatives are presented which would resolve the problems identified. The study concludes that the USAF could provide better career opportunities for helicopter pilots, as well as improve experience levels in the helicopter force, by enacting changes to current training programs. Author (GRA)

N86-12973# Systems Research Labs., Inc., Dayton, Ohio.
CRITERIA FOR A STATE-OF-THE-ART VISION TEST SYSTEM Final Report
K. MOFFITT and L. V. GENCO May 1985 109 p
(Contract F33615-82-C-0511)
(AD-A157099; AFAMRL-TR-85-004) Avail: NTIS HC A06/MF A01 CSCL 06P

Many vision test/screening devices used in the Armed Services have not changed since the 1940's. The reduction in the size of the pool of qualified aircrew candidates has caused operational Commands to question the validity of these tests. Current objectives of vision testing have evolved from a means to eliminate pilot candidates to methods of predicting aircrew performance. The Naval Aerospace Medical Research Laboratory (NAMRL) is attempting to correlate the results of several vision tests with the visual abilities of pilot trainees as demonstrated during monitored training flights. This report describes status that could be considered as useful parameters for testing in the Armed Forces vision test battery of the future. One major conclusion is that the operational visual task(s) must be suitably described in order to select appropriate clinical and laboratory test measures. Correlations and validation studies can then be performed with cooperative efforts such as those between NAMRL and AFAMRL. GRA

N86-13890# Air Force Human Resources Lab., Brooks AFB, Tex.
PILOT-ORIENTED PERFORMANCE MEASUREMENT Final Report, Jan. - Dec. 1983
J. DEMAIO, H. H. BELL, and J. BRUNDERMAN Aug. 1985 15 p
(Contract AF PROJ. 2313)
(AD-A158849; AFHRL-TP-85-18) Avail: NTIS HC A02/MF A01 CSCL 14B

Aircrew performance measurement is a critical problem in evaluating the quality of a visual simulation system and in determining the effectiveness of aircrew training devices. An effective performance measurement system must be able to separate performance into appropriate components and describe the relationship of these components. This paper describes a performance measurement system developed to analyze pilot performance in maintaining altitude in both straight and turning flight as a function of the object density of the simulated visual environment. The analysis indicates that pilot performance can be divided into perceptual and task difficulty factors and that the effect of the visual environment on each of these factors can be determined. A prototype performance measurement system was developed to describe pilot performance in a simulator. The pilot's task was to maintain altitude at 200 feet both in straight and in turning flight. Pilot performance was sensitive to task difficulty and to visual scene quality. The strength of this performance measurement system was that it analyzed performance in terms of overall task performance and also specific pilot control inputs. GRA

N86-13892*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF DIGITAL ALTIMETRY ON PILOT WORKLOAD
R. L. HARRIS, SR. and B. J. GLOVER Nov. 1985 20 p refs
(NASA-TM-86424; L-15989; NAS 1.15:86424) Avail: NTIS HC A02/MF A01 CSCL 05H

A series of VOR-DME instrument landing approaches was flown in the DC-9 full-workload simulator to compare pilot performance, scan behavior, and workload when using a computer-drum-pointer altimeter (CDPA) and a digital altimeter (DA). Six pilots executed two sets of instrument landing approaches, with a CDPA on one set and a DA on the other set. Pilot scanning parameters, flight performance, and subjective opinion data were evaluated. It is found that the processes of gathering information from the CDPA and the DA are different. The DA requires a higher mental workload than the CDPA for a VOR-DME type landing approach. Mental processing of altitude information after transitioning back to the attitude indicator is more evident with the DA than with the CDPA. E.A.K.

N86-13906# Purdue Univ., West Lafayette, Ind.
ALERTED MONITORS: HUMAN OPERATORS AIDED BY AUTOMATED DETECTORS Final Report
R. D. SORKIN and D. E. ROBINSON Dec. 1984 55 p
(Contract DTRS56-83-C-00047)
(PB85-222750; DOT/OST/P34-85/021) Avail: NTIS HC A04/MF A01 CSCL 05H

In an alerted monitor system, an automated detector assists a human operator in the detection and diagnosis of problems occurring in some monitored process. Air traffic control centers and the flight decks of commercial aircraft include many examples of such systems. This project developed a general model of the altered-monitor system and evaluated the effects on system performance of interactions between the human operator and automated detector. One of the types of interaction evaluated (contingent criterion strategy) yields optimal performance from the combined person-machine system. Two laboratory experiments were performed to evaluate the assumptions of the model and the interactions between the operator and automated components. GRA

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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.

A86-13049
HARDWARE INTEGRITY
W. J. CULLYER (Royal Signals and Radar Establishment, Malvern, England) Aeronautical Journal (ISSN 0001-9240), vol. 89, Aug.-Sept. 1985, p. 263-268. refs

The presently reported research has revealed problems with the use of commercial microprocessors in safety-critical equipment, due to imprecise documentation of the instruction sets issued by manufactures and changes in design and function over the years in which a commercially popular device is marketed. Attention is presently given to the development of formal methods for the design and implementation of VLSI chips for certain research applications, in which the chips furnish simple processing functions and can be proved to be functionally correct. The novel 32-bit microprocessor architecture designatted 'VIPER' is taken as an illustrative case. O.C.

A86-13125
FLEXIBLE ASSEMBLY SUBSYSTEMS
O. WEINGART (Rohr Industries, Inc., Riverside, CA) IN: National SAMPE Symposium and Exhibition, 30th, Anaheim, CA, March 19-21, 1985, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1985, p. 820-831.

