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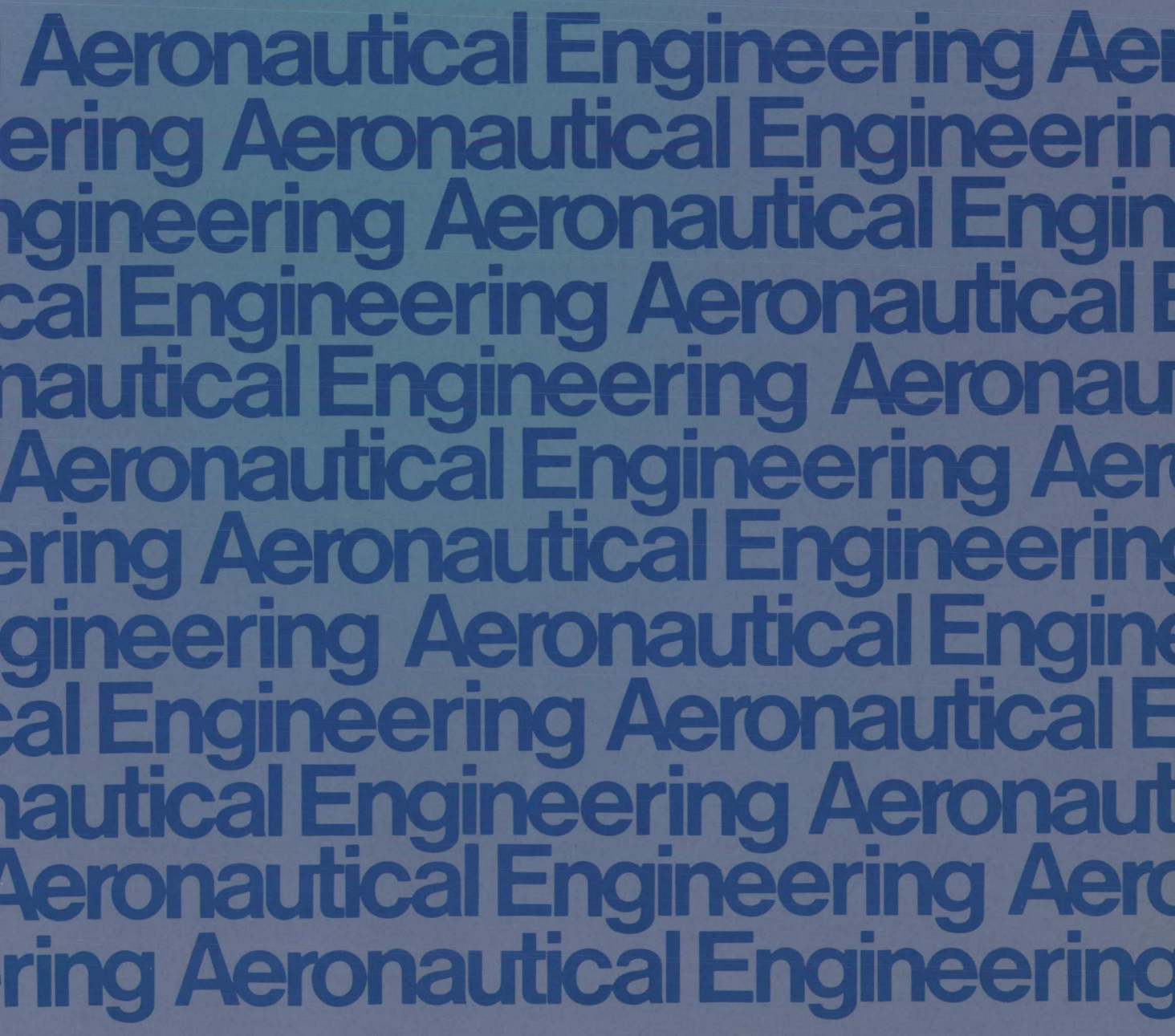
Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (119)
February 1980

National Aeronautics and Space Administration



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

STAR (N-10000 Series)	N80-10001 – N80-11998
IAA (A-10000 Series)	A80-10001 – A80-13128

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NASA SP–7037(119)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 119

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 January 1980 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 341 reports, journal articles, and other documents originally announced in January 1980 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 in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes -- subject, personal author, and contract number -- are included.

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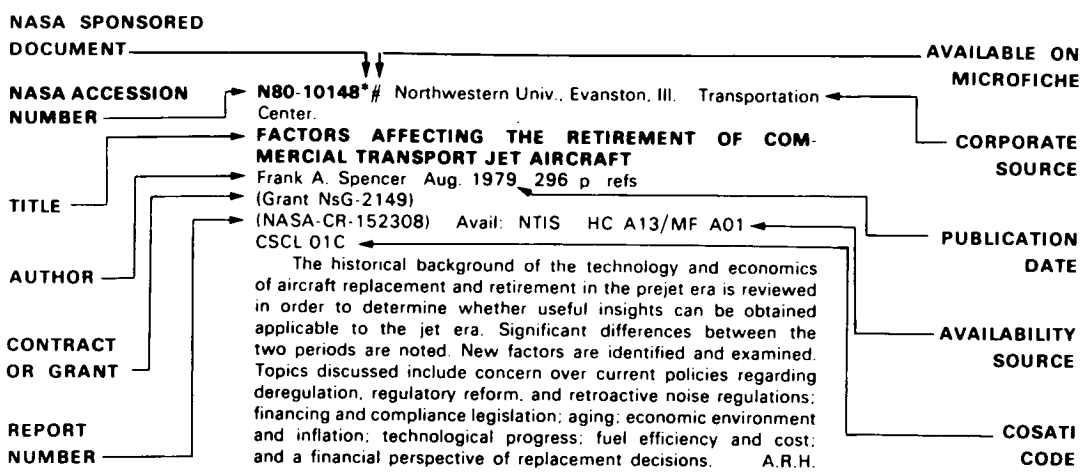

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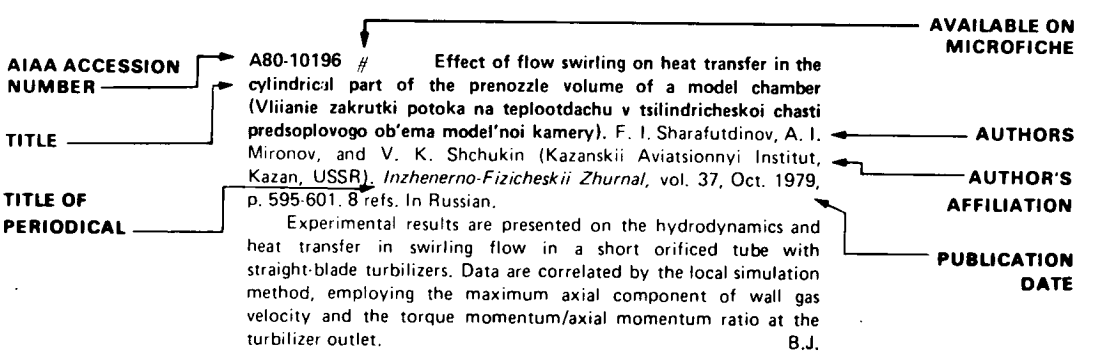

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 119)

FEBRUARY 1980

IAA ENTRIES

A80-10011 # **Three-dimensional velocity distribution between stator blades and unsteady force on a blade due to passing wakes.** T. Adachi (Tsukuba, University, Sakura, Ibaraki, Japan) and Y. Murakami (Osaka University, Toyonaka, Japan). *JSME, Bulletin,* vol. 22, Aug. 1979, p. 1074-1082. 8 refs.

The steady and unsteady three-dimensional velocity distributions between the stator blades due to passing wakes shed by upstream moving cylinders are measured. The method utilizes a hot-wire located in three-coordinate directions respectively. By using 'average response technique' on all hot-wire signal, the fluctuating component due to the Karman vortex is suppressed, and only the periodic component is extracted. The motion of the wake passing through the stator blade row and the effect of it on flow in a passage are considered and compared with the measured results of the unsteady force on the blade. (Author)

A80-10033 * # **Identification and dual adaptive control of a turbojet engine.** W. Merrill (NASA, Lewis Research Center, Cleveland, Ohio) and G. Leininger (Toledo, University, Toledo, Ohio). *International Federation of Automatic Control, Symposium on Identification and System Parameter Estimation, 5th, Darmstadt, West Germany, Sept. 24-28, 1979, Paper.* 8 p. 14 refs. Grant No. NGR-36-010-024.

The objective of this paper is to utilize the design methods of modern control theory to realize a 'dual-adaptive' feedback control unit for a highly non-linear single spool airbreathing turbojet engine. Using a very detailed and accurate simulation of the non-linear engine as the data source, linear operating point models of unspecified dimension are identified. Feedback control laws are designed at each operating point for a prespecified set of sampling rates using sampled-data output regulator theory. The control system sampling rate is determined by an adaptive sampling algorithm in correspondence with turbojet engine performance. The result is a 'dual-adpative' control law that is functionally dependent upon the sampling rate selected and environmental operating conditions. Simulation transients demonstrate the utility of the dual-adaptive design to improve on-board computer utilization while maintaining acceptable levels of engine performance. (Author)

A80-10034 * # **Turbine engine altitude chamber and flight testing with liquid hydrogen.** E. W. Conrad (NASA, Lewis Research Center, Cleveland, Ohio). *Deutsche Gesellschaft für Luft- und Raumfahrt and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, International Symposium on Hydrogen in Air Transportation, Stuttgart, West Germany, Sept. 11-14, 1979, Paper.* 20 p. 12 refs.

In the late fifties the Lewis Research Center evaluated experimentally the use of hydrogen using three different turbojet engines in altitude test chambers. One of these engines was later flown experimentally using liquid hydrogen fuel. This paper is a brief overview of the significant aspects of this exploratory research and gives a few implications of the results to modern turbine engines. A subsequent contract dealing with a positive displacement pump operating on liquid hydrogen is discussed and some aspects of liquid hydrogen propellant systems, reflected by rocket booster experience are treated briefly. Areas requiring further research and technology effort are delineated. (Author)

A80-10035 * # **Computerized systems analysis and optimization of aircraft engine performance, weight, and life cycle costs.** L. H. Fishbach (NASA, Lewis Research Center, Flight Performance Section, Cleveland, Ohio). *NATO, AGARD, Symposium on the Use of Computers as a Design Tool, Munich, West Germany, Sept. 3-6, 1979, Paper.* 20 p. 16 refs.

The paper describes the computational techniques employed in determining the optimal propulsion systems for future aircraft applications and to identify system tradeoffs and technology requirements. The computer programs used to perform calculations for all the factors that enter into the selection process of determining the optimum combinations of airplanes and engines are examined. Attention is given to the description of the computer codes including NNEP, WATE, LIFCYC, INSTAL, and POD DRG. A process is illustrated by which turbine engines can be evaluated as to fuel consumption, engine weight, cost and installation effects. Examples are shown as to the benefits of variable geometry and of the tradeoff between fuel burned and engine weights. Future plans for further improvements in the analytical modeling of engine systems are also described. C.F.W.

A80-10123 # **Organization of automatic control systems for technological processes in aircraft mechanical engineering (Organizatsiia ASUTP aviatsionnogo mashinostroeniia).** R. I. Adgamov, S. V. Dmitriev, Iu. V. Kozhevnikov, and G. P. Shibanov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 176 p. 69 refs. In Russian.

Approaches to the automation of technological processes involved in aircraft mechanical engineering are examined. The mathematical modelling of some typical technological processes is discussed, along with automation and mechanization techniques. The structure and performance of technological control systems is examined. V.P.

A80-10124 # **Transient, nearly periodic rotor oscillations (Nestatsionarnye pochti periodicheskie kolebaniia rotorov).** G. I. Anikeev. Moscow, Izdatel'stvo Nauka, 1979. 136 p. 50 refs. In Russian.

Nearly periodic rotor oscillations are investigated theoretically for characteristic transient and steady-state processes. Attention is given to the formulation and stability of the equations of a quasi-linear system for resonant, nonresonant and continuous finite variations in parameters, and to the moment equations and correlation functions for transient, nearly periodic oscillations of quasilinear systems with randomly varying parameters. The steady-state, nearly periodic oscillations of rotors undergoing a loss of stability due to internal friction, the effects of a liquid and dry friction are

examined, and transient, nearly periodic rotor oscillations are discussed for the examples of the transition through self-oscillation, a variable-mass rotor, and a gyroscopic rotor. Transient, nearly periodic oscillations in rotor systems subjected to random variations in system parameters are also considered for cases of nonequilibrium rotation, and for a lumber-dressing rotor apparatus. A.L.W.

A80-10196 # Effect of flow swirling on heat transfer in the cylindrical part of the prenozzle volume of a model chamber (Vliianie zakrutki potoka na teplootdachu v tsilindricheskoi chasti predsoplovogo ob'ema model'noi kamery). F. I. Sharafutdinov, A. I. Mironov, and V. K. Shchukin (Kazanskii Aviatsionnyi Institut, Kazan, USSR). *Inzhenerno-Fizicheskii Zhurnal,* vol. 37, Oct. 1979, p. 595-601. 8 refs. In Russian.

Experimental results are presented on the hydrodynamics and heat transfer in swirling flow in a short orificed tube with straight-blade turbilizers. Data are correlated by the local simulation method, employing the maximum axial component of wall gas velocity and the torque momentum/axial momentum ratio at the turbilizer outlet. B.J.

A80-10199 # An engine fuel chemistry solution to the problem of jet fuel supplies (Khimmotologicheskie resheniia problemy resursov reaktivnykh topliv). V. A. Piskunov, K. S. Chernova, P. A. Mikheichev, N. P. Iurukovskii, and V. N. Zrelov. *Khimiia i Tekhnologiia Topliv i Masel,* no. 10, 1979, p. 35-38. 8 refs. In Russian.

Fuel refining techniques are discussed as means of increasing jet fuel supplies. It is shown that expanding the boiling range of jet fuel allows a greater yield from crude oil, at the expense of diesel fuel fractions, and increases the concentration of aromatic hydrocarbons in the jet fuel fractions. Investigations of the behavior of lower-quality fuels (with elevated crystallization temperatures) under simulated flight temperatures and means of controlling fuel flow and combustion properties under these conditions are discussed. Results indicating the decrease of low temperature Jet A-1 fuel fluidity with paraffin content and the increase in combustion chamber temperature with increasing hydrocarbon content are presented, emphasizing the applicability of engine fuel chemical analysis to the interactions of fuel properties, aviation technology and operational conditions. A.L.W.

A80-10200 # The chemical stability of hydro-treated fuels and their stabilization by antioxidants (Khimicheskaia stabil'nost' gidroochishchennykh topliv i ikh stabilizatsiia antiokisliteliami). Z. A. Sablina, E. A. Tishina, K. A. Egorova, and T. I. Ermakova. *Khimiia i Tekhnologiia Topliv i Masel,* no. 10, 1979, p. 38-41. 9 refs. In Russian.

The oxidation resistance of jet fuels obtained by hydrogenation and catalytic hydro-treatment is investigated under conditions of artificial aging. The corrosion of jet fuels T-6, T-8 and RT was monitored during multiple exposures to temperatures of 120 C. Measurements of fuel oxygen activity, optical density and organic oxide content indicate that all fuels studied undergo significant oxidation, accompanied by the formation of soluble products. Amine and phenol antioxidants in concentrations between 0.001 and 0.003 wt. %, however, are found to be effective in inhibiting the oxidation of treated fuels. A.L.W.

A80-10206 # Design and operation of multi-specimen fully reversed fatigue systems for advanced composite materials. G. Waring, K. E. Hofer, Jr., I. Brown (IIT Research Institute, Chicago, Ill.), and R. E. Trabocco (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *Society for Experimental Stress Analysis, Spring Meeting, San Francisco, Calif., May 20-25, 1979, Paper.* 34 p. 24 refs. Navy-supported research.

Advanced composite materials are finding extensive utilization in aerospace structural applications. The composites appear usually as the skins (surfacing elements) on sandwich components. The paper describes an experimental system designed to investigate the static compressive strengths of graphite/epoxy composite sandwich structures with various defects, after exposure to combined moisture-saturation and elevated temperature environment in the presence of fatigue stress cycling of the variable amplitude type in a fully reversed mode. The objective of this program was to establish the degradation modes in sandwich construction as it applies to naval aircraft. The feasibility of testing several samples simultaneously in a simulated aerospace environment is clearly demonstrated by the results to date. Removal of blistered and cracked sealant revealed some evidence of aluminum honeycomb corrosion products, the corrosion being of general, not galvanic, nature. S.D.

A80-10234 # Application of the discrete-phase method /DPM/ to the study and control of aircraft turbine engine blade vibrations. I (Zastosowanie metody dyskretno-fazowej /MDF/ do badan i kontroli drgan lopatek lotniczych silnikow turbinowych. I). R. Laczkowski (Gdansk, Politechnika, Gdansk, Poland). *Technika Lotnicza i Astronautyczna,* vol. 34, Sept. 1979, p. 7-10. 5 refs. In Polish.

The paper deals with the discrete-phase method and its instrumentation. The application of the method to the determination of dynamic stresses and the mode shapes of blade vibrations is demonstrated. The design and principle of a blade damage indicator are examined. V.P.