A three-year Flexible Assembly Subsystems program was conducted in order to develop and demonstrate technologies that are critical for the achievement of flexible automated systems. The ultimate goal of this work is the furnishing of a technology base for the automation of military airframe assembly. Phase I of the program gives attention to hardware requirements, risk reduction, and simulation. Phase II will undertake component refinement, total system integration, and final demonstration of capabilities. O.C.

A86-13409
A METHOD FOR ARRANGING NODES ALONG THE LINES OF A COMPUTATIONAL GRID DURING THE NUMERICAL SOLUTION OF PROBLEMS IN MATHEMATICAL PHYSICS [METOD RASSTANOVKI UZLOV VDOL' LINII SCHETNOI SETKI PRI CHISLENNOM RESHENII ZADACH MATEMATICHESKOI FIZIKI]
V. L. IUMASHEV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 4, 1984, p. 115-119. In Russian.

Automatic grid generation during the numerical solution of problems in mathematical physics involves the problem of node arrangment along an arbitrary line in accordance with a given criterion. A numerical method for solving this problem is proposed which can be used in a sufficiently general case where the line and the node arrangement criterion are given in the form of certain computational procedures rather than in analytical form. The method is illustrated by an example in which a grid is constructed for a body with a variable-width elliptical cross-section representing a flight vehicle model. V.L.

A86-13418
APPLICATION OF THE STATE-SPACE METHOD TO ANALYZE THE STABILITY OF DIGITAL SYSTEMS [PRIMENENIE METODA PROSTRANSTVA SOSTOIANII DLIA ANALIZA USTOICHIVOSTI TSIFROVYKH SISTEM]
IU. I. DIDENKO, P. V. KUSHNIR, and IU. F. SHELIUKHIN TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 68-78. In Russian. refs

Methodological questions involving the use of state equations to analyze the stability of complex digital systems are examined. Consideration is given to delay in the feedback circuits, the use of several reception beats of input information, and the renewal of the state-vector components of the digital controlling part. Generalized matrix expressions describing the behavior of such systems are obtained. A digital flight control system is considered as an example. B.J.

A86-14434*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERT SYSTEMS AND THEIR USE IN AUGMENTING DESIGN OPTIMIZATION
G. H. KIDWELL and M. A. ESKEY (NASA, Ames Research Center, Moffett Field, CA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Colorado Springs, CO, Oct. 14-16, 1985. 16 p. refs
(AIAA PAPER 85-3095)

The challenging requirements that are evolving for future aircraft demand that each design be optimally integrated, for the penalties imposed by nonoptimal performance are significant. Classic numerical optimization algorithms have been and will continue to be important tools for aircraft designers. These methods are, however, limited to certain categories of aircraft design variables, leaving the remainder to be determined by the user. A method that makes use of knowledge-based expert systems offers the potential for aiding the conceptual design process in a way that is similar to that of numerical optimization, except that it would address discrete, discontinuous, abstract, or any other unoptimized aspect of vehicle design and integration. Other unique capabilities such as automatic discovery and learning in design may also be achievable in the near term. This paper discusses current practice in conceptual aircraft design and knowledge-based systems, and how knowledge-based systems can be used in conceptual design. Author

A86-14827
UNCERTAINTY AND CONTROL - SOME ACTIVITIES AT DFVLR
G. GRUEBEL (DFVLR, Institut fuer Dynamik der Flugsysteme, Oberpfaffenhofen, West Germany) IN: Uncertainty and control; Proceedings of the International Seminar, Bonn, West Germany, May 1985 . Berlin and New York, Springer-Verlag, 1985, p. 1-47. refs

Some activities at DFVLR which deal with system modelling and performance evaluation under uncertainty, as well as feedback control applications, are reported. Activities in applied nonlinear parameter identification, on-line wind measurement and prediction, stochastic simulation, and sensor diagnosis via analytic redundancy are briefly described. Applications of feedback control are examined, including model-following control for inflight simulation, robust stabilization of high-performance aircraft, aircraft flutter stability augmentation via active mode decoupling, and active damping of mechanical lightweight structures based on finite element modelling. C.D.

A86-14830
MULTI-MODEL APPROACHES TO ROBUST CONTROL SYSTEM DESIGN
J. ACKERMANN (DFVLR, Institut fuer Dynamik der Flugsysteme, Oberpfaffenhofen, West Germany) IN: Uncertainty and control; Proceedings of the International Seminar, Bonn, West Germany, May 1985 . Berlin and New York, Springer-Verlag, 1985, p. 108-130. refs

The design of fixed-gain, robust controllers is reviewed. Two design methods are considered: (1) the simultaneous assignment of the poles to a given region for all members of the plant family by parameter space methods, and (2) the interactive Pareto optimization of a vectorial performance index. The testing of the controller for parameter uncertainty in continuous intervals is examined. The existence and dynamic order of simultaneous Gamma stabilizers is discussed. C.D.

A86-15278
APPLICATIONS OF ARTIFICIAL INTELLIGENCE; PROCEEDINGS OF THE MEETING, ARLINGTON, VA, MAY 3, 4, 1984
J. F. GILMORE, ED. (Georgia Institute of Technology, Atlanta) Meeting sponsored by SPIE - The International Society for Optical Engineering. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 485), 1984, 243 p. For individual items see A86-15279 to A86-15285.
(SPIE-485)

Subjects related to expert systems are discussed, taking into account a context dependent automatic target recognition system, computer understanding of air traffic control displays, the role of the image analyst in computer vision, a demonstration of an ocean surveillance information fusion expert system, and the location of multiple faults by diagnostic expert systems. Other topics explored are concerned with knowledge-based systems, autonomous vehicles, and image understanding. Attention is given to aspects of interfacing an intelligent decision-maker to a real-time control system, a reasoning system for computer aided engineering, an 'intelligent' optical design program, an adaptive interpolator algorithm for area-array fine guidance sensors, terrain navigation concepts for autonomous vehicles, the autonomous helicopter system, an autonomous vehicle navigation algorithm, the planning of strategic paths through variable terrain data, the contextual analysis of tactical scenes, and a structural target analysis and recognition system. G.R.

A86-15283
AIRID - AN APPLICATION OF THE KAS/PROSPECTOR EXPERT SYSTEM BUILDER TO AIRPLANE IDENTIFICATION
J. P. ALDRIDGE (Los Alamos National Laboratory, NM) IN: Applications of artificial intelligence; Proceedings of the Meeting, Arlington, VA, May 3, 4, 1984 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1984, p. 73-79.

The Knowledge Acquisition System/Prospector expert system building tool has been used to construct an expert system to identify aircraft on the basis of observables such as wing shape, engine number/location, fuselage shape, and tail assembly shape. Additional detailed features are allowed to influence the identification as 'other favorable features'. Constraints on the observations imposed by bad weather and distant observations have been included as contexts to the models. Models for Soviet and U.S. fighter aircraft have been included. Inclusion of other types of aircraft such as bombers, transports, and reconnaissance craft is straightforward. Two models permit exploration of the interaction of semantic and taxonomic networks with the models. A full set of text data for fluid communication with the user has been included. The use of demons as triggered output responses to enhance utility to the user has been explored. This paper presents discussion of the ease of building the expert system using this powerful tool and problems encountered in the construction process. Author

N86-13051# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.
STATISTICAL SAMPLING OF AIRCRAFT OPERATIONS AT NON-TOWERED AIRPORTS
M. FORD and R. SHIRACK Apr. 1985 49 p
(AD-A157095; FAA-APO-85-7) Avail: NTIS HC A03/MF A01 CSCL 12A

The purpose of this handbook is to provide a statistically sound method of estimating aircraft operations at non-towered airports from sampling counts. The handbook is written for planners, engineers, airport operators responsible for aircraft planning, and persons that collect data for FAA Airport Master Records (Form 5010.1). Many of these users will be familiar with general aviation airports, but not necessarily with statistical methods. Accurate information on aircraft activity at non-towered airports is a major need of airport owners and operators as well as planners and administrators charged with the planning and development of the airport system. Unlike towered airports, where air traffic controllers keep constant tallies of activity, most non-towered airports have no accurate record of usage. Obtaining accurate aircraft activity counts will provide a variety of benefits. Investment decisions can be made with more confidence if benefit-cost analysis is based on accurate information about use of the facility. Design criteria, which may have a significant impact on development and operating costs, can be more efficiently applied. Even when decisions are based on forecasts rather than present circumstances, accurate base data is necessary to make accurate forecasts of activity. GRA

N86-13922*# Stanford Univ., Calif. Computer Systems Lab.
DEVELOPMENT OF A FLIGHT SOFTWARE TESTING METHODOLOGY Final Report
E. J. MCCLUSKEY and D. M. ANDREWS Sep. 1985 29 p refs
(Contract NAG2-246)
(NASA-CR-176391; NAS 1.26:176391) Avail: NTIS HC A03/MF A01 CSCL 09B

The research to develop a testing methodology for flight software is described. An experiment was conducted in using assertions to dynamically test digital flight control software. The experiment showed that 87% of typical errors introduced into the program would be detected by assertions. Detailed analysis of the test data showed that the number of assertions needed to detect those errors could be reduced to a minimal set. The analysis also revealed that the most effective assertions tested program parameters that provided greater indirect (collateral) testing of other parameters. In addition, a prototype watchdog task system was built to evaluate the effectiveness of executing assertions in parallel by using the multitasking features of Ada. Author

N86-13944*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE MISSION ORIENTED TERMINAL AREA SIMULATION FACILITY
J. T. KAYLOR, H. I. SIMMONS, P. B. NAFTEL (Research Triangle Inst.), J. A. HOUCK, and R. D. GROVE Oct. 1985 63 p refs
(NASA-TM-87621; NAS 1.15:87621) Avail: NTIS HC A04/MF A01 CSCL 09B

The Mission Oriented Terminal Area Simulation (MOTAS) was developed to provide an ATC environment in which flight management and flight operations research studies can be conducted with a high degree of realism. This facility provides a flexible and comprehensive simulation of the airborne, ground-based and communication aspects of the airport terminal area environment. Major elements of the simulation are: an airport terminal area environment model, two air traffic controller stations, several aircraft models and simulator cockpits, four pseudo pilot stations, and a realistic air-ground communications network. MOTAS has been used for one study with the DC-9 simulator and a series of data link studies are planned in the near future. Author

N86-13946*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A METHOD TO STABILIZE LINEAR SYSTEMS USING EIGENVALUE GRADIENT INFORMATION
C. D. WIESEMAN Nov. 1985 40 p refs
(NASA-TP-2479; L-15964; NAS 1.60:2479) Avail: NTIS HC A03/MF A01 CSCL 09B

Formal optimization methods and eigenvalue gradient information are used to develop a stabilizing control law for a closed loop linear system that is initially unstable. The method was originally formulated by using direct, constrained optimization methods with the constraints being the real parts of the eigenvalues. However, because of problems in trying to achieve stabilizing control laws, the problem was reformulated to be solved differently. The method described uses the Davidon-Fletcher-Powell minimization technique to solve an indirect, constrained minimization problem in which the performance index is the Kreisselmeier-Steinhauser function of the real parts of all the eigenvalues. The method is applied successfully to solve two different problems: the determination of a fourth-order control law stabilizes a single-input single-output active flutter suppression system and the determination of a second-order control law for a multi-input multi-output lateral-directional flight control system. Various sets of design variables and initial starting points were chosen to show the robustness of the method. Author