A80-10235 # The variable-geometry wing (Skrzydlo o zmiennej geometrii). J. Borgon. *Technika Lotnicza i Astronautyczna,* vol. 34, Sept. 1979, p. 10-13. 5 refs. In Polish.

The requirements placed on the aerodynamic design of supersonic aircraft are reviewed, and the variable-geometry wing is discussed as an example of matching solutions to incompatible problems. The advantages and drawbacks of the variable-geometry wing are noted. V.P.

A80-10236 # Construction of black boxes and mechanical elaboration of electronic units in aviation (Konstrukcja skrzynek i mechaniczne opracowanie blokow elektronicznych w lotnictwie). J. Dabrowska. *Technika Lotnicza i Astronautyczna,* vol. 34, Sept. 1979, p. 14-18, 24. In Polish.

The paper deals with various aspects of black box design and construction, and the preparation of aircraft electronics. The standards of the United States ARINC-404 air transport equipment and racking are reviewed. V.P.

A80-10237 # Method of determining the load classification number, LCN, of a semirigid composite runway surface (Sposob wyznaczania wskaznika nosnosci LCN lotniskowej nawierzchni zlozonej-polsztywnej). F. Kazmierczyk (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 34, Sept. 1979, p. 27-29. 6 refs. In Polish.

The load classification number (LCN), introduced by the ICAO, expresses the ratio of aircraft impact on the runway to the carrying capacity of the runway surface. In the present paper, a method is proposed for determining the LCN of a composite runway as a function of the thicknesses of the concrete bed and the upper asphalt concrete layer. V.P.

A80-10268 Nova satellite time experiment. L. J. Rueger and A. G. Bates (Johns Hopkins University, Laurel, Md.). *(International Union of Radio Science, Open Symposium on Time and Frequency, 1st, Helsinki, Finland, Aug. 1-4, 1978.) Radio Science,* vol. 14, July-Aug. 1979, p. 707-714.

A time transfer experiment was carried out between the master clocks of the U.S. Naval Observatory and the U.S. National Bureau of Standards in Boulder, Colorado, using passively recovered Nova

satellite time signals at each ground station. Timing correlation of the master clocks derived from the satellite signals agreed with comparisons made by Cs clock transfers within 50 ns. (Author)

A80-10289 Component evaluation and engine demonstration of gamma/gamma-prime-delta D.S. eutectic solid turbine blades. A. D. Cetel, M. Gell (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and J. W. Glatz (U.S. Naval Air Propulsion Test Center, Trenton, N.J.). In: Conference on In Situ Composites, 3rd, Boston, Mass., November 29-December 1, 1978, Proceedings. Lexington, Mass., Ginn Custom Publishing, 1979, p. 292-301; Discussion, p. 302. 21 refs. Contracts No. N00019-77-C-0121; No. N62269-76-C-0303.

The paper discusses the component and engine testing used to evaluate the capability of the directionally solidified eutectic alloy gamma/gamma prime-delta to perform as a solid first stage turbine blade in a small engine application (T400-WV-402). Attention is given to component testing which was conducted to assess the airfoil and root attachment behavior of the eutectic blade and to compare this behavior with that predicted by a comprehensive stress analysis. Also covered is the airfoil testing which consisted of creep-rupture, thermal fatigue, high frequency fatigue, and natural frequency testing of components and blades. In addition the root attachment evaluation is discussed. Finally, it is noted that these component tests indicate that the eutectic alloy offers about a 1.5 fold improvement in airfoil creep-rupture life over current bill-of-material alloy, D.S. MAR-M200 while maintaining an adequate fatigue capability. M.E.P.

A80-10310 Review of superalloy powder metallurgy processing for aircraft gas turbine applications. J. L. Bartos (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio). In: MiCon 78: Optimization of processing, properties, and service performance through microstructural control; Proceedings of the Symposium, Houston, Tex., April 3-5, 1978. Philadelphia, Pa., American Society for Testing and Materials, p. 564-577. 7 refs.

Superalloy powder metallurgy (P/M) processing for aircraft gas turbine applications is reviewed. P/M fabrication of high-strength nickel-base superalloy for aircraft engine rotating components is discussed, including hot isostatic pressing (HIP) of preforms and die forging to an oversize or a near net shape. The as-HIP processing technology in which the powder is only HIP and heat treated, eliminating secondary metalworking operations, is reviewed and examples of its application to engine hardware are discussed. Finally, the future of P/M processing in aircraft engine manufacture is considered, with emphasis on development of advanced superalloy materials uses. A.T.

A80-10343 # **Escape system technology.** T. Ford. *Aircraft Engineering,* vol. 51, Sept. 1979, p. 2-5.

The design and performance characteristics of several Martin-Baker ejection seats are surveyed, noting that the RAF and the U.S. Navy, among others, have been equipped with these systems for a number of years. Attention is given to the factors involved in the design of automatic seats, such as drogue deployment, occupant restraint and subsequent release, duplex drogues and the need for increased trajectory height due to the advent of aircraft with high fins. Other topics cover details on rocket assistance, an improved design that reduces complexity, the Mk. 10 seat and finally the ejection sequence. M.E.P.

A80-10482 # **Experimental investigation of the strength of rotor materials in the presence of surface cracks (Eksperimental'noe issledovanie prochnosti rotornykh materialov pri nalichii poverkhnostnykh treshchin).** N. N. Zorev, G. S. Vasil'chenko, A. V. Amel'ianchik, and D. N. Klauch (Tsentral'nyi Nauchno-Issledovatel'skii Institut Tekhnologii i Mashinostroeniia, Moscow, USSR). *Problemy Prochnosti,* Aug. 1979, p. 58-63. 8 refs. In Russian.

Comparative tests were carried out with 150-mm thick disk models made of 25KhN3MFA and 24KhN2MFA steels, spinning at rpms of up to 23,750 and 26,550, respectively. Each type of model was provided with fatigue cracks and with artificial rectilinear and semielliptic surface (part-through) cracks. The critical stresses are plotted vs the depth of the surface cracks. The distribution of elastic and elastoplastic stresses arising from inertial loads in disks is identified. The crack resistance limits determined in the tests are applied to an analysis of the strength of maximum-stress areas in a rotor assembled by welding. V.P.

A80-10607 Calculation of working process in 'slow-compression' piston-type aerodynamic tube. A. B. Berezovskii and V. B. Panfilovich. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 3-10.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 1-5. Translation.

The thermodynamic processes during the compression phase of the cycle of a piston-type slow compression wind tunnel are analyzed on the following assumptions: (1) the process is quasi-steady-state; (2) the gas is ideal; (3) the piston is massless; (4) heat exchange between the gas and the external medium is neglected; and (5) friction between the piston and wall is absent. The fundamental equations are the work equation of Leuchter (1965) and a given relation between the pressure of the working gas and the instantaneous volume. The resulting equations were numerically integrated to obtain plots of temperature and barotropic index as a function of time during compression and of the temperature of the compressed gas as a function of the pressure rise during passage of the gas through the nozzle. P.T.H.

A80-10608 Gas curtains in gas turbine engines. I. S. Varganov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 11-16.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 6-10. 13 refs. Translation.

The use of a gas curtain in the bypass circuit of a turbofan engine permitting variation of the flow rate ratio according to flight conditions is analyzed. To achieve a ratio of pressure behind turbine to pressure behind the fan of at least 2 during thrust reversal at constant rotational speed of the high pressure rotor, it is proposed to change the operating condition of the fan by reducing the slot area relative to the area of the exit nozzle of the main circuit. A method for establishing the energetic foundation for such a process is developed. P.T.H.

A80-10610 Study of homogeneous combustion chamber temperature field nonuniformity with primary zone parameter variation. O. A. Evin, V. M. Iankovskii, and I. N. Diatlov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 24-29.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 16-19. Translation.

A80-10611 Measurement of liquid pump torque in the starting regime. N. S. Ershov, V. V. Ramodina, and V. V. Chervakov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 30-35.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 20-25. Translation.

An experimental method was developed for determining the moment required by a high-speed bladed pump during transient regimes that makes use of coaxial input and output multipliers. A method for calculating the moments acting in the multipliers during startup with allowance for the friction in the supports and the inertia of the rotating masses is given. Experiments on empty and flooded pumps were performed to determine coefficients in the relationships. P.T.H.

A80-10612 Computer calculation of stationary temperature fields in air-cooled turbine rotor blades. V. I. Lokai, Iu. N. Ivan'shin, and Sh. Sh. Abdrakhmanov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 36-40.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 26-29. 6 refs. Translation.

A simple engineering method using a digital computer is proposed for calculating the steady-state temperature fields in the blades of turbines with longitudinal cooling channels under variable boundary conditions pertaining to the gas and coolant with allowance for the change in cross-sectional area of the blade and the dependence of the heat conduction coefficient on temperature. The blade is divided into sections, to each of which is applied the solution of the one-dimensional heat conduction problem with matched solutions at the section divisions. P.T.H.

A80-10613 Selection of optimal parameters of heat-pipe heat exchanger for a gas turbine engine. N. V. Lokai and I. I. Mosin. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 41-46.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 30-34. 5 refs. Translation.

Some means of achieving maximum degree of regeneration in a heat exchanger with heat pipes are investigated by extending some previous analysis methods for heat exchangers with intermediate heat carrier. Two conditions are found which must be satisfied in order to achieve maximum degree of regeneration: (1) the heat transmitting power of the heat pipes must exceed the heat release intensity from both the gas and air directions; and (2) two dimensionless parameters for the gas and air sides must be equal. P.T.H.

A80-10614 Computer calculation of stationary temperature fields in cooled turbine discs. V. I. Lokai, V. V. Zhuikov, and R. D. Fakhrutdinov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 47-50.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 35-38. Translation.

The calculation of the steady-state temperature field in a cooled turbine disk of arbitrary shape is based on the solution of the Bessel equation for a disk of constant thickness. The variable-thickness disk is divided into a series of concentric rings such that at the edges of each ring the relevant parameters can be regarded as constant, and the Bessel equation solution is worked out for each ring. An algorithm for the method is given, and some computer calculation results are presented and compared with temperature field measurements in a real disk. P.T.H.

A80-10616 Systematization of simple detail parts of regulable nozzle of gas turbine engine. I. E. Sapozhkov and E. D. Sten'kin. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 57-63.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 44-49. Translation.

A systematic approach to the classification of gas turbine engine nozzle parts is based on function of the part in its module, its connection modes, surface types, type of initial forming, type of finishing, type of strength calculation, and basic shape. Such a subsystem approach reveals that in a regulated nozzle 30-70% of the parts are not subjected to strength analysis and that their shape and dimensions are determined from structural considerations, and also enables establishing the most common type of connection and the most massive shape. P.T.H.

A80-10619 Study of mass exchange between primary zone and secondary air jets in gas turbine engine combustion chambers. V. G. Chumachenko, V. M. Iankovskii, and A. V. Talantov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 81-85.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 64-67. Translation.

The oxygen excess coefficient in the primary zone of a combustion chamber depends on the amount of air reaching the primary zone from jets of secondary air. This paper is concerned with determining this amount by a combined experimental-theoretical technique for combustion chambers in which the flow pattern in the primary zone is formed by secondary flow jets of the first belt of openings. P.T.H.

A80-10627 On the influence of short shroud platforms on turbine stage operation. R. V. Kuz'michev and G. V. Proskuriakov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 105-107.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 90-92. 6 refs. Translation.

The present experiments, carried out with an experimental air-driven turbine, showed that the use of shortened shrouds (at the concave and convex blade surfaces) did not improve noticeably the structure of the flow while complicating appreciably the manufacturing procedure. Nor was there any noticeable increase in stage efficiency at commonly used tip clearances and blade-ring spacings. V.P.

A80-10630 On axial turbine stage rotor blade twist with tangential tilt of the stator vanes. Iu. I. Mitiushkin, A. V. Perevoznikov, and V. P. Iakovlev. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 112-115.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 99-101. 5 refs. Translation.

Tangential inclination of nozzle blades in an axial turbine is an effective way to reduce the reactivity gradient along the turbine blades. This paper presents experimental results on the influence of turbine blade twist on the efficiency of axial turbines in the case of tangential inclination of nozzle blades; investigations were conducted at nozzle outlet velocities of M = 0.48-0.5 and nozzle outlet Reynolds numbers of 500,000 to 570,000. B.J.

A80-10632 Study of size distribution of oil drops formed in GTE oil system lines. P. G. Petrov and O. A. Povarov. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 117-119.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 105-107. Translation.

A80-10633 Nonstationarity of heat transfer in axial turbine blading during engine startup. A. M. Poliakov, V. S. Petrovskii, and V. I. Krichakin. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 119-123.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 108-111. Translation.

In the thermal design of gas-turbine elements, it is conventionally assumed that the heat transfer coefficients are independent of the nonstationarity of the heat transfer process. In the present paper, the time dependence of the coefficient of local heat transfer at the surface of the rotor blades of an axial-flow gas-turbine is determined on the basis of temperature measurement during start-up of the engine. V.P.

A80-10635 Pneumatic distributor for turbojet engine control system. M. G. Khabibullin. *(Aviatsionnaia Tekhnika,* vol. 22, no. 1, 1979, p. 126, 127.) *Soviet Aeronautics,* vol. 22, no. 1, 1979, p. 115, 116. Translation.

A pneumatic distributor developed for the thrust reverser control system of the NK-8-2U turbojet engine used in the TU-154 is described. The load bearing rings are made of metallographite which acts as a lubricant for the contact surfaces. The distributor partition is significantly thinner than the load bearing rings, a design feature which reduces the driving stroke of the sleeve valve and the overall dimensions of the distributor. C.K.D.

A80-10763 The impact of the limits of simulation in extending the use of simulators in training. D. R. Tait (CAE Electronics, Ltd., St. Laurent, Quebec, Canada). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 1. London, Royal Aeronautical Society, 1979, p. 50-57.

While there is no limit to how closely a simulation model can approach the faithful representation of an aircraft in its operating environment, exact duplication of its characteristics can never be achieved regardless of the computing power which is applied to the task. Flight simulator specifications normally resolve this dilemma by defining the maximum error which is aceptable in simulating the various features of the aircraft. This paper examines the role of limits of simulation in extending the use of training simulators. B.J.

A80-10765 * The development and use of large-motion simulator systems in aeronautical research and development. J. C.

Dusterberry (NASA, Ames Research Center, Moffett Field, Calif.) and M. D. White (G. E. Cooper Associates, Saratoga, Calif.). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 2. London, Royal Aeronautical Society, 1979, p. 1-16. 23 refs.

The paper examines the evolution of manned aircraft simulators with large-motion systems and provides a brief description of important design details along with physical descriptions of a number of systems. Attention is given to the use of large translational motions in providing the simulator pilot with a close approximation of the cues of aircraft flight; examples are cited comparing pilot reactions to simulators with and without motion. How these simulators have been used in programs that effectively influenced aircraft design and operating problems is discussed. B.J.

A80-10766 Recent advances in control loading and motion systems used in simulation. M. Lacroix (Le Matériel Téléfonique, Boulogne-Billancourt, Hauts-de-Seine, France). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 2. London, Royal Aeronautical Society, 1979, p. 17-29.

As part of a program of improvements to cabin motion systems, LMT has designed a new servo jack, using hydrostatic bearings and a modified servovalve, which has resulted in a considerable reduction of the acceleration noise level. In addition, a control loading system was developed which considerably reduces parasitic cues in the flight controls, while facilitating maintenance of the system. These results are due to the combination of a low-friction jack with a high-speed digital control computer. B.J.

A80-10768 The capability of CGI in flight simulation. T. W. Rowley (Marconi Radar Systems, Ltd., Leicester, England). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 2. London, Royal Aeronautical Society, 1979, p. 43-50.

CGI flight simulation techniques are examined with reference to the example of the Marconi TEPIGEN (TElevision PIcture GENerator). Consideration is given to visuals-to-task matching, constant image density, visual perception, surface information, color, texture, surface shading, modeling languages, instant scenery, and fuzzy objects. B.J.

A80-10776 Recent and future engineering developments in flight training simulators. M. Bolton, D. Campbell, P. Murray, G. Olive, and M. Roberts (Redifon Simulation, Ltd., Crawley, Sussex, England). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 3. London, Royal Aeronautical Society, 1979, p. 53-71. 31 refs.

In the present paper, the current status of flight training simulators is reviewed from an engineering point of view, and possible improvements to next-generation training simulators are examined. Such future improvements include: increased realism; more effective training; more cost effective operation; less instructor involvement in non-training tasks; increased reliability; and more data acquisition and analyses from training. Some suggestions contributing to these areas are presented. V.P.

A80-10777 The interrelationships between engineering development simulation and flight simulation. E. R. Jones (McDonnell Douglas Corp., St. Louis, Mo.). In: 50 years of flight simulation; Proceedings of the Conference, London, England, April 23-25, 1979. Session 3. London, Royal Aeronautical Society, 1979, p. 72-86. 24 refs.

High-fidelity engineering simulators, which are currently used in the development of a new aircraft, can improve the flight simulators and training programs for that aircraft. The present paper deals with the problem of blending the two manned simulator developments in a symbiotic relationship that can result in a smoother transition to the new aircraft and in a flight simulator that incorporates empirically derived critical tasks, proficiency assessment capabilities, and instructional concepts. V.P.