N86-14104*# Bradley Univ., Peoria, Ill. Dept. of Mathematics.
COMPUTER GRAPHICS APPLICATIONS TO CREW DISPLAYS Final Report
J. WYZKOSKI *In* NASA. Johnson (Lyndon B.) Space Center The 1983 NASA/ASEE Summer Faculty Fellowship Research Program Research Reports 10 p Sep. 1983 refs
Avail: NTIS HC A18/MF A01 CSCL 09B

Astronauts are provided much data and information via the monochrome CRT displays on the orbiter. For this project two areas were investigated for the possible introduction of computer graphics to enhance and extend the utility of these displays. One involved reviewing the current orbiter displays and identifying those which could be improved via computer graphics. As an example, the tabular data on electrical power distribution and control was enhanced by the addition of color and bar charts. The other dealt with the development of an aid to berthing a payload with the Remote Manipulator System (RMS). This aid consists of a graphics display of the top, front and side views of the payload and cargo bay and point of resolution (POR) position and attitude data for the current location of the payload. The initial implementation was on an IBM PC clone. The demonstration software installed in the Johnson Space Center Manipulator Development Facility (MD) was

reviewed. Due to current hardware limitations, the MDF verision is slow, i.e., about a 40+ seond update rate and, hence, not real-time. Despite this fact, the evaluation of this additional visual cue as an RMS operator aid indicates that this display, with modifications for speed, etc., can assist the crew. Further development is appropriate. Author

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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.

A86-13031
RADIATIVE GASDYNAMIC PROCESSES IN IMPLODING DISCHARGES IN A PLASMODYNAMIC MAGNETOPLASMA COMPRESSOR
A. S. KAMRUKOV, N. P. KOZLOV, IU. S. PROTASOV, and S. N. CHUVASHEV (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 55, Mar. 1985, p. 533-543) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 30, March 1985, p. 315-321. Translation. refs

Radiative gasdynamic processes in collapsing radiating plasmodynamic discharges in magnetoplasma compressors are simulated numerically and the results are compargd with available experimental data. The nonequilibrium ionic composition, the electron-ion temperature stratification, and the vaporization and influx of vaporized material from the transparent channel walls into the plasma in the implosion zone are all found to be important. The interaction between radiation and vaporization appreciably alters the time dependence of the light output relative to the pumping pulse and enhances the light-emitting efficiency of the discharge. Author

A86-13416
ACOUSTIC CHARACTERISTICS OF MODELS OF EJECTOR SUPPRESSORS OF JET NOISE [AKUSTICHESKIE KHARAKTERISTIKI MODELEI EZHEKTORNYKH GLUSHITELEI SHUMA STRUI]
IU. G. ZHULEV, O. V. LEBEDEVA, A. G. MUNIN, and IU. F. POTAPOV TsAGI, Uchenye Zapiski (ISSN 0321-3429), vol. 15, no. 5, 1984, p. 46-53. In Russian. refs

The paper presents the results of an experimental study of the acoustic characteristics of a jet-noise suppressor in the form of a corrugated nozzle and an ejector with sound-absorbing walls. It is shown that a particular combination of outlet-nozzle shapes and ejector dimensions makes it possible to reduce the jet noise to 13 dB in the range of spectrum components where the noise is maximal. This result holds both for stationary conditions and for flight conditions at speeds up to 270 km/hour. B.J.

A86-15340
FIBER OPTICS IN ADVERSE ENVIRONMENTS II; PROCEEDINGS OF THE MEETING, SAN DIEGO, CA, AUGUST 22-24, 1984
R. A. GREENWELL, ED. (Science and Engineering Associates, Inc., Seattle, WA) Meeting sponsored by SPIE - The International Society for Optical Engineering. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 506), 1984, 244 p. For individual items see A86-15341 to A86-15343.
(SPIE-506)

Measurements and characterization of fiber optics in radiation environments are considered, taking into account material dispersion measurements on fiber optic cables used at the Nevada Test Site, gamma-ray to Cerenkov light conversion efficiency for pure-silica-core optical fibers, the measurement of transient radiation effects in optical fibers, optical characterization of radiation-resistant fibers, and a high-bandwidth multichannel fiber optic system for measuring gamma rays. Other topics discussed are related to radiation test monitoring systems using fiber optics, fiber optic systems in adverse environments, fiber optics in the electromagnetic environment, environmental effects on fiber optic components, radiation effects in optical fibers, and radiation effects on fiber optic devices. Attention is given to the radiation response of optical fibers in a nuclear reactor, a fiber optic digital uplink for ocean-floor experimentation, fiber optic aircraft systems electromagnetic pulse (EMP) survivability, and transient attenuation in optical fibers. G.R.

A86-16058* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOUND GENERATION BY FLOW OVER RELATIVELY DEEP CYLINDRICAL CAVITIES
S. P. PARTHASARATHY, Y. I. CHO, and L. H. BACK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Acoustical Society of America, Journal (ISSN 0001-4966), vol. 78, Nov. 1985, p. 1785-1795. Army-sponsored research. refs

To develop a system for acoustic coding of moving objects containing drilled cylindrical cavities, the production of high-intensity tones by deep cylindrical cavities in a flat surface at low (0.12-0.24) Mach numbers was investigated. The sound intensity and frequency have been determined as functions of flow velocity, diameter, and depth of the cavities. It is shown that whistles can be designed for a given frequency (in the range of 5-17 kHz) and flow, and the sound pressure levels can be calculated by the equations given. Using these equations a whistle producing 106 dB at a 30.5-cm distance from a cylindrical cavity of 0.508 cm in diameter and 1.32 cm in depth with an airflow of 57.7 m/s past the cavity was designed. I.S.

N86-14006*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY MEASUREMENT OF THE NOISE FROM THE 2/9 SCALE MODEL OF THE LARGE-SCALE ADVANCED PROPFAN (LAP) PROPELLER, SR-7A
J. H. DITTMAR Sep. 1985 22 p refs
(NASA-TM-87116; E-2718; NAS 1.15:87116) Avail: NTIS HC A02/MF A01 CSCL 02A

Noise data on the Large-scale Advanced Propfan (LAP) propeller model SR-7A were taken into the NASA Lewis 8- by 6-Foot Wind Tunnel. The maximum blade passing tone decreases from the peak level when going to higher helical tip Mach numbers. This noise reduction points to the use of higher propeller speeds as a possible method to reduce airplane cabin noise while maintaining high flight speed and efficiency. Comparison of the SR-7A blade passing noise with the noise of the similarly designed SR-3 propeller shows good agreement as expected. The SR-7A propeller is slightly noisier than the SR-3 model in the plane of rotation at the cruise condition. Projections of the tunnel model data are made to the full-scale LAP propeller mounted on the test bed aircraft and compared with design predictions. The prediction method is conservative in the sense that it overpredicts the projected model data. Author

N86-14007*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME DESIGN PHILOSOPHY FOR REDUCING THE COMMUNITY NOISE OF ADVANCED COUNTER-ROTATION PROPELLERS
J. H. DITTMAR Aug. 1985 29 p refs
(NASA-TM-87099; E-2692; NAS 1.15:87099) Avail: NTIS HC A03/MF A01 CSCL 20A

Advanced counter-rotation propellers have been indicated as possibly generating an unacceptable amount of noise for the people living near an airport. This report has explored ways to reduce this noise level, which is treated as being caused by the interaction of the upstream propeller wakes and vortices with the downstream propeller. The noise reduction techniques fall into two categories: (1) reducing the strength of the wakes and vortices, and (2) reducing the response of the downstream blades to them. The noise from

the wake interaction was indicated as being reduced by increased propeller spacing and decreased blade drag coefficient. The vortex-interaction noise could be eliminated by having the vortex pass over the tips of the downstream blade, and it could be reduced by increased spacing or decreased initial circulation. The downstream blade response could be lessened by increasing the reduced frequency parameter omega or by phasing of the response from different sections to have a mutual cancellation effect. Uneven blade to blade spacing for the downstream blading was indicated as having a possible effect on the annoyance of counter-rotation propeller noise. Although there are undoubtedly additional methods of noise reduction not covered in this report, the inclusion of the design methods discussed would potentially result in a counter-rotation propeller that is acceptably quiet. Author

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SOCIAL SCIENCES

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

A86-14239#
SELECTION OF AN OPTIMAL COST INDEX FOR AIRLINE HUB OPERATION
A. CHAKRAVARTY (Boeing Commercial Airplane Co., Seattle, WA) (Guidance and Control Conference, Seattle, WA, August 20-22, 1984, Technical Papers, p. 182-187) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Nov.-Dec. 1985, p. 777-781. Previously cited in issue 21, p. 3122, Accession no. A84-43421.

A86-14372
LIABILITY OF AIR TRAFFIC CONTROL AGENCIES AND AIRPORT OPERATORS IN CIVIL LAW JURISDICTIONS
A. E. DU PERRON Air Law (ISSN 0165-2079), vol. 10, Oct. 1985, p. 203-216. refs

N86-13219*# Akron Univ., Ohio. Dept. of Civil Engineering.
NASA LERC/AKRON UNIVERSITY GRADUATE COOPERATIVE FELLOWSHIP PROGRAM AND GRADUATE STUDENT RESEARCHERS PROGRAM Interim Report, Nov. 1981 - Oct. 1983
D. G. FERTIS Oct. 1983 59 p refs
(Contract NAG3-50; NGT36-001-800; NGT36-001-801)
(NASA-CR-174826; NAS 1.26:174826; NAUFP-202-3) Avail: NTIS HC A04/MF A01 CSCL 05I

On June 1, 1980, the University of Akron and the NASA Lewis Research Center (LERC) established a Graduate Cooperative Fellowship Program in the specialized areas of Engine Structural Analysis and Dynamics, Computational Mechanics, Mechanics of Composite Materials, and Structural Optimization, in order to promote and develop requisite technologies in these areas of engine technology. The objectives of this program are consistent with those of the NASA Engine Structure Program in which graduate students of the University of Akron participate by conducting research at Lewis. This report is the second on this grant and summarizes the second and third year research effort, which includes the participation of five graduate students where each student selects one of the above areas as his special field of interest. Each student is required to spend 30 percent of his educational training time at the NASA Lewis Research Center and the balance at the University of Akron. His course work is judiciously selected and tailored to prepare him for research work in his field of interest. A research topic is selected for each student while in residence at the NASA Lewis Research Center, which is also approved by the faculty of the University of Akron as his thesis topic for a Master's and/or a Ph.D. degree. Author

N86-13220# Naval Postgraduate School, Monterey, Calif.
COMPUTER AIDED INSTRUCTION IN ENGINEERING M.S. Thesis
T. S. ROSE Mar. 1985 53 p
(AD-A156828; AD-E301723) Avail: NTIS HC A04/MF A01 CSCL 05I