A80-10823 # Development of an aircraft-derivative gas turbine with high performance and large output. Y. Shimura (Ishikawajima-Harima Heavy Industries Co., Ltd., Turbine and Compressor Engineering Div., Tokyo, Japan) and K. Takeo (Ishikawajima-Harima Heavy Industries Co., Ltd., Turbine Design Dept., Tokyo, Japan). *IHI Engineering Review,* vol. 12, July 1979, p. 29-32.

The design and performance of the 50,000 horsepower IM5000 industrial gas turbine are examined. Attention is given to the gas generator which is an industrial version of the GE CF-6 turbofan engine. The power turbine is described, noting that it can be used for generating 50/60-Hz power and mechanical drive applications. Areas of the power turbine examined include aerodynamic design, basic construction design concept, and component design such as buckets, vanes, rotor, transition duct, turbine casing, exhaust casing, and exhaust scroll. Finally, it is reported that tests revealed higher performance than predicted, and that NO(x) emissions are reduced with a water injection system. M.E.P.

A80-10866 # Lubricants for the aircraft gas turbine. F. T. Barcroft (Shell Research, Ltd., Chester, England). *Aircraft Engineering,* vol. 51, Oct. 1979, p. 7-9.

The article reviews three decades of synthetic oil development. It is noted that after WWII, the newly emerging gas turbine could not take advantage of state of art man-made lubricants because such data was still classified. Attention is given to problems associated with mineral oils in use at the time such as oxidation and short life. Also covered are the emergence of synthetic oils following the declassification of pertinent information, and the development of lubricants for the Concorde. Finally, possible advances in lubricant technology are assessed noting that fluids that can cope with the oxidative regime predicted in the absence of antioxidants will be necessary. These are discussed according to their major classes: (a) organometalloids, (b) aromatic hydrocarbons or ethers, (c) fluorinated hydrocarbons or ethers, and (d) inorganic polymers. M.E.P.

A80-10884 A helmet-mounted sight using C.C.D. technology. M. D. Stephenson (Marconi Avionics, Ltd., Rochester, Kent, England). *Radio and Electronic Engineer,* vol. 49, Oct. 1979, p. 511-513.

A helmet mounted sight system using CCD technology is described which can be used outside the restricted viewing area of the head up display, but with reduced accuracy. It is noted that the system consists of two parts: the helmet mounted display and the helmet optical position sensor. It is reported that a limited amount of essential information (i.e. aiming reticule, weapon lock, etc.) can be displayed on the surface of the helmet mounted display, noting that the limit is set by the pilot's inability to assimilate further data. Attention is given to the helmet optical position sensor which consists of two triads of LED's mounted on the sides of the helmet and two CCD cameras mounted in the cockpit. Finally, it is concluded that using the CCD to its full capability enables a small compact system to be produced without the need for fast analog to digital converters and a large digital store. M.E.P.

A80-10897 Prediction of surge-point in multi-stage axial compressors. N. Yamaguchi (Mitsubishi Heavy Industries, Ltd., Takasago Technical Institute, Takasago, Japan). *Mitsubishi Heavy Industries Technical Review,* vol. 16, June 1979, p. 92-108. 8 refs.

The paper presents a method for the prediction of surge-points in multistage axial compressors. The method simulates a compressor-duct system, which is basically an air column with distributed parameters, by alternate applications of field-transfer and point-transfer matrices. Advantages cited are that the equations are reasonably accurate and easy to handle. It is reported that they allow quick and reliable calculation of characteristic roots of the oscillation and their modes. Finally, several examples are given to demonstrate the practicability of the method and to describe the nature of compressor surge. M.E.P.

A80-10899 **The Tornado Two takes off.** *Air International,* vol. 17, Nov. 1979, p. 214-221, 243, 244.

The design and specifications of the Tornado F Mk 2, designed to meet the specifically British need for a long range multi-purpose interceptor to replace the RAF's Lightnings and Phantoms in the mid 1980's is surveyed. Attention is given to those needs which include the need to counter mass-raid tactics, give protection against enemy attacks, and to counter the high level of ECM support accompanying an enemy attack. Details discussed include the lengthened fuselage to allow the use of four fuselage mounted Sky Flash air-to-air missiles and an additional fuel tank. Additional length also results from the use of a new air intercept radar which is detailed. Also covered are the wing changes made to counter the resulting CG shift forward. Finally, the development program and progress are discussed as well as new features such as SPILS (spin prevention and incidence limiting system) and auto-sweep for automatic selection of the wing sweepback angle. M.E.P.

A80-10900 **In Soviet service. VII - Mikoyan Foxbat.** *Air International,* vol. 17, Nov. 1979, p. 245-252.

The design, specifications, and performance of the MiG-25 Foxbat are surveyed. Attention is given to the fact that the aircraft was intended to intercept the B-70 supersonic bomber which resulted in a design that placed all emphasis on straight-line supersonic flight at extreme altitudes. The aircraft, publicly introduced in 1967, employs a conservative design which adheres to proven design principles and techniques by using arc-welded nickel steel, and restricting the use of titanium to the most highly heat-stressed areas. Also noted are the aircraft's vacuum tube avionics, and missiles such as the AA-5 Ash, and AA-6 Acrid. The Fox Fire phased array search and tracking radar and the Sirena radar warning system is covered as well as the Tumansky R-31 engines which do not utilize a bypass system or variable compressor geometry. Finally, the latest versions, the MiG 25-R Foxbat B reconnaissance and ELINT version and the Foxbat D, a dedicated ELINT version, are covered. M.E.P.

A80-10919 **Numerical computation of neighboring optimum feedback control schemes in real-time.** H. J. Pesch (München, Technische Universität, Munich, West Germany). *Applied Mathematics and Optimization,* vol. 5, no. 3, 1979, p. 231-252. 32 refs.

A modification of the theory of neighboring extremals is presented which leads to a new formulation of a linear boundary value problem for the perturbation of the state and adjoint variables around a reference trajectory. On the basis of the multiple shooting algorithm, a numerical method for stable and efficient computation of perturbation feedback schemes is developed. This method is then applied to guidance problems in astronautics. Using as much stored a priori information about the precalculated flight path as possible, the only computational work to be done on the board computer for the computation of a regenerated optimal control program is a single integration of the state differential equations and the solution of a few small systems of linear equations. The amount of computation is small enough to be carried through on modern board computers for real-time. Nevertheless, the controllability region is large enough to compensate realistic flight disturbances, so that optimality is preserved. (Author)

A80-11057 # **Lubrication of aircraft gas-turbine engines (Smazka aviatsionnykh gazoturbinnykh dvigatelei).** M. M. Bich, E. V. Veinberg, and D. N. Surnov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 176 p. 50 refs. In Russian.

The book deals with some aspects of designing lubrication systems for aircraft gas-turbine engines. The friction properties of a number of representative lubricants are noted, and the operational characteristics of some lubrication schemes are described. The designs and characteristics of the principal lubrication system components are discussed. V.P.

A80-11154 **The array processor AP-120B/190L for simulation applications.** K. Kemmler and W. Martson (Floating Point Systems GmbH, Unterhaching, West Germany). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 43-52.

The paper describes a peripheral or digital array processor (AP) designed as a programmable auxiliary processor to a host computer. The main function of the processor is to perform high-speed array processing, indexing and control, as well as floating-point computations at an execution speed of up to 60 million instructions per second. Attention is given to the AP's floating-point adder and multiplier, memory register, table and data memory operations, and to the program source memory and its address calculation system with associated registers. It is noted that both floating-point add and multiply computations can be carried out simultaneously, and also that pipeline processing allows the computations to proceed at a high rate. Five simulation applications that employ the AP are discussed, including target, vocal track and flight simulation. C.F.W.

A80-11164 **Radar remoting.** W. Goodwin and M. Beyer (4C Corp., Lomita, Calif.). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 237-260.

Remoting of multiple radars from the command and control center offers some advantages for the conduct of offensive and defensive air operations. These include better radar coverage through geographic dispersion; command and control center protection from homing antiradiation missiles; improved operations in a jamming enviroment; ability to make a better tactical site selection; and improvement in automatic track initiation and tracking. Methods used to remote radars are discussed, along with factors influencing the methodology chosen for radar remoting. V.P.

A80-11167 **AEW Nimrod system and operation.** A. C. Leacy (Marconi Avionics, Ltd., Borehamwood, Herts., England). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 313-320.

An Airborne Early Warning (AEW) Nimrod system that incorporates the significant advances in component and digital technology of the last six years is described. The Mission System Avionics (as it has been named) is divided into three groups: a group of sensors, a communication system, and a data handling system that includes the central processor and display, the mission software, and the operators. These three systems are discussed in detail, showing their effectiveness and some advantages. Attention is given to the mission software concerned with both automatic tracking and data management, and emphasis is placed on its three tasks. C.F.W.

A80-11168 **E-3A sentry, airborne early warning and control for Europe.** H. A. Williams (Boeing Co., Seattle, Wash.). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 321-333.

The Airborne Warning and Control System (AWACS), officially designated as the E-3A, is described. The key system elements are described, noting that the E-3A provides timely detection, tracking, and identification of aircraft within its surveillance volume during all kinds of weather and above all kinds of terrain. Attention is given to the operational radar and its modes: pulse Doppler nonelevation scan (PDNES), pulse Doppler elevation scan (PDES), beyond-the-horizon (BTH), passive, maritime, interleaved mode, test/maintenance, and standby. Also discussed is the data display and control system which offers several control and display options. Finally, attention is given to electronic counter-countermeasures. M.E.P.

A80-11170 **Improvement of weapon system performance in air to air and air to ground operation with airborne radar.** A. Inbar (Elta Electronics, Ltd., Lod, Israel). In: Military Electronics Defence

Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 344-357.

The paper describes air-to-air combat, based on target tracking and the snapshot concept. Attention is given to the equations that show the difference in lead angles and emphasis is placed on the types of variables that can cause these equations to change. A discussion of air-to-ground weapons is presented employing equations for free fall space. Three configurations, gunsight with barometer, gunsight with radar, and modern W.D.S. with radar, are analyzed and consideration is given to laser and radar relative accuracies. C.F.W.

A80-11171 The 'Viggen' multimode radar. S.-B. Thelander (LM Ericsson Telefon AB, Molndal, Sweden). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 358-375.

The paper surveys the radar employed in the fighter version of the Viggen aircraft. Attention is given to different tactical requirements for a multipurpose aircraft and specific radar requirements are defined. Also reviewed are candidate radar concepts including waveform considerations. The Viggen radar architecture and essential qualities such as operational modes, key parameters, technical performance, availability and physical design are described. Finally, the display system concept is reviewed in terms of cockpit layout, HDD format, and of an example of displayed information. M.E.P.

A80-11172 Technological trends in electronic warfare. F. Bennett and M. Zimet (Loral Corp., Electronics Systems Div., New York, N.Y.). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 386-407.

Technological trends in electronic warfare (EW) are examined based on the use of radar equipment for aircraft detection and weapons control accuracy in modern air defense systems. In operating against these systems the aircraft must degrade the effectiveness of the system's radars by evasive maneuvers to avoid the weapons system, 'jinking' to overload system's servo-loop response, electronic countermeasures to confuse the radar echo, and disposable countermeasures to conceal the true position of the aircraft. For electronic and disposable countermeasures, the characteristics of the radar being countered shape the character of the response, and are measured by the radar warning receiver (RWR). For evasive maneuvers or avoidance of a radar, it is necessary to know the location of the radar, which is also determined by the RWR. A.T.

A80-11173 The target tracking problem using airborne radar under ECM environment. F. A. Faruqi (Hunting Engineering, Ltd., Ampthill, Beds., England). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 414-432. Research supported by the Ministry of Defence.

The paper deals with the design and operation of a Kalman filter for estimating the state (heading, lateral acceleration, range, and range rate) of an airborne target, using an airborne interceptor radar, in the case where the target state is denied to the radar by electronic countermeasures. In the development of the Kalman filter, it is assumed that the angular information regarding the target is the only measurement available from the radar. V.P.

A80-11174 Technical concept for a strike-RPV flight guidance and weapon delivery system. G. Kriechbaum (Dornier GmbH, Friedrichshafen, West Germany). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 435-454. 17 refs.

Tactical strike RPVs are intended to complement (rather than replace) other weapons systems in such missions where target detection and identification by the pilot are not required. In the present paper, some experience obtained in the design and development of strike RPVs during the past seven years is reviewed, along with the respective flight guidance and weapon delivery systems. V.P.

A80-11175 Take-off and landing problems of ship based RPVs. M. Natter (Dornier GmbH, Friedrichshafen, West Germany). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 455-472.

The paper deals with some aspects of takeoff and landing of VTOL remotely piloted vehicles (RPVs) on ship decks. Experience obtained with Dornier's Aerodyne concept of combining VTOL properties with high-speed flight is discussed. Some results of evaluation studies are noted. V.P.

A80-11176 Delta multiplex system DX 15-60. H. J. Rall (Telefunken AG, Backnang, West Germany). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 475-488.

The present paper deals with the physical design, purpose, and use of the DX 15-60 system intended as a communications system for military mobile tactical service. Versatility of the DX 15-60 system is provided by its modular construction and subdivision into a number of separate units. The discussion covers the multiplex unit, the analog-digital converter unit, the bulk encryption unit, the line terminal unit, and the terminating unit. V.P.

A80-11180 IR-camera for day and night fire control. H. Samuelsson (Saab-Scania AB, Goteborg, Sweden). In: Military Electronics Defence Expo '78; Proceedings of the Conference. Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 573-581.

The paper deals with an optronic fire control system developed for the Swedish Navy's coast artillery to combat airborne targets. The system can be operated at fixed land-based installations or can be mounted on mobile units. The tracking subsystem incorporates a platform with sensors (a daylight TV camera and laser range finder) and digital optronic tracking electronics. An IR camera has been developed and its installation is foreseen. V.P.

A80-11187 Design of a strapdown navigator aided by position measurements. R. Lenz (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). In: Military Electronics Defence Expo '78; Proceedings of the Conference, Wiesbaden, West Germany, October 3-5, 1978. Geneva, Interavia, S.A., 1979, p. 719-728.

Recent advances in terrain contour matching (TERCOM) make it possible to provide accurate position measurements over a long travelling distance and to use them for aiding an inertial navigation system (INS). This paper contributes to the problem of updating a strapdown inertial navigation system. An updating algorithm is derived and tested by simulation. It is shown, that the navigation accuracy of the aided navigation system depends no more on time or distance travelled. (Author)

A80-11205 Parameters of spatial flow past a hydrofoil near the free surface of a ponderable liquid. A. B. Lukashevich. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar.-Apr. 1979, p. 54-62.) *Fluid Dynamics,* vol. 14, no. 2, Sept. 1979, p. 210-216. 10 refs. Translation.

The three-dimensional flow past a submerged wing is studied on the basis of a singularity method wherein the effect of the free surface of the ponderable fluid is represented as the effect of an infinite layer of sources. Particular consideration is given to the relationship between wave generation behind the wing and the separation of free vortices from the wing. Downwash distribution behind the wing is investigated. B.J.

A80-11208 Hypersonic viscous shock layer on sweptback wings of infinite span at different angles of attack. I. G. Brykina and E. A. Gershbein. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar.-Apr. 1979, p. 91-102.) *Fluid Dynamics,* vol. 14, no. 2, Sept. 1979, p. 238-246. 13 refs. Translation.

The paper presents a theoretical investigation of the flow of a viscous compressible gas in a hypersonic shock layer on infinite-span arrow wings with blunt leading edges at angle of attack. The hypersonic shock-layer equations are solved by the method of successive approximations, which permits an analytical solution for the first approximation as well as an exact numerical solution. Formulas are presented for coefficients of friction and heat transfer on the surface of the body as well as for velocity and temperature profiles across the shock layer. B.J.

A80-11221 Some cases of instability of a gyrohorizon compass. S. A. Agafonov. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* Jan.-Feb. 1979, p. 5-10.) *Mechanics of Solids,* vol. 14, no. 1, 1979, p. 3-7. 8 refs. Translation.

The stability of the precessional motion of a gyro-horizon compass is studied for the case when the suspension of the gyrosphere is moving along a parallel with constant velocity. Two special cases are considered: (1) internal third-order resonance exists between the frequencies of the linear system and (2) one of the frequencies is zero. It is shown that internal third-order resonance leads to instability. When one of the frequencies is zero, instability is proved by constructing the Chetaev (1965) function. P.T.H.

A80-11255 Installation for investigating the effect of non-steady-state supersonic gas flow on the blades of a plane cascade. B. I. Buryshev and A. G. Navrotskii. *(Problemy Prochnosti,* Feb. 1979, p. 85-87.) *Strength of Materials,* vol. 11, no. 2, Oct. 1979, p. 212-214. 7 refs. Translation.

A80-11345 Aircraft designers follow the birds. M. Hewish. *New Scientist,* vol. 84, Oct. 4, 1979, p. 33-35.