This thesis presents evidence that computer aided instruction (CAI) is effective and can improve instructional efficiency when it is properly implemented. An overview of CAI in other colleges is presented as a source of ideas. The Department of Aeronautics of the Naval Postgraduate School is used as an example of where CAI can be applied. Procedures for the proper implementation of CAI are presented; and the summary includes specific recommendations for the Aeronautics Department. GRA

N86-13235*# National Academy of Sciences - National Research Council, Washington, D. C. Panel on Vehicle Applications.
AERONAUTICAL TECHNOLOGY 2000: A PROJECTION OF ADVANCED VEHICLE CONCEPTS
1985 116 p
(Contract NASW-3455)
(NASA-CR-176322; NAS 1.26:176322) Avail: NTIS HC A06/MF A01; also available from Aeronautics and Space Engineering Board, National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418 CSCL 05A

The Aeronautics and Space Engineering Board (ASEB) of the National Research Council conducted a Workshop on Aeronautical Technology: a Projection to the Year 2000 (Aerotech 2000 Workshop). The panels were asked to project advances in aeronautical technologies that could be available by the year 2000. As the workshop was drawing to a close, it became evident that a more comprehensive investigation of advanced air vehicle concepts than was possible in the limited time available at the workshop would be valuable. Thus, a special panel on vehicle applications was organized. In the course of two meetings, the panel identified and described representative types of aircraft judged possible with the workshop's technology projections. These representative aircraft types include: military aircraft; transport aircraft; rotorcraft; extremely high altitude aircraft; and transatmospheric aircraft. Improvements in performance, efficiency, and operational characteristics possible through the application of the workshop's year 2000 technology projections were discussed. The subgroups also identified the technologies considered essential and enhancing or supporting to achieve the projected aircraft improvements. B.W.

N86-14078*# National Aeronautics and Space Administration. Johnson (Lyndon B.) Space Center,
THE 1983 NASA/ASEE SUMMER FACULTY FELLOWSHIP RESEARCH PROGRAM RESEARCH REPORTS Final Reports
W. J. HORN, ed. (Texas A&M Univ., College Station) and M. B. DUKE, ed. Sep. 1983 409 p refs Program held in College Station, Tex., 1983
(Contract NGT-44-001-800)
(NASA-CR-171904; NAS 1.26:171904) Avail: NTIS HC A18/MF A01 CSCL 05I

The 1983 NASA/ASEE Summer Faculty Fellowship Research Program was conducted by Texas A&M University and the Lyndon B. Johnson Space Center (JSC). The 10-week program was operated under the auspices of the American Society for Engineering Education (ASEE). The basic objectives of the programs, which began in 1965 at JSC and in 1964 nationally, are (1) to further the professional knowledge of qualified engineering and science faculty members, (2) to stimulate an exchange of ideas between participants and NASA, (3) to enrich and refresh the research and teaching activities of participants' institutions, and (4) to contribute to the research objectives of the NASA Centers. The faculty fellows spent 10 weeks at JSC engaged in a research project commensurate with their interests and background. They worked in collaboration with a NASA/JSC colleague. This document is a compilation of final reports on their research during the summer of 1983.

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SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

N86-14111# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE
30 Sep. 1985 156 p refs Transl. into ENGLISH from various Russian articles
(JPRS-USP-85-005) Avail: NTIS HC A08

Progress in USSR aerospace science and technology is reported. Topics discussed include: aerospace engineering, interplanetary sciences, life sciences, space applications, space policy and administration, and launch tables.

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GENERAL

A86-13462
STUDIES IN THE HISTORY AND THEORY OF THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN THE FIELDS OF AVIATION, ROCKETRY, AND SPACE. NUMBER 3 [ISSLEDOVANIIA PO ISTORII I TEORII RAZVITIIA AVIATSIONNOI I RAKETNO-KOSMICHESKOI NAUKI I TEKHNIKI. NUMBER 3]
B. V. RAUSHENBAKH, ED. Moscow, Izdatel'stvo Nauka, 1984, 248 p. In Russian. No individual items are abstracted in this volume.

The papers presented in this volume provide an overview of developments in the field of rocket and spacecraft building and manned space flights in the USSR. In particular, attention is given to the analysis of the works of the founders of theoretical space science, problems in the development and building of aviation engines, and methodological problems associated with the study of the development of aerospace systems. V.L.

A86-15913#
A BRIEF HISTORY OF THE FIRST U.S. JATO FLIGHT TESTS OF AUGUST 1941
H. A. BOUSHEY IAF, International Astronautical Congress, 36th, Stockholm, Sweden, Oct. 7-12, 1985. 9 p.
(IAF PAPER 85-453)

A brief narrative history of the first Jet Assisted Take-Off tests in the US is given. The tests were conducted by the Army Air Corps in 1941 to study the capabilities of rockets. A photograph of the Ercoup jet-assisted test aircraft is provided. I.H.