Advanced, lightweight, flexible composite materials and metal joining techniques for future aircraft structures are presented. Advanced composites are shown to require fewer parts to form a structure and less enery to produce than structural metals, in addition to being stronger, stiffer and more corrosion resistant. The fabrication of carbon- and boron-fiber-reinforced plastics is examined and examples of applications of carbon-fiber composites in British fighter aircraft and boron-fiber composites in U.S. bombers and fighters including those of the Air Force/NASA-sponsored Highly Maneuverable Aircraft Technology program are presented. Boron-fiber-reinforced aluminum and boron/carbon/glass fiber epoxy composites and other promising fiber-matrix combinations are indicated, and complementary developments in the powder casting of aluminum, aluminum-lithium alloys and titanium aircraft structures are outlined. Results of the U.S. Air Force Primarily Adhesively Bonded Structure Technology program are presented and the use of new materials for space structures is considered. A.L.W.

A80-11351 A pulse compression, precision DME system (Système DME de précision a compression d'impulsions). M. Schilliger (Le Matériel Téléphonique, Boulogne-Billancourt, Hauts-de-Seine, France). *Navigation* (Paris), vol. 27, Oct. 1979, p. 387-401. In French. Research supported by the Service Technique de la Navigation Aérienne.

Pulse compression, precision distance measuring equipment (DME) systems are discussed as a possible component of a microwave landing system (MLS). Pulse spectrum spreading and the binary phase shift keying and decoding of pulses are considered, and compression of the pulses by an adaptive filter from 3.44 to 0.22 microsec in length with a 31 fold increase in signal level is outlined. Advantages of pulse compression in precision DME systems are discussed, including precision, multitrajectory immunity, code and frequency selectivity, the utilization of simple pulses and a low power requirement, and the choice of pulse duration, moments and moment duration is considered. The operation of a precision DME system in the presence of a DME/Tacan system is discussed and the compatibility of the two systems with respect to mutual perturbations and ground and airborne equipment is examined. It is concluded that the pulse compression precision DME system appears well suited to distance measurements during landing, particularly as part of an MLS. A.L.W.

A80-11352 Electronic instrumentation in civil aviation (L'instrumentation électronique dans l'aviation civile). F. Muszynski (Compagnie Nationale Air France, Service Environment-Systèmes, Paris, France). *Navigation* (Paris), vol. 27, Oct. 1979, p. 402-413. In French.

Future developments in the electronic instrument technology of civil aviation aircraft are considered. The digital information systems of planned aircraft and their relationships to onboard instruments are discussed, noting that digitalization has lead many airlines to adopt cathode ray tube instrumentation. The appearance of cathode ray tube displays is discussed, taking into consideration existing attitude director and horizontal situation indicators and possible additional display functions. Various possible cockpit configurations are illustrated, and cathode ray tube technology is presented. Profound changes in equipment/aircraft/environment interfaces are foreseen as a result of the emerging technology of screen displays. A.L.W.

A80-11354 Avionics software and equipment. R. Boudarel (Compagnie d'Informatique Militaire, Spatiale et Aéronautique, Vélizy-Villacoublay, Yvelines, France). *Navigation* (Paris), vol. 27, Oct. 1979, p. 419-426. In English and French.

The advantages and disadvantages of present-generation avionics equipment and software are examined. Reasons for the evolution of microprocessor-based digital techniques are outlined, noting the basic advantage of greater software flexibility, coupled with the requirement of data sampling procedures. The sources and manifestations of software bugs are considered, and various remedies, including specification languages, high-level languages and program test methodologies are presented. The need for equipment qualification covering the unique features of avionics equipment is also pointed out. A.L.W.

A80-11379 A singular perturbation analysis of optimal aerodynamic and thrust magnitude control. A. J. Calise (Drexel University, Philadelphia, Pa.). *IEEE Transactions on Automatic Control,* vol. AC-24, Oct. 1979, p. 720-730. 20 refs.

This paper illustrates the application of singular perturbation methods to optimal thrust magnitude control (TMC) and optimal lift control in flight mechanics. The modeling is restricted to horizontal plane dynamics. A multiple time scale analysis results in nonlinear feedback control solutions for lift and thrust during a turn to a specified down range position. The analysis is carried out to first order with respect to the position state variables. Numerical results for a medium range and a short range air-launched missile are given, and comparisons are made to two alternative propulsion control concepts. The multiple time scaling procedure used here is applicable to solving a wide class of optimal control problems. It avoids the problem in asymptotic methods of picking the unknown adjoints to suppress unstable modes in the boundary layer and reduces the two-point boundary value problem to a series of pointwise function extremizations. Hence, the optimal control solution is essentially analytic and algebraic. (Author)

A80-11393 # Developing an aircraft configuration using a minicomputer. D. P. Raymer (Rockwell International Corp., North American Aircraft Div., El Segundo, Calif.). *Astronautics and Aeronautics,* vol. 17, Nov. 1979, p. 26-34.

The paper describes the use of microcomputers for aircraft configuration development. The advantages and disadvantages of the three-dimensional configuration development system (CDS) are

examined. Attention is given to biquartic surface design, which defines cross sections by using reflex, conic, circular arc, and straight-line curve commands. The analysis tools employed in the system, including initial mission, sizing, tail, tire, strut sizing, cost estimation, and friction and wave drag analysis are discussed. An example of the system is given that depicts a graphic, step-by-step illustration of the CDS in progress. It is concluded that: (1) the CDS enables a reduction of time and cost, and (2) the system provides a three-dimensional computer data set, rather than a simple blue-line drawing print. C.F.W.

A80-11395 # **Developing large helicopters.** G. J. Tobias (United Technologies Corp. Sikorsky Aircraft Div., Stratford, Conn.). *Astronautics and Aeronautics,* vol. 17, Nov. 1979, p. 52-54.

The paper briefly describes the large helicopter industry and its future. Two groups of helicopters are discussed, those below 14,000 lb and those above. Two possible paths for future helicopter growth are presented: (1) an extension of our ancient history which views large distance flights only by airport-to-airport, fixed-wing missions, and (2) the traditional means of improving aircraft production by increasing its size and speed. Attention is given to the civil and military sides of the industrial market and two opportunities for the helicopter are identified. The first involves missions that cannot reasonably be carried out except by helicopters, while the second includes activities that can be performed in a number of ways. C.F.W.

A80-11396 # **Technical challenges in developing the new wave of small and medium helicopters.** J. F. Atkins (Bell Helicopter Textron, Fort Worth, Tex.). *Astronautics and Aeronautics,* vol. 17, Nov. 1979, p. 55-57, 86.

The paper presents an overview on some of the problems encountered in the advancement of helicopters for civil use. Growth forecasts for small and medium helicopters are given through 1990 together with actual numbers since 1960. One use that will help the drive for expansion of commercial helicopter applications is the need for energy exploration transportation. Attention is given to the worldwide commercial and industrial growth scene, and it is noted that the excellence of U.S. designs and their proven dependability, especially their outstanding service and logistics support, have thus far offset the foreign competitive advantages. C.F.W.

A80-11397 # **Light turbine helicopters to the year 2000.** T. R. Stuelpnagel (Hughes Helicopters, Culver City, Calif.). *Astronautics and Aeronautics,* vol. 17, Nov. 1979, p. 58-61.

The light (3000 lb maximum), single-engine helicopter is discussed with respect to its growing use by the year 2000. Attention is given to cost estimates, payload capacities, and operating costs. It is determined that not only is the helicopter the quietest of all aircraft, but it is also the most versatile mobility yet devised by man. The advantages of helicopters are discussed, including the ability to avoid inflight accidents and their emergency landing capabilities. The use of onboard computers, made possible by microprocessor technology, is discussed, and it is noted that it represents the greatest advancement in helicopter technology since the turbine engine. Other factors, including the application of composites to helicopters and the reduction of manufacturing costs, as well as the effect of redundant load path on reliability of critical blades, masts and straps are also discussed. C.F.W.

A80-11398 # **The market for large civil helicopters.** C. W. Ellis (Boeing Vertol Co., Philadelphia, Pa.). *Astronautics and Aeronautics,* vol. 17, Nov. 1979, p. 62-65.

The expected growth rate of large civil helicopters is discussed and several proposals for heavy-lift (200 passengers) aircraft are presented. Attention is given to the fastest growing segments of the large-helicopter market, such as off-shore oil and gas developments, logging, power line construction and commercial passenger service. Other definitive market segments that include wood-products recovery and remote resource development are also discussed. Graphs are presented for comparative direct operating costs, U.S. fixed-wing short-haul passenger-miles growth, as well as projections for passenger-mile generation capacity and predicted sales of heavy helicopters between now and the year 2000. C.F.W.

A80-11432 # **Large-amplitude fluctuations of velocity and incidence of an oscillating airfoil.** D. Favier, J. Rebont, and C. Maresca (Aix-Marseille I, Université; CNRS, Marseille, France). *AIAA Journal,* vol. 17, Nov. 1979, p. 1265-1267. 10 refs. Direction Technique des Constructions Aéronautiques Contract No. 76-98214-00481-7581.

Unsteady flow features due to large-amplitude fluctuations of both velocity and incidence induced by an airfoil executing cyclic time-dependent fore and aft translations were investigated from lift, drag, and skin-friction measurements performed in a low-turbulence open circuit wind tunnel. It is concluded that when combined fluctuations out of phase of velocity and incidence are simulated, unsteady flow features are of a similar nature to those observed when incidence or velocity oscillations are simulated separately. The study has relevance to the three-dimensional aerodynamic behavior of a helicopter blade section in foward flight. B.J.

A80-11453 The Tornado multi-function combat aircraft - An accomplishment of international collaboration (L'avion de combat polyvalent Tornado - Une réalisation à porter au crédit de la collaboration internationale). B. O. Heath. *(Journée des Pionniers Européens, 4th, Paris, France, Apr. 26, 1979.) L'Aéronautique et l'Astronautique,* no. 78, 1979, p. 3-16. In French.

The British-German-Italian Tornado multi-function combat aircraft is presented and the history, organization and results of the international project are discussed. The two-seat, twin-engine jet aircraft with variable wing geometry is described, with attention given to the three possible wing configurations and their applications for various national requirements. Political factors influencing the development of the Tornado are outlined, and the formal organization responsible for project management is presented, considering the division of responsibilities between the project management agency NAMMA, Paniavia and Turbo-Union. Practical and operational aspects of project management are related, and the results of the collaboration in the fields of aircraft performance, cost price and project schedule are examined. Implications of the management of the Tornado project for international relations are also pointed out. A.L.W.

A80-11454 Fire on board transport aircraft and passenger safety (L'incendie à bord des avions de transport public et la sécurité des passagers). A.-E. Blavy (Société Nationale Industrielle Aérospatiale, Laboratoire Central, Paris, France). *(Journée des Pionniers Européens, 4th, Paris, France, Apr. 26, 1979.) L'Aéronautique et l'Astronautique,* no. 78, 1979, p. 17-28. In French.

The fire safety of passenger aircraft cabin materials is discussed and present materials tests are presented. Crash conditions conducive to jet aircraft fires are outlined and the irritant, narcotic and paralytic effects of gases released from cabin materials are indicated. Past and present aircraft materials are surveyed and the development of fire-proofing procedures and flammability certification tests by the United States, Great Britain and France is outlined. Current flammability, quantitative smoke emission and combustion and pyrolysis gas composition tests are detailed, noting material acceptance criteria, and the use of a protective hood is proposed to prevent exposure to combustion gases and smoke during inflight fires. It is pointed out that, although only 10 flights out of 58 million departures from 1965 to 1976 resulted in accidents in which fire was the cause of death, efforts to improve fire safety will always be necessary. A.L.W.

A80-11647 # **Method for calculating wing loading during maneuvering flight along a three-dimensional curved path.** J. Katz (Technion - Israel Institute of Technology, Haifa, Israel). *Journal of Aircraft,* vol. 16, Nov. 1979, p. 739-741.

The aerodynamic forces due to the nonsteady motion of a lifting surface along a three-dimensional path are analyzed. For this purpose, available steady-state calculation methods, based on potential theory, were modified by retaining the nonsteady terms in the

governing equations. The surface motion is limited to such cases where the linear analysis can be applied. As an example, the time-dependent forces and moments of a slender wing in various nonsteady motions were studied. (Author)

A80-11648 * # **Flight through thunderstorm outflows.** W. Frost (FWG Associates, Inc.; Tennessee, University, Space Institute, Tullahoma, Tenn.), B. Crosby (ARO, Inc., Arnold Engineering and Development Center, Arnold Air Force Station, Tenn.), and D. W. Camp (NASA, Marshall Space Flight Center, Space Sciences Laboratory, Huntsville, Ala.). *Journal of Aircraft,* vol. 16, Nov. 1979, p. 749-755. 11 refs.

Computer simulation of aircraft landing through thunderstorm gust fronts is carried out. The 3 degree-of-freedom, nonlinear equations of aircraft motion for the longitudinal variables containing all two-dimensional wind shear terms are solved numerically. The gust front spatial wind field inputs are provided in the form of tabulated experimental data which are coupled with a computer table lookup routine to provide the required wind components and shear at any given position within an approximate 500 m x 1 km vertical plane. The aircraft is considered to enter the wind field at a specified position under trimmed conditions. Both fixed control and automatic control landings are simulated. Flight paths, as well as control inputs necessary to maintain specified trajectories, are presented and discussed for aircraft having characteristics of a DC-8, B-747, and a DHC-6. (Author)

A80-11649 # **Required radar ranges for AEW aircraft.** J. Bracken and J. H. Grotte (Institute for Defense Analyses, Arlington, Va.). *Journal of Aircraft,* vol. 16, Nov. 1979, p. 792-797.

The paper, through the application of simple analytical models, investigates the minimum radar ranges necessary to permit interdiction of the raid as well as escape to safety of the airborne early warning system. These radar ranges are dependent on characteristics of all the aircraft in the scenario. The results of many calculations are presented, showing the sensitivity of radar range to selected parameters. (Author)

A80-11650 # **Burning sprays of jet A fuel-water emulsions.** H. Jahani and S. R. Gollahalli (Oklahoma, University, Norman, Okla.). *Journal of Aircraft,* vol. 16, Nov. 1979, p. 798-800. 6 refs.

The paper presents the results of a study of the characteristics of burning Jet A fuel-water emulsions. Attention is given to the effects of (1) adding surfactant to the fuel, (2) varying the surfactant concentration in emulsions, and (3) varying the water concentration of emulsions on (a) flame stand-off distance, (b) flame length, (c) flame spread, and (d) the fraction of heat release radiated by burning sprays over an air-blast atomizer. It is concluded that it seems that the effects of emulsion variables on flame characteristics are not monotonic, and that a properly matched set of emulsion characteristics would be necessary to exploit the benefits of emulsification. M.E.P.

A80-11652 **Definition of a system concept study for future air traffic control (Definition einer Systemkonzeptstudie für die zukünftige Flugverkehrsführung).** *Ortung und Navigation,* no. 2, 1979, p. 211-257. In German.

An attempt is made to outline a concept on which future research and development planning of air traffic control can be based. Attention is given to present systems and their evaluation. Factors to be considered in future planning consist of increased safety, environmental protection, reduction of pilot and controller workload, and profitability of air traffic. Other areas covered include: air traffic expectations, flight safety requirements, function analysis, subsystem characteristics, system configuration, selection and optimization of system concepts, and suggestions for development. M.E.P.

A80-11653 **Requirements for short instrument runways.** W. O. Toepel (Bayerisches Staatsministerium für Wirtschaft und Verkehr, Munich, West Germany). *Ortung und Navigation,* no. 2, 1979, p. 266-271.

The implementation of IFR-traffic on airports with short runways is studied. Criteria are developed for air traffic services which are: the total number of annual aircraft movements, the number of regular passenger services, the number of nonlocal flights, aircraft mix concerning approach speed, the number of IFR/VFR-flights, and local parameters. Discussion of facilities covers radio navigation aids such as VDF, NDB, and VOR, as well as visual aids such as runway edge lights, threshold lights and taxiway lights. Finally, recommendations are made on physical characteristics and obstacle clearance for short runways. M.E.P.

A80-11769 **An optical technique for the investigation of flow in gas turbine combustors.** J. E. C. Topps (National Gas Turbine Establishment, Farnborough, Hants., England). In: Symposium /International/ on Combustion, 17th, Leeds, England, August 20-25, 1978, Proceedings. Pittsburgh, Pa., Combustion Institute, 1979, p. 347-353. 7 refs.

The distribution of a pulse of mercury vapor injected into an airstream flowing past a V-gutter has been investigated at downstream stations by the measurement of the absorption of radiation at 254 nm. Using this technique, the length of the reversal zone and the vortex flow pattern deduced for isothermal flow agree with other observations. The distribution of absorption observed with combustion indicates that recirculation is substantially reduced, and the flame emission observed shows that the fusion of vortices is inhibited. The interpretation of these results as a function of vortex frequency and ignition delay has enabled disparate observations of the length of flow reversal zones with combustion to be reconciled, so that the precision of estimates of post-flame combustion residence time can be improved. (Author)

A80-11773 **Predictions of the flow field and local gas composition in gas turbine combustors.** W. P. Jones (Imperial College of Science and Technology, London, England) and C. H. Priddin (Rolls-Royce, Ltd., Aero Div., Derby, England). In: Symposium /International/ on Combustion, 17th, Leeds, England, August 20-25, 1978, Proceedings. Pittsburgh, Pa., Combustion Institute, 1979, p. 399-407; Comments, p. 407-409. 12 refs.

A mathematical model for calculating the three-dimensional flow, gas composition, and temperature fields in gas-turbine combustion chambers is described. The model makes use of the density-weighted averaged forms of the governing conservation equations with the two-equation kinetic energy-dissipation rate model for turbulent transport. The chemical reactions associated with heat release are assumed to be fast, and fluctuations in scalar properties are accounted for by use of a beta-probability density function (pdf). For liquid-spray-fuelled combustors the droplet concentration field is described via an equation for the pdf for droplet size. For a propane-fuelled model gas-turbine combustor the method yields calculated fields of gas composition and pollutants (NO, CO and UHC) which are in good overall agreement with measured values. (Author)

A80-11793 **Pollutant emissions from 'partially' mixed turbulent flames.** H. G. Semerjian, I. C. Ball (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and A. Vranos (United Technologies Research Center, East Hartford, Conn.). In: Symposium /International/ on Combustion, 17th, Leeds, England, August 20-25, 1978, Proceedings.
Pittsburgh, Pa., Combustion Institute, 1979, p. 679-686; Comments, p. 686, 687. 12 refs.

Pollutant formation was studied in partially mixed turbulent flames at atmospheric pressure. Jet A fuel was injected into a preheated, unvitiated airstream by means of spray nozzles located at various distances upstream of a perforated plate flameholder. The results show that, for very lean flames, integrated NO levels are

substantially higher than obtained in premixed-prevaporized flames at the same equivalence ratio. Local NO levels correlate approximately with local fuel-air equivalence ratios. Luminous combustion was not observed, thereby indicating that droplet evaporation was very rapid in the premixing section. Therefore, it is concluded that high NO levels result primarily from nonuniform introduction of fuel and insufficient mixing of vaporized fuel and air. (Author)

A80-11869 # **Flight-vehicle equipment (Oborudovanie letatel'nykh apparatov).** I. V. Kolchin, V. I. Kochetkov, and A. V. Tumanov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 152 p. 51 refs. In Russian.

Design aspects and instrumentation of onboard flight-vehicle equipment are presented. Attention is drawn to physical principles of operation of onboard instruments and systems. Consideration is given to automation of flight-vehicle propulsion systems. Systems for automatic flight control are discussed along with actuators of such systems, as well as navigation and radio equipment. Telemetry systems, avionics, and onboard digital computers are described. Emphasis is placed on testing of onboard equipment and the reliability of this equipment. V.T.

A80-11875 # **Operation of airborne equipment and flight safety (Ekspluatatsiia aviatsionnogo oborudovaniia i bezopasnost' poletov).** V. G. Denisov, V. V. Kozaruk, A. S. Kuraev, M. I. Pal'chikh, and I. M. Sindeev. Moscow, Izdatel'stvo Transport, 1979. 240 p. 65 refs. In Russian.

The book deals with some aspects of organizing aircraft engineering service and aircraft operation. Particular attention is given to methods of operating and maintaining modern piloting and navigational equipment and aircraft power plants and safety systems. Modern methods of testing and checking various aircraft systems are described. V.P.

A80-11879 # **Flaw detection of aircraft components in operation (Defektoskopiia detalei pri ekspluatatsii aviatsionnoi tekhniki).** P. I. Beda, Iu. A. Glazkov, S. P. Luts'ko, A. I. Ugarov, and G. S. Shelikhov. Moscow, Voenizdat, 1978. 232 p. 16 refs. In Russian.

The book discusses basic information on optical, liquid penetrant, magnetic particle, eddy current, ultrasonic, and impedance methods of flaw detection applied during operation of aircraft equipment to reveal discontinuity defects in component materials. Possible defects subject to detection are examined, and errors in application and interpretation of flaw detection are indicated. In aircraft operation, flaw detection is used for control of turbine and compressor vanes and disks, bulkhead frames, stringers, and longerons, helicopter propeller blades, landing gear struts and wheels, and other stressed components of gliders and engines. A.T.

A80-11890 # **Antennas /Current status and problems/ (Antenny /Sovremennoe sostoianie i problemy/).** D. I. Voskresenskii, V. L. Gostiukhin, K. I. Grineva, A. Iu. Grinev, B. Ia. Miakishev, L. I. Ponomarev, and V. S. Filippov. Moscow, Izdatel'stvo Sovetskoe Radio (Biblioteka Radioinzhenera: Sovremennaia Radioelektronika, No. 16), 1979. 208 p. 82 refs. In Russian.

The state of the art of antenna technology, as relating to the fields of radar, telecommunications, and radio astronomy, is reviewed. Particular consideration is given to the basic characteristics of linear and plane antennas, phased arrays, aperture antennas, antennas with signal processing, active arrays, and directional passive and active antennas. Problems of antenna synthesis and automated design of antennas are also discussed. B.J.

A80-12003 **Applied technology in turbofan engines.** B. Walsh. *Aviation Engineering and Maintenance,* vol. 3, May 1979, p. 24-27.

The article surveys development work performed by NASA's engine component improvement (ECI) program which is leading to design changes in production engines used on standard and wide body commercial transports. It is noted that some of the technology has already been adopted in CF6, JT8D, and JT9D engines. Attention is given to modification goals which include a 5% reduction in specific fuel consumption, as well as improvements in performance retention and lower maintenance costs. CF6 modifications discussed include an improved fan, a redesigned core exhaust system and improved front engine mount. Also covered are high pressure turbine roundness design and improved active control of turbine clearances for the CF6 low pressure and high pressure turbine rotors and their respective shrouds. M.E.P.

A80-12030 # **Optimal receivers and discrete-signal processors for hyperbolic radar navigation systems (Optimal'nye ustroistva priema i diskretnoi obrabotki signalov radionavigatsionnykh giperbolicheskikh sistem).** M. S. Iarlykov and V. S. Danilin. *Radioelektronika,* vol. 22, Aug. 1979, p. 3-9. 7 refs. In Russian.

An approach involving nonlinear continuous-discrete Markov filtering is applied to optimal discrete processing of continuous radar signals with interference. Useful signals were observed on a background of cumulative Gaussian white noise. The design of an optimal processor for radar signals in a hyperbolic navigation system is described; the accuracy and noise immunity of the processor are evaluated. B.J.

A80-12031 # **Use of sign statistics for sequential signal detection in a pulse radar system (Ispol'zovanie znakovykh statistik pri posledovatel'nom obnaruzhenii signala v impul'snoi RLS).** Iu. N. Klochan and A. A. Spektor. *Radioelektronika,* vol. 22, Aug. 1979, p. 10-14. 5 refs. In Russian.

The paper discusses a sequential procedure, based on sign statistics, for the detection of unknown signal and noise characteristics. Particular consideration is given to a method for determining the median of noise distribution. The principal characteristics of a sequential sign procedure are examined using an equivalent continuous Markov process. The sign detector is compared with other types of detectors. B.J.

A80-12042 # **Experimental and theoretical investigation of the internal-duct hydraulics of stator and rotor blades for a semiclosed-cycle air cooling system (Eksperimental'noe i raschetnoe issledovanie gidravliki vnutrennego trakta soplovykh i rabochikh lopatok dlia vozdushnoi poluzamknutoi sistemy okhlazhdeniia).** E. A. Manushin and R. E. Danilov (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). *Energetika,* vol. 22, July 1979, p. 45-51. 6 refs. In Russian.

A80-12076 **Diffusion bonding as a production process.** Abington, Cambs., England, Welding Institute, 1979. 37 p. $20.

The fundamentals of diffusion bonding are reviewed and attention is given to practical process considerations. Diffusion bonding is compared with other welding processes, and consideration is given to general engineering, aerospace, and military applications of diffusion bonding. B.J.

A80-12081 **Diffusion bonding - Aerospace applications.** E. F. Sheldon (Rolls-Royce, Ltd., Derby Engine Div., Derby, England). In: Diffusion bonding as a production process.
Abington, Cambs., England, Welding Institute, 1979, p. 26-31.

Potential and existing aerospace applications of diffusion bonding are surveyed. Consideration is given to such applications as surface-to-surface joints, hollow airfoils, complex fabrications, and bonding of double-skin sheets. The advantages of diffusion bonding, as compared with other processes, are stressed. B.J.

A80-12110 **The role of aluminum segregation in the wear of aluminum/bronze-steel interfaces under conditions of boundary lubrication.** W. Poole and J. L. Sullivan (Aston, University, Birmingham, England). *American Society of Lubrication Engineers, Annual*

Meeting, 34th, St. Louis, Mo., Apr. 30-May 3, 1979, Preprint 79-AM-5E-1. 7 p. 10 refs. Research supported by the Science Research Council, University of Aston, and Lucas Aerospace.

An interest in the wear of steel-nonsteel systems, currently in use in aircraft fuel systems, has led to a study of aluminum bronze sliding on KE961 steel in the presence of kerosene with, and without, the addition of a commercial boundary lubricant. Experiments were conducted to determine wear rates with change of load together with an extensive investigation of the contacting surfaces using physical techniques such as EPMA, SEM and Auger spectroscopy. It was found that the additive had an initial pro-wear effect on the bronze followed by a sharp reduction in wear. The results of the measurements, and of the surface analysis, indicate that the mechanism responsible for this wear is due to preferential segregation of the aluminum to the surface. In the absence of the additive, aluminum is transferred to the steel and forms a solid solution which can cause seizure to occur. (Author)

A80-12157 A regression model of fatigue crack propagation under flight simulation loading. R. Sunder (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Engineering Fracture Mechanics,* vol. 12, no. 2, 1979, p. 147-154. 8 refs.

A multivariable regression analysis is made of crack propagation data under flight simulation loading for the 2024-T3 and 7075-T6 alloys. The study is made using an equivalent effective stress range concept based on crack closure considerations. A two-variable regression model of the equivalent stress range is suggested. The model is used to calculate fatigue crack propagation lives. Predictions using the proposed model are compared with empirical results. It is shown that the model accounts for the influence of maximum, minimum and mean stress levels of the load spectrum. (Author)

A80-12312 Generating innovation for Navy's F-18. H. K. Lew. *Aviation Engineering and Maintenance,* vol. 3, Oct. 1979, p. 22-25.

The F-18 electrical power system consisting of two 40KVA variable speed constant frequency (VSCF) generators, is examined. The generator is a conventional wound rotor design that replaces the usual hydromechanical constant speed transmission with a system in which a solid state cycle transformer rectifies the variable frequency output to maintain a constant output of 400 Hz alternating current. This is cited as a key factor in the projected MTBF of 3150 hours, exceeding Navy specifications by 1500 hours. Other factors covered are the sharing of cooling oil with the aircraft mounted accessory drive (AMAD) which eliminates the need for a separate cooling system, and the compact generator's high accessibility, for quick removal and replacement of failed parts. M.E.P.

A80-12315 F-16 co-production - An American point of view. J. P. Geddes. *Interavia,* vol. 34, Nov. 1979, p. 1090-1092.

The article examines some doubts still existing about the benefits, current and potential, of the overall F-16 coproduction program between some European nations and the U.S. Attention is given to concurrence risks which involve the taking place of a large number of events in the design, test, and production cycle in parallel. It is noted that pressures to get the program moving have resulted in an imbalance in the national offset shares and complaints that the program has not produced the degree of technology transfer that was anticipated. Also covered are the baseline program, different costs, technology transfer, airframe and engine examples and the avionics and other systems. M.E.P.

A80-12375 On the acoustic power emitted by helicopter rotor blades at low tip speeds. N. G. Humbad and W. L. Harris (MIT, Cambridge, Mass.). *Journal of Sound and Vibration,* vol. 66, Sept. 22, 1979, p. 290-294.

The purpose of this note is to show the effectiveness of a helicopter rotor blade tip region in generating the acoustic power and to show how the acoustic power radiated by the rotor blade varies during a cycle. The simple analysis presented here serves in establishing the dominant region on the rotor disk that contributes more to the overall noise. Two basic source mechanisms are considered in the analysis: (a) turbulent inflow, and (b) boundary layer radiation. (Author)

A80-12423 Blow-down and sled-run simulation of transonic flow (Transsonische Umströmungssimulation durch Fahrtwind und Blaswind). T. Hottner (Stuttgart, Universität, Stuttgart, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung,* vol. 3, Sept.-Oct. 1979, p. 293-303. 16 refs. In German.

In the present paper, blow-down, sled-run, cryogenic, magnetic-suspension, and hybrid transonic simulation techniques are evaluated with respect to energy consumption. It is shown that a high-pressure test track facility provides a means of obtaining sufficiently high Reynolds numbers at power inputs below those of an equivalent blow-down wind tunnel. Furthermore, test-track and hybrid simulation provides substantial investment savings as compared to the blow-down technique. Solution of the wall interference problem for test-track and hybrid facilities, however, requires further research work. V.P.

A80-12537 # Application of the design diagram for a layered viscoelastic medium to the evaluation of the stress-strain state of road and runway surfaces for moving loads (O primenenii raschetnoi skhemy sloistoi viazko-uprugoi sredy k otsenke napriazhennogo sostoianiia dorozhnykh i aerodromnykh pokrytii pri podvizhnoi nagruzke). B. S. Radovskii (Gosudarstvennyi Dorozhnyi Nauchno-Issledovatel'skii Institut, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 15, Oct. 1979, p. 50-57. 11 refs. In Russian.

The present analysis deals with the stress-strain state induced by a moving load in a viscoelastic plate resting on a viscoelastic half-space. Numerical results obtained for conditions corresponding to a road surface are examined from the point of view of decreasing traffic damage to the surface and increasing the weight of trucks without impairing surface life. V.P.

A80-12597 # Predicted jet thickness effects on the lift of an augmentor wing. V. Q. Tang and J. Tinkler (Manitoba, University, Winnipeg, Canada). *Canadian Aeronautics and Space Journal,* vol. 25, 3rd Quarter, 1979, p. 260-270. 13 refs. Defence Research Board of Canada Grant No. 9550-52; National Research Council of Canada Grant No. A-5562.

The flow about a two-dimensional augmentor wing is represented by a vortex distribution along its chord, and source and vortex distributions at the jet origin and boundaries. The source strength is related to the jet momentum coefficient and the vortex distributions are calculated by an iterative numerical method which requires the flow to be tangential to the aerofoil and jet boundaries, and the jet shape to be in equilibrium under the pressure loading. The solutions for a very thin jet agree with linear theory and experiments. Increasing the jet thickness gives a very small increase of lift and a small decrease in the nose down pitching moment. (Author)

A80-12598 # On supersonic flow with attached shock waves over delta wings. M. E. Ahrens and W. H. Hui (Waterloo, University, Waterloo, Ontario, Canada). *Canadian Aeronautics and Space Journal,* vol. 25, 3rd Quarter, 1979, p. 271-277. 14 refs. Research supported by the National Research Council of Canada.

The steady supersonic/hypersonic inviscid flow with attached shock waves past the compression side of a plane delta wing is investigated for small sweep back angle epsilon. The square-root singularity of the pressure curve slope at the cross flow sonic point in Hui's (1971) first order solution is removed by the strained coordinates technique, yielding a uniformly valid solution, which

shows excellent agreement with large scale numerical solutions and experiments even for cases with epsilon = 0(1). The relative merits of Lighthill's original formulation and Pritulo's simplified formulation of the strained coordinate technique are discussed, and it is demonstrated in this problem that, contrary to existing assertion (Crocco, 1972), Lighthill's formulation can be more advantageous. (Author)

A80-12599 # **Extension of Prandtl's biplane theory to wing-tail combinations.** E. V. Laitone (California, University, Berkeley, Calif.). *Canadian Aeronautics and Space Journal,* vol. 25, 3rd Quarter, 1979, p. 278-285. 7 refs.

Prandtl's biplane theory is used to calculate the minimum induced drag for several wing-tail combinations with a vertical separation (gap) distance of one fifth of the wing span. It is shown that Prandtl's theory is valid only if both lifting surfaces have the ideal elliptic load distribution, and the mutually induced drag is actually decreased if the rear lifting surface has a larger span and a uniform load distribution. The self-induced drag of the rear lifting surface is increased by the departure from the ideal elliptic load distribution so the total induced drag is not correspondingly decreased, however, but the beneficial result for a canard or tandem aircraft is that now the smaller front span can carry more of the aircraft weight at the minimum induced drag condition. (Author)

A80-12612 **Processing noise and vibration data for gas turbine engine development.** R. E. Harper (United Technologies Corp., Commercial Products Div., East Hartford, Conn.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 1. Pittsburgh, Pa., Instrument Society of America, 1979, p. 179-183.

Special data processing procedures are required to accommodate some data in the development of gas-turbine engines. Three cases are discussed, each showing a need to modify a more common data reduction process in order to satisfy a particular analysis requirement. The three procedures developed for these cases can be implemented with instruments common to any modern data reduction center, without the need for any special hardware. The solutions discussed involve a means of increasing the spectral resolution of a Fourier-type analyzer through intentional aliasing of the digitized data; a method of extracting phase information from unsteady signals; and a statistical description of the unsteadiness of acoustic signals, using a variant of the amplitude histogram. V.P.

A80-12618 **A V/STOL ground effects test facility.** T. M. Evans and J. M. Cooksey (Vought Corp., Dallas, Tex.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 1. Pittsburgh, Pa., Instrument Society of America, 1979, p. 245-252. 15 refs.