N86-14213*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EMERGING AEROSPACE TECHNOLOGIES
W. F. BALLHAUS, JR. and L. A. MILOV Sep. 1985 16 p refs (NASA-TM-86837; REPT-85409; NAS 1.15:86837) Avail: NTIS HC A02/MF A01 CSCL 05D

The United States Government has a long history of promoting the advancement of technology to strengthen the economy and national defense. An example is NASA, which was formed in 1958 to establish and maintain U.S. space technology leadership. This leadership has resulted in technological benefits to many fields and the establishment of new commercial industries, such as satellite communications. Currently, NASA's leading technology development at Ames Research Center includes the Tilt Rotor XV-15, which provides the versatility of a helicopter with the speed of a turboprop aircraft; the Numerical Aerodynamic Simulator, which is pushing the state of the art in advanced computational mathematics and computer simulation; and the Advanced Automation and Robotics programs, which will improve all areas of space development as well as life on Earth. Private industry is involved in maintaining technological leadership through NASA's Commercial Use of Space Program, which provides for synergistic relationships among government, industry, and academia. The plan for a space station by 1992 has framed much of NASA's future goals and has provided new areas of opportunity for both domestic space technology and leadership improvement of life on Earth.
Author

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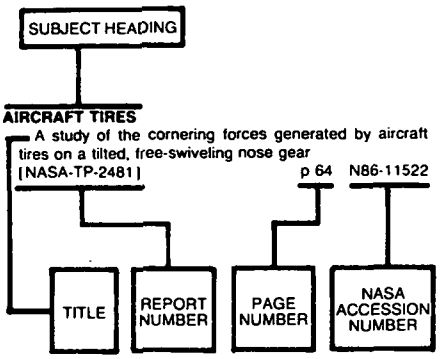

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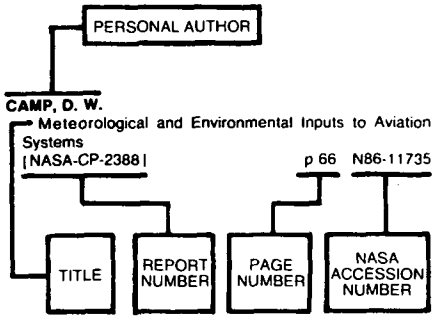

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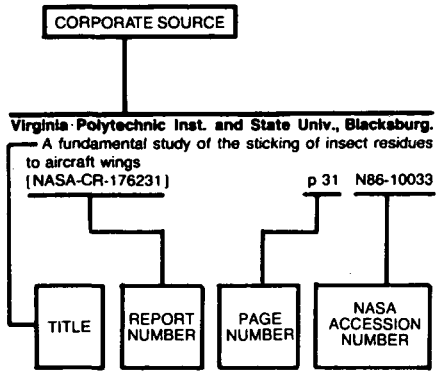

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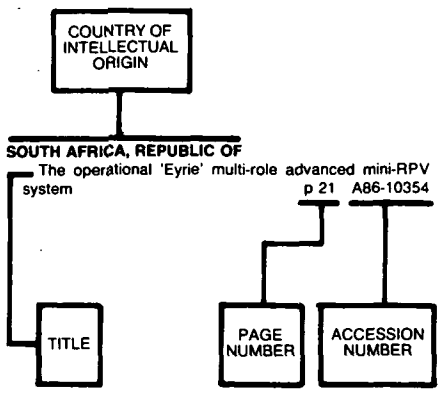
Typical Foreign Technology Index Listing



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FOREIGN

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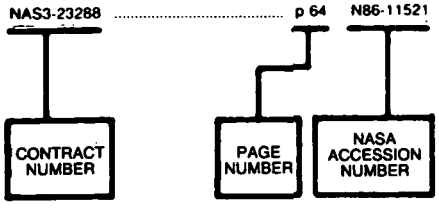
Standardised fatigue loading sequences for helicopter rotors (Helix and Felix). Part 2: Final definition of Helix and Felix
[AD-A156622] p 101 N86-13322

Typical Contract Number Index Listing



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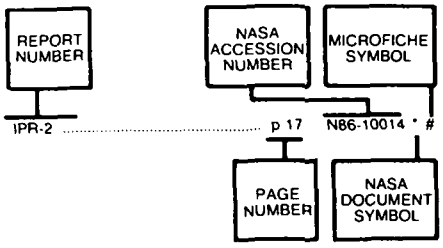

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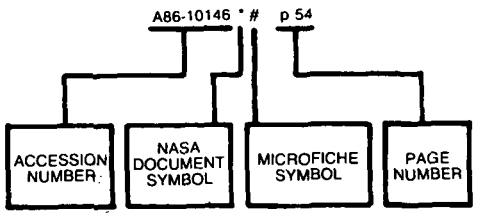