A test facility for evaluation of the aerodynamic-propulsion interface characteristics of V/STOL aircraft configurations in hover flight mode in proximity to the ground with surface winds is presented. Proximity to the ground results in interactions between the lifting jets and the lower surface of the aircraft, and also reingestion of lifting jet flow into the engine inlets. The design requirements, simulation problems, the outdoor test site approach, wind generator, model support, and instrumentation system of the test facility are discussed. Testing is performed in the open-air to avoid tunnel wall or enclosure wall constraints, and the facility provides controlled ground wind velocities from an azimuth relative to the model. Finally, instrumentation and data acquisition considerations, aerodynamic design requirements, climatology analysis, and model support design features are described. A.T.

A80-12620 **Wind tunnel model deflection system.** R. F. Jarvis (Grumman Aerospace Corp., Bethpage, N.Y.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 1. Pittsburgh, Pa., Instrument Society of America, 1979, p. 263-271.

The measurement of deformation on a wind tunnel model has met with varying degrees of success. Generally, those techniques that are the most successful from a measurement standpoint tend to be the most expensive due to equipment requirements, set-up time and extensive data reduction procedures. A system has been developed which is simple, economical and capable of producing accurate deflection data both statically and dynamically. The system uses a series of strain gaged beams which are installed in the model and provide a means of measuring the slope at discrete points as the model undergoes deformations. The curve generated from these data is then integrated to produce the model deflection curve. The design, fabrication, installation, calibration and testing of this model deformation system is described. (Author)

A80-12621 * **Real-time data acquisition system for the NASA Langley transonic dynamics tunnel.** P. H. Cole (NASA, Langley Research Center, Hampton, Va.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 1. Pittsburgh, Pa., Instrument Society of America, 1979, p. 273-286.

The hardware configuration of the Transonic Dynamics Wind Tunnel Data Acquisition System (DAS) which consists of an analog front end that can process up to 260 channels of data is presented. The DAS also has a multi-channel analog-to-digital subsystem that can process up to 50,000 samples of data per sec, and a digital computer with standard and nonstandard devices, with graphics capability. The software configuration of the DAS and complex hardware/software interfaces are described, which can provide automatic amplifier gain and offset adjustment for each data channel. Finally, a summary of specific DAS applications is given including the real-time processing of dynamic deflection data, unsteady pressure measurements, and flutter and buffet data. A.T.

A80-12622 **Use of an 'off-the-shelf' data acquisition system for wind tunnel data processing.** J. F. Marchman, III and J. J. Kunz (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 1. Pittsburgh, Pa., Instrument Society of America, 1979, p. 287-291.

In July 1977 a commercially manufactured data acquisition system consisting of a scanning voltmeter, a minicomputer, and an X-Y plotter was purchased for the Virginia Tech Stability Wind Tunnel. This facility is used for a wide variety of testing, including aircraft and submarine flowfield research, boundary layer transition research, studies of flow around buildings and structures, aircraft dynamic stability testing, as well as conventional model force and moment measurement. A versatile data acquisition system which can be operated by researchers, faculty, and students with no prior experience is needed to meet these testing requirements. The system chosen has proved readily adaptable to all research and teaching needs and its use in these applications is described for case studies ranging from forces on garbage cans to the examination of turbulence spectra in boundary layers. It is shown that such a general purpose, off-the-shelf system can indeed meet almost any need of a large university wind tunnel operation at minimum time and expense. (Author)

A80-12630 * **Measuring unsteady pressure on rotating compressor blades.** D. R. Englund (NASA, Lewis Research Center, Cleveland, Ohio), H. P. Grant, and G. A. Lanati (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 413-426. 7 refs.

The capability for accurate measurement of unsteady pressure on the surface of compressor and fan blades during engine operation was established. Tests were run on miniature semiconductor strain gage pressure transducers mounted in several arrangements. Both surface mountings and recessed flush mountings were tested. Test

parameters included mounting arrangement, blade material, temperature, local strain in the blade, acceleration normal to the transducer diaphragm, centripetal acceleration, and pressure. Test results showed no failures of transducers or mountings and indicated an uncertainty of unsteady pressure measurement of approximately + or - 6%, plus 0.1 kPa for a typical application. V.T.

A80-12634 A Laser Doppler Velocimeter system to investigate unsteady flow separation. G. W. Sparks, Jr., J. P. Retelle, Jr., J. E. Keesee, M. S. Francis, and J. M. Lind (U.S. Air Force Academy, Colorado Springs, Colo.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 467-476. 7 refs. USAF-sponsored research.

The adaptation of multi-component Laser Doppler Velocimetry (LDV) techniques for the measurement of flow velocity in regions of unsteady separation is discussed. A positionable, two color backscatter LDV system was employed in conjunction with a disk-based minicomputer to assess unsteady flow separation generated on an airfoil surface behind a controlled, oscillating, fence-type spoiler in a subsonic wind tunnel environment. The solutions to significant optical noise problems created by limited optical access and the nature of the experimental configuration are described. The acquisition of discontinuous data signals provided by the LDV counters using an asynchronous sampling technique is also addressed. The determination of time-varying mean values of the velocity components has been effected through the adaptation of a phase-locked ensemble averaging scheme originally developed for use with continuous (analog) signals. Interactive computer control of the positioning of the measurement value using a two-dimensional traversing mechanism is also described. The resultant measurements using this system are compared with those obtained by a hot-wire anemometer in an unsteady, non-reversing flow environment compatible to both techniques. (Author)

A80-12637 A fiber-optic link for high-speed, DDAS-to-computer data transmission. B. G. Mahrenholz and R. R. Little, Jr. (ARO, Inc., Arnold Air Force Station, Tenn.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 501-512.

This paper describes a fiber-optic data link used to transmit data from a ramjet engine test cell for a distance of two kilometers to a base central data processing center. Over this link, data from a minicomputer-controlled, high-speed, digital data acquisition system are transmitted at rates of up to 690,000 sixteen-bit words a second. The practical problems encountered in the installation of a direct-burial cable to an industrial environment are discussed. A description is given of the equipment used to interface the cable at each end as well as the transmission formats and protocols used in the system. (Author)

A80-12638 # A survey of laser Doppler velocimeter applications at the Arnold Engineering Development Center. V. A. Cline and F. L. Crosswy (ARO, Inc., Arnold Air Force Station, Tenn.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 513-524. 16 refs.

The basic theory of the laser Doppler velocimeter (LDV) is very briefly discussed using the fringe model description of the technique. Applications in six different testing facilities of the Arnold Engineering Development Center (AEDC) are described to demonstrate the capabilities and advantages of the technique, and to point out problems encountered and their possible solutions. The systems used are discussed briefly, and sample data are presented from experimental studies of shock/boundary-layer interaction, multiple wing-store flow fields, two-dimensional slotted walls for wind tunnels, model after-bodies and simulated plume flows, wind tunnel flow angle, free-jet mixing, and jet engine exhausts. (Author)

A80-12640 Microprocessors as aircraft fatigue monitors. G. H. Lindsey (U.S. Naval Postgraduate School, Monterey, Calif.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 553-558.

The paper presents the results of a feasibility study employing processor units as aircraft in-flight fatigue-data acquisition systems. These systems are dedicated to sensing significant strain events experienced by wings and recording those events. The system includes various hardware components to monitor, digitize, process, and record signals which are generated by strain gages or other transducers up to a total of eight separate inputs. The software package for the microprocessor controls the hardware components and monitors their functions. Screening, formating, storing, and recording of data are also functions performed by the software package. Laboratory and flight tests are also described. V.T.

A80-12642 Calibration of a low cost strapdown inertial guidance system. H. Musoff (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 569-574. 10 refs. Contract No. F08635-78-C-0306.

A set of techniques is presented for calibration of the inertial reference unit of a Low Cost Inertial Guidance Subsystem (LCIGS). Very large instrument error parameters are estimated without the need for external precise knowledge of the system orientation with respect to the earth rate and gravity vectors. This is made possible by utilizing the known nonlinear relations between the components of earth rate and gravity sensed by the instruments and the respective magnitudes of earth rate and gravity at the system test location in addition to the known relations between the error parameters and measurements to allow solution of the parameters from complete sets of simultaneous equations. (Author)

A80-12645 Design and simulation of a helicopter target hand-off computer. J. S. Boland, III (Auburn University, Auburn, Ala.), W. W. Malcolm (U.S. Army, Missile Research and Development Command, Redstone Arsenal, Ala.), and L. J. Pinson (Tennessee, University, Tullahoma, Tenn.). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 587-594. Grants No. DAAH01-76-C-0396; No. DAAK40-77-C-0156.

The design of an airborne computer capable of automatic hand-off of a target from a precision pointing and tracing system (PTS) to an imaging missile seeker is considered in this paper. The computer, using the digitized PTS video as a reference, employs a correlation technique to search in the seeker field-of-view (FDV) for the target. The algorithm works in real-time (i.e., the correlation peak is updated on each TV field, 1/60th of a second). When the target is found, the computer generates error signals which are used to slew the seeker line-of-sight (LOS) such that the target is in the center of its FOV. At this time the missile tracker can be activated and the missile can be fired. The emphasis of this paper is on the design of the correlator (or computer) and on simulation of its performance using four digitized scenes. (Author)

A80-12647 Instrumentation for the determination of aircraft performance from dynamic maneuvers. H. Pouwels (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: International Instrumentation Symposium, 25th, Anaheim, Calif., May 7-10, 1979, Proceedings. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 611-621. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart.

On-board instrumentation for acquisition of aircraft performance data from a single dynamic flight maneuver is described. The instrumentation installed on board a medium size twin turbofan aircraft consists of a strap-down inertial system, an accurate air data measurement system, an engine-parameter measurement system, and a measurement system for the settings of the aircraft control

surfaces. The data are acquired and stored on magnetic tape by a computer data acquisition system, which also controls a sensor system. It is outlined that the dynamic flight test technique offers a 50% decrease in flight test time at the cost of a more sophisticated instrumentation system and data processing procedures. V.T.

A80-12716 # **Singular values and feedback - Design examples.** G. Stein (Honeywell Systems and Research Center, Minneapolis, Minn.; MIT, Cambridge, Mass.) and J. C. Doyle (California, University, Berkeley, Calif.). In: Annual Allerton Conference on Communication, Control and Computing, 16th, Monticello, Ill., October 4-6, 1978, Proceedings. Urbana, Ill., University of Illinois, 1978, p. 461-470. Contract No. N00014-75-C-0144.

The purpose of the paper is to explore and illustrate the role which singular-value analysis might play in multivariable design. Several trial control design examples are presented for the longitudinal degrees of freedom of the CH-47 helicopter. Bounding formulas for model perturbations and Doyle's stability-robustness results are reviewed. Specifics of the CH-47 design problems are given and various trial designs are discussed. The examples confirm that the stability-robustness condition used in the study provides a reliable measure of robustness and offers a natural way to limit multivariable bandwidth during the design process. V.T.

A80-12908 # **Steady flow over the pressure side of a piecewise-flat delta wing with supersonic leading edges (Statsionarnoe obtekanie nizhnei poverkhnosti kusochno-ploskogo treugol'nogo kryla so sverkhzvukovymi perednimi kromkami).** S. M. Ter-Minasiants. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept.-Oct. 1979, p. 80-90. 18 refs. In Russian.

The analysis deals with the supersonic flow over a wing surface composed of arbitrary flat triangular elements connected to each other at small angles along straight lines that intersect at a point on the leading edge. A three-dimensional shock wave is attached to the leading edge having the shape of a broken line. The pressure distribution over the wing span and the pressure at the center of the wing are calculated. V.P.

A80-12911 # **Construction of a nonstationary nonlinear propeller theory (K postroeniiu nestatsionarnoi nelineinoi teorii vozdushnogo vinta).** S. M. Belotserkovskii, V. A. Vasin, and B. E. Loktev. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept.-Oct. 1979, p. 107-113. 8 refs. In Russian.

The paper considers application of the discrete vortex method for construction of a nonlinear nonstationary propeller theory in an incompressible medium. The method allows modelling of propeller transition operations, and of conditions like the 'vortex ring' and 'vortex cushion'. The method is based on substitution of actual load bearing surfaces (propeller blades) with infinitely thin surfaces followed by substitution with a vortex sheet. The impermeability boundary condition is satisfied on the blade surfaces; velocity circulations along the closed fluid are constant with time, so that circulations of free vortices are also constant with time. The Chaplygin-Zhukovsky hypothesis on finiteness of velocities is realized during the take-off flow around the blade rear edges and on the side and front edges. Convergence of free vortices which occurs along the tangent to the propeller surface is assumed at these edges, concluding that the proposed method allows determination of nonstationary dispersed and combined aerodynamic characteristics, velocity fields, and vortex structures behind the propeller. A.T.

A80-12912 # **Solution of linear problems of flow about finite span wing (O reshenii zadach obtekaniia kryla konechnogo razmakha v lineinoi postanovke).** N. F. Vorob'ev. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept.-Oct. 1979, p. 114-125. 9 refs. In Russian.

Correspondence of solutions of direct and inverse problems of the wing theory for a finite span wing is established in the framework of the linear theory based on the solution of the Volterra wave equation for supersonic flow, and the solution of the Laplace equation in the form of Green's formula for subsonic flow. For the direct problem in the supersonic case, a formula is derived for determining wing loading which most fully considers the wing geometry characteristics. For the inverse supersonic and subsonic flows, formulas are derived for determining wing geometry by specified wing loadings and the change in loading along the wing span. The solution of the inverse problem is presented in the form of integral convergence of internal points on the wing surface, with the wing surface representing a vortical surface of mutually orthogonal vertical lines. A.T.

A80-12930 # **The collision avoidance problem requires a mix of partial solutions.** J. P. Tymczyszyn (FAA, Systems Research and Development Service, Washington, D.C.). *Aircraft Engineering,* vol. 51, Nov. 1979, p. 18-21.

The article surveys some proposed collision avoidance techniques noting that no single device or procedure can deal adequately with the mid-air collision prevention problem. Attention is given to the need for new systems to be compatible with the current ICAO air traffic control radar beacon system (ATCRBS). Three approaches are presented: automatic traffic advisory and resolution service (ATARS), discrete address beacon system (DABS), and beacon collision avoidance system (BCAS). Finally, the relationship between BCAS and DABS is discussed noting that while the Active and Full versions of BCAS require that the equipped aircraft have a DABS transponder, successful operation of BCAS does not depend on the implementation of DABS sites on the ground. M.E.P.

A80-13052 # **Active flutter control in transonic conditions.** A. Gravelle (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(International Union of Theoretical and Applied Mechanics, Symposium on Structural Control, Waterloo, Ontario, Canada, June 4-7, 1979.) ONERA, TP* no. 1979-100, 1979. 14 p.

Wind tunnel tests are carried out at ONERA on several aeroelastic models with a view toward investigating the possibility of controlling the flutter instabilities, due to the presence of stores on military aircraft, in the transonic range. The control forces are obtained by using an existing aileron that is controlled by an actuator. The control law used during wind tunnel tests avoids the frequency coalascence which produces the flutter instability by introducing positive or negative stiffness forces on the wing. Two illustrative examples demonstrate the possibility of controlling flutter in the transonic range with a relatively simple control law using only one sensor per wing. S.D.

A80-13060 # **Experimental techniques developed at ONERA for advanced compressor testing.** J. Fabri (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Symposium International sur les Compresseurs pour l'Industrie, Prague, Czechoslovakia, Oct. 2-4, 1979.) ONERA, TP* no. 1979-129, 1979. 24 p. 17 refs.

Developments in instrumentation, data acquisition and reduction, and flow visualization at ONERA with regard to the testing of high-performance compressors are reviewed. Experimental techniques include: (1) determination of overall performance and description of the performance map (mass flow, pressure ratio, and efficiency); (2) visualization of the flow field, streamlines, and shock waves; and (3) measurements of local parameters including static and total pressure, flow angle, and total temperature. B.J.

A80-13064 * # **UHF coplanar-slot antenna for aircraft-to-satellite data communications.** R. W. Myhre (NASA, Lewis Research Center, Cleveland, Ohio). *New Mexico State University and U.S. Army, Printed Circuit Antenna Technology Workshop, Las Cruces, N. Mex., Oct. 17-19, 1979, Paper.* 19 p.

The initiative for starting the Aircraft-to-Satellite Data Relay (ASDAR) Program came from a recognition that much of the world's weather originates in the data sparse area of the tropics which are primarily ocean. The ASDAR system consists of (1) a data acquisition and control unit to acquire, store and format these data; (2) a clock to time the data sampling and transmission periods; and (3) a transmitter and low-profile upper hemisphere coverage antenna to relay the formatted data via satellite to the National Weather Service ground stations, as shown schematically. The low-profile antenna is a conformal antenna based on the coplanar-slot approach. The antenna is circular polarized and has an on-axis gain of nearly 2.5 dB and a HPBW greater than 90 deg. The discussion covers antenna design, radiation characteristics, flight testing, and system performance. S.D.

A80-13066 * # **State-of-the-art of SiAlON materials.** S. Dutta (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Specialist Meeting on Ceramics for Turbine Engine Applications, Cologne, West Germany, Oct. 7-12, 1979, Paper.* 21 p. 41 refs.

The state of the art of 'SiAlONs' is reviewed, noting that the term has become a generic one applied to Si3N4 based materials. Attention is given to work on phase relations, crystal structure, synthesis, fabrication, and properties of various SiAlONs. Also discussed are the essential features of compositions, fabrication methods, and microstructures. In addition, consideration is given to high temperature flexure strength, creep, fracture toughness, oxidation, and thermal shock resistance. Finally, these data are compared to those for some currently produced silicon nitride ceramics to assess the potential of SiAlON materials for use in advanced gas turbine engines. M.E.P.

A80-13068 * # **NASA gear research and its probable effect on rotorcraft transmission design.** E. V. Zaretsky, D. P. Townsend, and J. J. Coy (NASA, Lewis Research Center, Cleveland, Ohio). *American Helicopter Society, Meeting on Helicopter Propulsion Systems, Williamsburg, Va., Nov. 6-8, 1979, Paper.* 17 p. 42 refs.

The NASA Lewis Research Center devised a comprehensive gear technology research program beginning in 1969, the results of which are being integrated into the NASA civilian Helicopter Transmission System Technology Program. Attention is given to the results of this gear research and those programs which are presently being undertaken. In addition, research programs studying pitting fatigue, gear steels and processing, life prediction methods, gear design and dynamics, elastohydrodynamic lubrication, lubrication methods and gear noise are presented. Finally, the impact of advanced gear research technology on rotorcraft transmission design is discussed. M.E.P.

A80-13126 **Impression fatigue.** J. C. M. Li (Bochum, Ruhr-Universität, Bochum, West Germany) and S. N. G. Chu (Rochester, University, Rochester, N.Y.). *Scripta Metallurgica*, vol. 13, Nov. 1979, p. 1021-1026. 12 refs. Contract No. EY-76-S-02-2296-002.

The effect of variable-amplitude loading on the fatigue crack growth behavior is important in aircraft design considerations. A novel fatigue test is designed to shed some light on the mechanism of fatigue crack propagation. In this test, a cylindrical indenter with a flat end is pressed onto the surface of a beta-tin crystal with cyclic load. The indenter produces an impression whose depth increases with time, thereby creating a situation where a plastic zone propagates into the material without a crack. The increase in depth per cycle dl/dn is fast in the beginning and then decreases to a steady-state value. A power law is found to hold between this steady-state value and the maximum stress with a stress exponent of 4. The effects of overloading and underloading are determined. Since there is no crack in the present test, it is proposed that the overloading and underloading effects of fatigue crack propagation may arise from plastic zone properties rather than crack closure. S.D.

STAR ENTRIES

N80-10003 Allerton Press, Inc., New York, N. Y.
PARAMETRIC METHOD OF AIRCRAFT ENGINE STATUS DIAGNOSTICS BASED ON LIMITED INFORMATION

A. M. Akhmedzyanov, A. P. Tunakov, Kh. S. Gumerov, Yu. D. Degtyarev, and E. I. Morkovnikova *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 6-11 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 12-18

An algorithm was developed for engine flow path diagnostics based on limited information on the thermogasdynamic parameters. A mathematical model of the engine is used as the diagnostic communication channel. A.R.H.

N80-10006 Allerton Press, Inc., New York, N. Y.
INFLUENCE OF GAS TURBINE ENGINE COMBUSTION CHAMBERS GEOMETRIC PARAMETERS ON MIXTURE FORMATION CHARACTERISTICS

P. P. Grigorenko, Yu. A. Spiridonov, and A. V. Talantov *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 20-24 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats Tekh. (USSR), v. 21, no. 3, 1978 p 30-37

Results are presented of a study of the number of rows, number n of holes, and area ratio f of a mixer on the mixing quality theta. It is shown that increase of n and f leads to increase of the required flowrate G3 at the singular point, characterized by the jet penetration depth h = approximately 0.3d(k). A design diagram is proposed for selecting the optimal mixer parameters corresponding to minimal temperature field nonuniformity. Author

N80-10011 Allerton Press, Inc., New York, N. Y.
DETERMINATION OF TURNING ANGLE OF A JET IMPINGING ON A BUCKET WITH VISOR

L. M. Kotlyar, S. G. Margulis, and E. D. Nesterov *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 40-43 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR) v. 21, no. 3, 1978 p 58-62

The problem of jet impingment on a bucket with a visor is solved by the singular point method. The dependence of the jet turning angle on several geometric parameters of the bucket is determined. Calculations made on an M-222 computer are compared to experimental results and recommendations are given on estimation of the flow exit angle. K.L.

N80-10022 Allerton Press, Inc., New York, N. Y.
STUDY OF HEAT-PIPE HEAT EXCHANGER IN THE SMALL GAS TURBINE ENGINE SYSTEM

V. K. Shchukin, I. I. Mosin, N. V. Lokai, and Yu. V. Matveev *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 93-96 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 127-132

A theoretical optimization of the elements of heat-pipe heat exchangers in application to small gas turbine engines (SGTE), is presented in order to study the possibility of using this type of heat exchanger as a SGTE regenerator. The regeneration ratio sigma sub p approximately 0.82 with admissible pressure losses in the heat exchanger passages delta P 6% was obtained. In order to confirm the validity of the theoretical results, an experimental study was made of a heat exchanger matrix consisting of 49 ribbed sodium heat pipes on a specially developed test stand simulating SGTE regenerator operating conditions. This study confirms the possibility of using the heat-pipe heat exchanger as an SGTE regenerator. M.M.M.

N80-10024 Allerton Press, Inc., New York, N. Y.
ANALYTIC REPRESENTATION OF TURBINE CHARACTERISTICS IN FORM CONVENIENT FOR COMPUTER CALCULATION OF GTE PARAMETERS

V. I. Bakulev, K. A. Malinovskii, and V. S. Yakushev *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 104-110 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 142-144

A method is proposed for representing turbine characteristics in a form convenient for computer calculation of gas turbine engine parameters. The method makes it possible to specify the turbine characteristic completely by two functions. The form of the functions is approximated well by polynomials, which makes it possible to specify simply the turbine operating field region and is convenient for computer calculation of GTE characteristics. Author

N80-10027 Allerton Press, Inc., New York, N. Y.
LONG-LIFT GTE OPERATION BASED ON TECHNICAL CONDITION

A. A. Mukhin, A. A. Kovalev, and A. A. Kornoukhov *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 116-118 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 153-156

Methods for evaluating turbine rotor blade technical condition during operation of the loads on aircraft engines are examined. Methods include using a service life counter, manual recordings and a computer, and a magnetic flight data recorder to record the accumulated time of operation at takeoff and other operating regimes such as number of takeoffs and landings, the number of transient regimes, and the maximum gas temperature in the turbine inlet under flight conditions. A.W.H.

N80-10028 Allerton Press, Inc., New York, N. Y.
USE OF THE METHOD OF VARIABLE DIRECTIONS FOR NUMERICAL STUDY OF THE TEMPERATURE STATES OF A TURBINE DISK WITH BLADES

A. M. Polyakov, V. S. Petrovskii, and V. I. Krichakin *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 119-122 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 156-160

The system of two dimensional unsteady heat conduction equations for a turbine blade and disk is presented. The disk profile, specified by arbitrary functions bounding the side surface contour, is analyzed. The transformation of the curvilinear disk region contour into a rectangular region using linear transformation is described. A.W.H.

N80-10029 Allerton Press, Inc., New York, N. Y.
CHARACTERISTICS OF AFTERBURNING BYPASS TURBOJET ENGINE WITH OXYGEN INJECTION INTO THE AFTERBURNER CHAMBER

B. D. Fishbein *In its* Soviet Aeron., Vol. 21, No. 3 1978 p 123-126 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 3, 1978 p 160-164

The thermodynamic effectiveness of increasing the augmentation ratio and thrust of the afterburning bypass turbojet engine with oxygen injection into the afterburner chamber under flight conditions is investigated. The thermodynamic characteristics of the air, mixture of air and oxygen, and products of complete combustion of kerosene in air and in a mixture of air and oxygen are presented. The kerosene flow rate in the turbine and afterburner combustion chambers is determined and the kerosene expansion in the propulsive nozzle is calculated using the temperature dependence of the working fluid specific heat. A.W.H.

N80-10035# Allerton Press, Inc., New York, N. Y.
ANALYTIC DESIGN OF REGULATORS FOR CONTROLLING ELASTIC FLIGHT VEHICLE ROTATION ABOUT THE LONGITUDINAL AXIS

A. A. Baloev *In its* Soviet Aeron., v. 21, no. 4, 1978 p 16-21 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4 1978 p 23-28

On the basis of classical variational calculus an algorithm is developed for synthesis of the optimal control of elastic flight vehicle rotation about the longitudinal axis. The known analogous algorithms developed on the basis of the dynamic programming method are more tedious, since their application requires solution of nonlinear Riccatti-type equations. F.O.S.

N80-10037 Allerton Press, Inc., New York, N. Y.
OPTIMAL CONTROL OF FLIGHT VEHICLE WITH ELASTIC ELEMENTS

V. V. Vatolin, G. L. Degtyarev, and N. K. Yunusov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 27-31 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 36-42

The problem is examined of synthesizing an optimal control as is a function of the measured variables. The optimality criterion is the value of a quadratic form of the observed variables at the current instant of time. An analytic expression is obtained for the optimal control and the condition which the flight vehicle state measurement technique must satisfy and analyze the influence of measurement sensor location on controlled motion quality. F.O.S.

N80-10038 Allerton Press, Inc., New York, N. Y.
ANALOG MODELING IN STUDYING SUPERSONIC FLOW AROUND A WING AND ITS GOVERNING ANALOG-CRITERIA

R. I. Vinogradov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 32-37 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4 1978 p 43-48

In examining the gas-hydraulic analogy, no systematic study has been made of the questions for determining the criteria which ensure proper analog modeling. The mathematical similitude analog-criterion concept is introduced. Recommendations are given on the conduct of mixed analog-physical modeling when conducting experiments to study the flow patterns around an oscillating wing by the gas-hydraulic analogy method. F.O.S.

N80-10042 Allerton Press, Inc., New York, N. Y.
BASIC PROBLEM OF AIRCRAFT GAS TURBINE ENGINE ANALYTIC DESIGN, PART 1

Yu. V. Kozhevnikov, V. O. Borovik, V. S. Ivanov, V. A. Talyzin, Agliullin, and Ya. V. Melusov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 53-57 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 68-74 (For primary document see N80-10031 01-01)

The general problem of gas turbine engine design is considered. The problem of modeling and optimizing the engine thermodynamic and gasdynamic parameters is defined as the basic problem; the solution yields the system of basic data for constructive detail design of the gas turbine engine elements. A formulation of the basic analytic design problem is presented accounting for the effect of random factors and the multi-regime nature of engine operation. J.M.S.

N80-10043 Allerton Press, Inc., New York, N. Y.
ANALYSIS OF THIN-WALL BEAMS BY THE METHOD OF SEGMENTS

A. S. Kretov and V. G. Shataev *In its* Soviet Aeron., v. 21, no. 4, 1978 p 58-61 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 75-80

The stress-strain state of thin wall structures such as a flight vehicle wing or body having an irregular structural scheme is examined. It is assumed that the cross-section contour does not change in the deformation process, the skin works in shear, and the stringers work in tension-compression. The structure is broken down into several segments of variable section, which are analyzed numerically by a finite sum method. An algorithm is proposed for constructing the segment coupling matrix equations. The solution is realized in the form of an ALGOL program and the analysis results are compared with experimental data. J.M.S.

N80-10044 Allerton Press, Inc., New York, N. Y.
SELECTING THE GEOMETRIC PARAMETERS AND POSITION OF A NOSE FLAP ON THE ROOT PROFILE OF A SWEPT WING USING TUNNEL TEST DATA, PART 2

A. I. Matyah, V. A. Sterlin, V. A. Popov, V. V. Isaev, and G. A. Cheremukhin *In its* Soviet Aeron., vol. 21, no. 4, 1978 p 62-66 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 81-87

The installation of a nose flap on the swept wing of a transport airplane is analyzed. The aerodynamic effects associated with installation of the flap are identified and evaluated on the basis of data from wind tunnel tests of a full-scale airplane model. It is shown that the use on the nose of the swept wing of combined mechanization in the form of a slat on the outer part of the wing and a nose flap at the root improves the aerodynamic characteristics in the region of both moderate and high angles of attack. Some questions of design nature which may arise when installing a nose flap are included. J.M.S.

N80-10045 Allerton Press, Inc., New York, N. Y.
LAMINAR BOUNDARY LAYER CALCULATION FROM EXPERIMENTAL PRESSURE DISTRIBUTION

V. D. Osorgin, A. N. Popkov, O. P. Sidorov, and S. O. Sidorova *In its* Soviet Aeron., v. 21, no. 4, 1978 p 67-71 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 88-93

A technique for calculating the laminar boundary layer from an experimental pressure distribution is presented. For this the discrete experimental wing profile surface pressure function is approximated by a spline function which is continuous together with its first derivative. A single-parameter method is used to calculate the boundary layer at a profile specified in tabular form and the calculation results are presented. J.M.S.

N80-10046 Allerton Press, Inc., New York, N. Y.
ON MODELING SENSITIVITY OF A LINEAR SYSTEM TO REDUCTION OF ITS ORDER BY THE INFINITESIMAL TRANSFORMATION METHOD IN THE YAW MOTION CONTROL PROBLEM
V. G. Pavlov *In its* Soviet Aeron., v. 21, no. 4 1978 p 72-75 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats Tekh., (USSR), v. 21, no. 4, 1978 p 94-98

A method based on the use of some concepts of continuous group theory is proposed for solving the problem of linear system sensitivity to reduction of its order. The basic idea is that the original process is embedded in a continuous ensemble obtained by transformation of the nominal process. A system of lower order is taken as the original system. The entire process ensemble corresponding to higher-order systems is obtained by transformation of the original system. Use of this method is examined in the yaw motion control problem. It is shown that the sensitivity study can be modeled by a continuous transformation group defined by the Lie algebra of three basis operators. A precise estimate of system sensitivity to reduction of its order is obtained. J.M.S.

N80-10047 Allerton Press, Inc., New York, N. Y.
ON THE EMPENNAGE SNAP-THROUGH PROBLEM
V. A. Pavlov and S. K. Chernikov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 76-80 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved Aviats Tekh., (USSR), v. 21, no. 4, 1978 p 99-104

The structural stability of flight vehicle empennage-type structures is examined. A mathematical model made up of a system on nonlinear integral-differential equations is obtained and solved by the successive loading method with refinement of the roots using the Newton-Kantorovich method. Results of calculations are presented and are confirmed by experiments. J.M.S.

N80-10048 Allerton Press, Inc., New York, N. Y.
ELECTRICAL CHARGING OF FABRIC AND FILM MATERIALS
B. G. Popov, V. N. Baklygin, and I. I. Chistyakov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 81-86 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 105-111

The mechanism of fabric and film material electrification during contact with one another is examined. Results of an analytic and experimental study are presented which establish the connection between the charge formed on the surface and the properties of the materials and the intensity of their mutual contact. J.M.S.

N80-10050 Allerton Press, Inc., New York, N. Y.
MOTION OF RECTANGULAR WING BETWEEN PARALLEL WALLS
K. V. Rozhdestvenskii *In its* Soviet Aeron., v. 21, no. 4, 1978 p 92-97 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 117-123

The method of matched decompositions is used to find the asymptotic expression for the potential of the flow around a rectangular wing between parallel walls. Formulas for the lift coefficient are obtained and numerical results are presented illustrating the influence of the walls on the lift force for various wing aspect ratios and distances between the walls. The results are valid for small relative distance of the wing from the lower wall. Author

N80-10053 Allerton Press, Inc., New York, N. Y.
STRUCTURAL ANALYSIS OF VARIABLE-SWEEP WINGS

N. A. Shelqmov and N. A. Gorozhankin *In its* Soviet Aeron., v. 21, no. 4, 1978 p 106-113 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 133-141

A technique based on a combined system model in the differential formulation is presented for structural analysis of variable sweep wings. The problem is examined for momentless conical and cylindrical skewed shells located between the wing ribs. The differential equations of equilibrium of a skewed momentless shell element are discussed. A.W.H.

N80-10054 Allerton Press, Inc., New York, N. Y.
DETERMINATION OF STRAIN FIELDS NEAR CONCENTRATORS FROM STRAIN GAGE INDICATORS
A. L. Brushkovskii *In its* Soviet Aeron., v. 21, no. 4, 1978 p 142-144 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aeron. Tekh., (USSR), v. 21, no. 4, 1978 p 114-116

A technique is presented for determining the strain fields in stress concentrator zones from strain gage indications without account for, and with partial or complete account for, the design schemes of the objects. The strain determination algorithms (without account for the design schemes of the elements) are discussed due to their poor sensitivity to changes of the field outside the comparison nodes. Methods to account for the physical aspect of the error in the algorithm are described. A.W.H.