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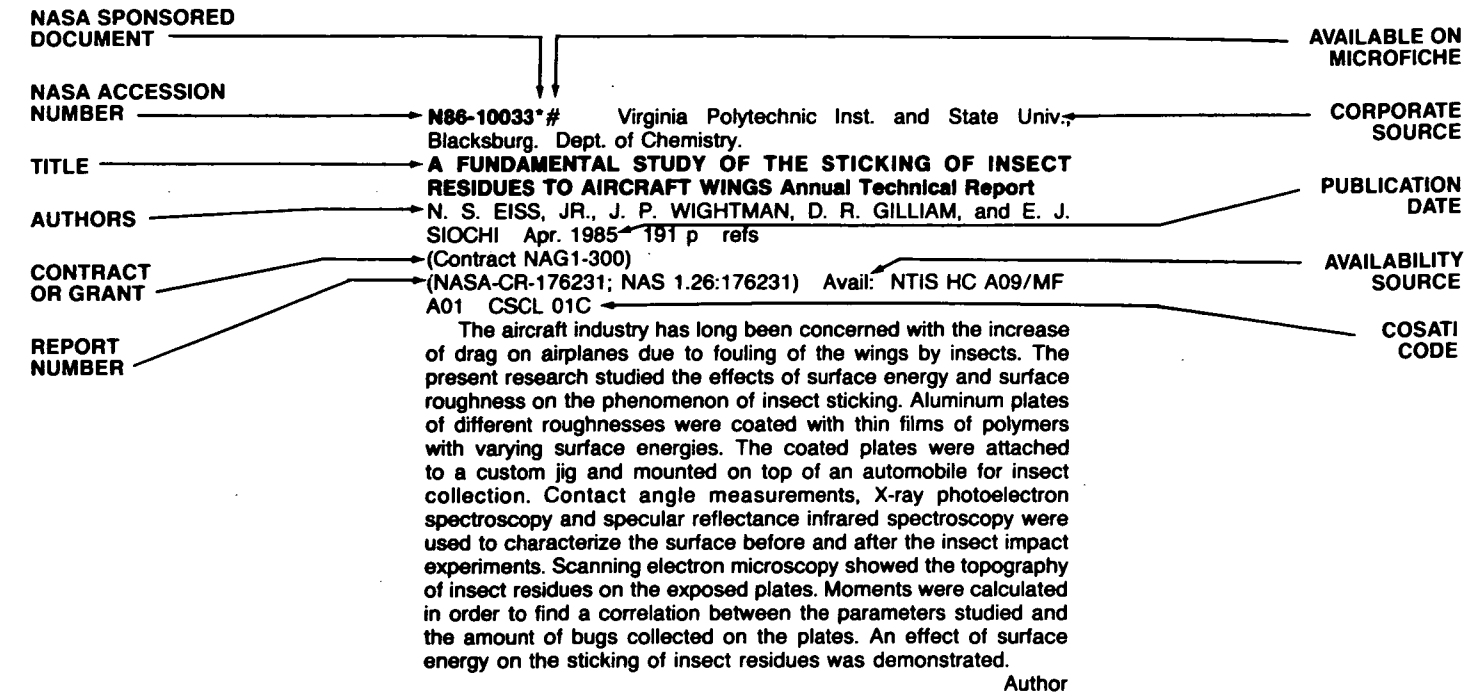

N86-10033*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.

A FUNDAMENTAL STUDY OF THE STICKING OF INSECT RESIDUES TO AIRCRAFT WINGS Annual Technical Report

N. S. EISS, JR., J. P. WIGHTMAN, D. R. GILLIAM, and E. J. SIOCHI Apr. 1985 191 p refs

(Contract NAG1-300)

(NASA-CR-176231; NAS 1.26:176231) Avail: NTIS HC A09/MF A01 CSCL 01C

The aircraft industry has long been concerned with the increase of drag on airplanes due to fouling of the wings by insects. The present research studied the effects of surface energy and surface roughness on the phenomenon of insect sticking. Aluminum plates of different roughnesses were coated with thin films of polymers with varying surface energies. The coated plates were attached to a custom jig and mounted on top of an automobile for insect collection. Contact angle measurements, X-ray photoelectron spectroscopy and specular reflectance infrared spectroscopy were used to characterize the surface before and after the insect impact experiments. Scanning electron microscopy showed the topography of insect residues on the exposed plates. Moments were calculated in order to find a correlation between the parameters studied and the amount of bugs collected on the plates. An effect of surface energy on the sticking of insect residues was demonstrated.

Author

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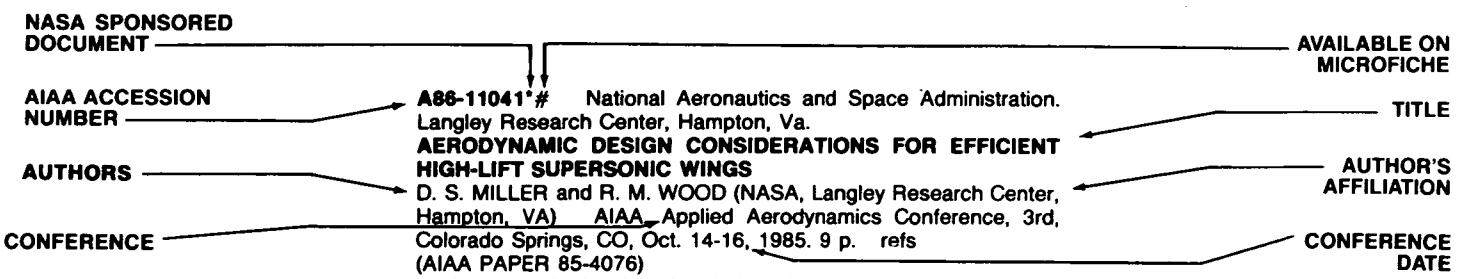

A86-11041*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AERODYNAMIC DESIGN CONSIDERATIONS FOR EFFICIENT HIGH-LIFT SUPERSONIC WINGS

D. S. MILLER and R. M. WOOD (NASA, Langley Research Center, Hampton, VA) AIAA, Applied Aerodynamics Conference, 3rd, Colorado Springs, CO, Oct. 14-16, 1985. 9 p. refs

(AIAA PAPER 85-4076)

A previously developed technique for selecting a design space for efficient supersonic wings is reviewed; this design-space concept is expanded to include thickness and camber effects and is evaluated for cambered wings at high-lift conditions. The original design-space formulation was based on experimental upper-surface and lower-surface normal-force characteristics for flat, uncambered delta wings; it is shown that these general characteristics hold for various thickness distributions and for various amounts of leading-edge camber. The original design-space formulation was also based on the assumption that the combination of Mach number and leading-edge sweep which would produce an equal division of flat-wing lift between the upper and lower surface would also be the proper combination to give the best cambered-wing performance. Using drag-due-to-lift factor as a measure of performance, for high-lift conditions cambered-wing performance is shown to significantly increase as conditions approach the design space; this correlation is demonstrated for both subcritical and supercritical flows.

Author

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