N80-10057 Allerton Press, Inc., New York, N. Y.
ON THIN-WALL BEAM EFFECTIVE STIFFNESS
V. A. Pavlov *In its* Soviet Aeron., v. 21, no. 4, 1978 p 124-128 ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 151-155

The bending stiffness of a thin wall beam in a constrained, deplanation zone is analyzed. A condition of the analysis, that the law of planar distribution of the relative elongation is violated, is described. The bending stiffness of a thin wall beam determined from the Odinakov theory is presented. A.W.H.

N80-10058 Allerton Press, Inc., New York, N. Y.
APPLICATION OF THE FACTOR INTERPOLATION METHOD IN FLIGHT VEHICLE LANDING GEAR ANALYTIC DESIGN

A. V. Svilin *In its* Soviet Aeron., v. 21, no. 4, 1978 p 129-131 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., (USSR), v. 21, no. 4, 1978 p 155-158

A technique for solving the problem of landing gear analytic design with random inputs is presented. The probabilities that the landing gear quality indices will lie in given regions with respect to the values of their mathematical expectations and dispersions are discussed. The mathematical expectations and dispersions of the landing gear quality indices are determined using the factor interpolation method. A.W.H.

N80-10060 Allerton Press, Inc., New York, N. Y.
FLOW-AROUND SMALL-ASPECT-RATIO DELTA WING WITH VORTEX 'BURSTING'
G. A. Cheremukhin, E. A. Truneva, and E. Ya. Pivkin *In its* Soviet Aeron., v. 21, no. 4, 1978 p 135-140 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh.,

(USSR), v. 21, no. 4, 1978 p 162-167

The vortex flow around a delta wing of small aspect ratio is discussed. The connection between the state of the vortex and the flow over the surface of the wing is examined. Influences on the pressure distribution and the aerodynamic characteristics, due to the appearance of the vortex bursting above the wing surface are reported. A.W.H.

N80-10063 Allerton Press, Inc., New York, N. Y.
GAS CURTAINS IN GAS TURBINE ENGINES
I. S. Varganov *In its* Soviet Aeron., v. 22, no. 1 1979 p 6-10 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 11-16

The application of gas curtains for thrust reversal in gas turbine engines is numerically examined. The use of gas curtains in the fan flow makes it possible to vary the flow rate ratio as a function of flight regime. The energy capabilities of this reversal technique are determined in terms of the relative required flow rate. J.M.S.

N80-10065 Allerton Press, Inc., New York, N. Y.
STUDY OF HOMOGENEOUS COMBUSTION CHAMBER TEMPERATURE FIELD NONUNIFORMITY WITH PRIMARY ZONE PARAMETER VARIATION
O. A. Evin, V. M. Yankovskii, and I. N. Pyatlov *In its* Soviet Aeron., v. 22, no. 1 1979 p 16-19 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 24-29

The influence of the primary zone parameters on the temperature field nonuniformity of homogeneous combustion chambers was studied using a flame tube of a production combustion chamber. Results are discussed. J.M.S.

N80-10068 Allerton Press, Inc., New York, N. Y.
SELECTION OF OPTIMAL PARAMETERS OF HEAT-PIPE HEAT EXCHANGER FOR A GAS TURBINE ENGINE
N. V. Lokai and I. I. Mosin *In its* Soviet Aeron., v. 22, no. 1 1979 p 30-34 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 41-46

Requirements that assist in achieving the maximal heat exchanger degree of regeneration are examined. It is shown that in a specific gas turbine engine equipped with a heat exchanger the degree of regeneration can be improved by observing the following conditions: (1) The heat transfer capacity of the heat exchanger heat pipes must exceed the rate of heat transfer from the gas and air sides; (2) the condition of equality of certain dimensionless groupings on the hot and cold sides of the heat exchanger must be satisfied. R.E.S.

N80-10071 Allerton Press, Inc., New York, N. Y.
SYSTEMATIZATION OF SIMPLE DETAIL PARTS OF REGULABLE NOZZLE OF GAS TURBINE ENGINE
I. E. Sapozhkov and E. D. Stenkin *In its* Soviet Aeron., v. 22, no. 1 1979 p 44-49 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 57-63

A subsystem principle of studying gas turbine design which accounts for the characteristics of the working process and which can be used in studying various mechanical systems is proposed. The structural schemes and 'typizations' of gas turbine engine regulable nozzle details were determined. These schemes are necessary in developing optimal design methods and their computer formalization. M.M.M.

N80-10074 Allerton Press, Inc., New York, N. Y.
DYNAMICS OF DIESEL FUEL COMBUSTION IN TURBULENT FLOW
F. A. Khamidullin, A. F. Kuzin, O. V. Strogonov, Yu. V. Troitskii, and A. V. Talantov *In its* Soviet Aeron., v. 22, no. 1 1979 p 58-63 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 73-80

A study of diesel fuel and also TS-1 kerosene and B-70 gasoline combustion in a turbulent stream is presented. These fuels are compared and the dependence of the combustion zone length and the combustion time on mixture composition, velocity, and initial temperature under the model combustion chamber conditions was established. M.M.M.

N80-10075 Allerton Press, Inc., New York, N. Y.
STUDY OF MASS EXCHANGE BETWEEN PRIMARY ZONE AND SECONDARY AIR JETS IN GAS TURBINE ENGINE COMBUSTION CHAMBERS
V. G. Shumachenko, V. M. Yankovskii, and A. V. Stalantov *In its* Soviet Aeron., v. 22, no. 1 1979 p 64-67 ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 81-85

The experimental and theoretical determination of the secondary air jets G sub pz in application to combustion chambers is presented as well as the flow structure in the primary zone which is formed by the secondary air jets of the first row of holes. In such combustion chambers, the air flow rate through the front end assembly G sub pz does not exceed 5-10% of the overall air flow rate through the chamber, and most of the air enters the primary zone from the secondary air jets. M.M.M.

N80-10077 Allerton Press, Inc., New York, N. Y.
AERODYNAMIC EFFICIENCY OF GAS TURBINE INTAKE DUCT
I. G. Gogolev, P. V. Korolev, Yu. D. Kudashev, V. A. Magala, and B. A. Shifrin *In its* Soviet Aeron., v. 22, no. 1 1979 p 71-73 Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 88-91

Cold flow tests were conducted on an aerodynamic stand for a small transport gas turbine power plant segment consisting of a combustion chamber, an intake duct, and a stator cascade. Pneumometric probes were used to measure static pressure, total pressure, and flow angles in the radial and tangential directions at the segment control sections. Velocity fields, mass rate distributions and the streamline shape were found. Energy losses in the segment elements were determined separately and their mutual influence during combined operation was analyzed. Increasing the radius of curvature of the intake duct surface was found to eliminate flow separation and reduce nonuniformity in the radial and circumferential flow parameter distribution. Although the stator cascade efficiency remained unchanged, the efficiency of the entire segment was increased as a result of elimination of energy losses in the flow entering the cascade. K.L.

N80-10083 Allerton Press, Inc., New York, N. Y.
ON THE INFLUENCE OF SHORT SHROUD PLATFORMS ON TURBINE STAGE OPERATION
R. V. Kuzmichev and G. V. Proskuryakov *In its* Soviet Aeron., v. 22, no. 1 1979 p 90-92 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1,

1979 p 105-107 (For primary document see N80-10061 01-01)
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Techniques for improving the efficiency of unshrouded turbine stages using short shroud platforms are examined. Two air turbine engine models were tested for the overall improvement in stage efficiency. The use of short one sided and two sided shroud platforms on the performance of the rotor blades, the blade tips, and the flow structure near the periphery is discussed. Stage efficiency improvement in the limits of the inter row clearance and radial clearance is determined. A.W.H.

N80-10085 Allerton Press, Inc., New York, N. Y.
STUDY OF COMBINED OPERATION OF SELF-EVACUATING VORTEX TUBE WITH DIFFUSER
A. P. Merkulov and V. T. Volov *In its* Soviet Aeron., v. 22, no. 1 1979 p 96-98 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 109-112
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The effect created by the self evacuating vortex tube (SEVT) and the cooling of the near axis SEVT layers in certain operating regimes is examined. An isogradient radially symmetric diffuser which transforms the kinetic energy of the gas entering the diffuser into pressure energy is described. The reduction of SEVT dimensions for use in aircraft equipment is discussed. A.W.H.

N80-10088 Allerton Press, Inc., New York, N. Y.
STUDY OF SIZE DISTRIBUTION OF OIL DROPS FORMED IN GTE OIL
P. G. Petrov and O. A. Povarov *In its* Soviet Aeron., v. 22, no. 1 1979 p 105-107 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 117-119
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The replica method was used to study the oil drop size distribution. A probe was installed in the air-oil separator housing ahead of the impeller. After reaching steady-state conditions and complete stabilization of the parameters, the sample was taken (measurement time 0.06 to 0.1 sec). Then the drop 'replicas' were photographed through a microscope. Photography of a calibrated wire with identical magnification was used to determine the dimensions of the oil drop replicas. Results show that the air-oil mixture which forms in the oil system lines has a very broad oil drop size spectrum with the maximum number of drops (about 20%) being on the order to 10 microns in diameter.
A.R.H.

N80-10089 Allerton Press, Inc., New York, N. Y.
NONSTATIONARITY OF HEAT TRANSFER IN AXIAL TURBINE BLADING DURING ENGINE STARTUP
A. M. Polyakov, V. S. Petrovskii, and V. I. Krichakin *In its* Soviet Aeron., v. 22, no. 1 1979 p 108-111 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 119-123

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In all gas turbine element temperature calculations, the coefficient of heat transfer are assumed to be independent of the nonstationarity of the heat transfer process. Of interest are the time dependence of the local coefficient of heat transfer on axial gas turbine rotor blade surfaces found from the results of temperature survey during startup. The first-stage and second-stage rotor blade temperatures at the mean diameter of the turbine of an aircraft auxiliary power unit engine were continuously recorded. The temperature values through the blade thickness were averaged. A.R.H.

N80-10091 Allerton Press, Inc., New York, N. Y.
PNEUMATIC DISTRIBUTOR FOR TURBOJET ENGINE CONTROL SYSTEM
M. G. Khabibullin *In its* Soviet Aeron., v. 22, no. 1 1979 p 115-116 refs Transl into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), v. 22, no. 1, 1979 p 126-127
Copyright. Avail: Allerton Press, Inc., 150 Fifth Ave., New York, N. Y. 10011; $50.00

A distributor, introduced into the thrust reverser control system of the NK-8-2U TJE for the Tu-154 airplane, consists of the housing with sleeve, in the bore of which the spool is installed. The central port in the housing is for air entry from the pressure source - the cavity downstream of the TJE compressor. There are two ports for air supply to the actuator, and two others for discharge of the used air into the atmosphere. The support lands are made from graphite-impregnated metal to ensure small dry-friction forces during displacement, since the graphite-impregnated metal acts as a lubricant for the contacting surfaces and eliminates the possibility of spool binding. The middle distributing land is metal, is integral with the spool and its width is considerably less than the width of the supporting lands, which makes it possible to reduce the spool working travel and the overall dimensions of the unit. In order to eliminate the possibility of contact of the land with the sleeve, since the metal-metal friction pair would not operate satisfactorily under dry-friction conditions, the diameter of the land is less than the diameter of the supporting lands by 0.01 to 0.02 mm with allowance for thermal expansion. A.R.H.

N80-10097 Engineering Sciences Data Unit, London (England).
WING-BODY YAWING MOMENT AND SIDEFORCE DERIVATIVES DUE TO SIDESLIP: Nv AND Yv
1979 14 p
(ESDU-79006; ISBN-0-85679-251-9; ISSN-0141-397X) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $386.50

A means is provided for estimating the yawing moment and sideforce derivatives due to sideslip for wing-body combinations at small angles of attack and sideslip at subsonic speeds. For stability calculations, an accurate prediction is more important for Nv than for Yv. The data are primarily intended for predicting Nv. Because Nv is dependent on the choice of yaw axis position, a knowledge of Yv is needed to convert Nv from one axis position to another. An accurate estimate of Yv is difficult and the method given may involve substantial errors for certain configurations, but it is considered adequate in allowing for changes in yaw axis position between 0.41(b) and 0.61(b) as, subject to that limitation, quite large uncertainties in Yv do not give rise to significant errors in Nv. ESDU

N80-10098 Texas Univ. at Arlington.
CROSS FLOW FAN EXPERIMENT DEVELOPMENT AND FINITE ELEMENT MODELING Ph.D. Thesis
Gary James Harloff 1979 230 p
Avail: Univ. Microfilms Order No. 7922981

A compressible one dimensional finite element differential analysis is presented which accounts for area changes, rotor lumped blade forces, turbulent wall friction, and heat input. The analysis permits integration through the rotors. Good agreement with test data is obtained. The analysis indicates that appreciable heating of the through flow occurs. The heat input is due to viscous dissipation in the airfoils. This heat input causes thermal chocking in the second stage rotor fan. An incompressible two dimensional finite element analysis is also presented which also permits integration through the rotors. The flow outside the rotors is treated as potential flow and the flow inside the rotors is treated as rotational flow. Good agreement with low speed test data is obtained. Maximum velocities of twice the rotor tip speed are predicated inside the outlet rotor. Dissert. Abstr.

N80-10101*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF WINGLETS ON A FIRST-GENERATION JET TRANSPORT WING. 6: STABILITY CHARACTERISTICS FOR A FULL-SPAN MODEL AT SUBSONIC SPEEDS
Stuart G. Flechner Oct. 1979 69 p refs
(NASA-TP-1330; L-12514) Avail: NTIS HC A04/MF A01 CSCL 01A

A wind tunnel investigation to identify changes in stability and control characteristics of a model KC-135A due to the addition of winglets is presented. Static longitudinal and lateral-directional aerodynamic characteristics were determined for the model with and without winglets. Variations in the aerodynamic characteristics at various Mach numbers, angles of attack, and angles of slidslip are discussed. The effect of the winglets on the drag and lift coefficients are evaluated and the low speed and high speed characteristics of the model are reported. A.W.H.

N80-10102*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL INVESTIGATION OF THE VALIDITY OF A SONIC-BOOM-MINIMIZATION CONCEPT
Robert J. Mack and Christine M. Darden Oct. 1979 47 p refs
(NASA-TP-1421; L-12661) Avail: NTIS HC A03/MF A01 CSCL 01A

The Langley unitary plan unitary plan wind tunnel was used to determine the validity of a sonic-boom-minimization theory. Five models - two reference and three low-boom constrained - were tested at design Mach numbers of 1.5 and 2.7. Results show that the pressure signatures generated by the low-boom models had significantly lower overpressure levels than those produced by the reference models and that small changes in the Mach number and/or the lift caused relatively small changes in the signature shape and overpressure level. Boundary-layer effects were found in the signature shape and overpressure level. Boundary-layer effects were found to be sizable on the low-boom models, and when viscous corrections were included in the analysis, improved agreement between the predicted and the measured signatures was noted. Since this agreement was better at Mach 1.5 than at Mach 2.7, it was concluded that the minimization method was definitely valid at Mach 1.5 and was probably valid at Mach 2.7, with further work needed to resolve the uncertainty. A.R.H.

N80-10103*# Johns Hopkins Univ., Laurel, Md.
ADVANCED MISSILE TECHNOLOGY. A REVIEW OF TECHNOLOGY IMPROVEMENT AREAS FOR CRUISE MISSILES Final Report
L. L. Cronvich and H. P. Liepman Washington Oct. 1979 66 p refs
(NASA Order L-75242A)
(NASA-CR-3187; BFD-0-79-001) Avail: NTIS HC A04/MF A01 CSCL 01A

Technology assessments in the areas of aerodynamics, propulsion, and structures and materials for cruise missile systems are discussed. The cruise missiles considered cover the full speed, altitude, and target range. The penetrativity, range, and maneuverability of the cruise missiles are examined and evaluated for performance improvements. A.W.H.

N80-10104*# National Aeronautics and Space Administration, Washington, D. C.
THE SIGNIFICANCE OF WING END CONFIGURATION IN AIRFOIL DESIGN FOR CIVIL AVIATION AIRCRAFT
H. Zimmer Oct. 1979 35 p refs Transl. into ENGLISH of "Die Bedeutung der Fluecelendformen Tragfluecelentwurf fuer Flugzeuge der Zivilen Luftfahrt", paper-77-030 Deutsche Gesellschaft fuer Luft-und Raumfahrt, Jahrestagung 10th, Berlin, 15 Sep. 1977 40 p Transl. by Leo Kanner Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-75711; Paper-77-030) Avail: NTIS HC A03/MF A01 CSCL 01A

Lift-dependent induced drag in commercial aviation aircraft is discussed, with emphasis on the necessary compromises between wing and configuration modifications which better lift performance and the weight gains accompanying such modifications. Triangular, rectangular and elliptical configurations for wing ends are considered; attention is also given to airfoil designs incorporating winglets. Water tunnel tests of several configurations are reported. In addition, applications of wing and modifications to advanced technology commercial aviation aircraft and the Airbus A-300 are mentioned. Author

N80-10105*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ESTIMATION OF ATTAINABLE LEADING-EDGE THRUST FOR WINGS AT SUBSONIC AND SUPERSONIC SPEEDS
Harry W. Carlson, Robert J. Mack, and Raymond L. Barger 1979 62 p refs
(NASA-TP-1500; L-13032) Avail: NTIS HC A04/MF A01 CSCL 01A

The factors which place limits on the theoretical leading edge thrust are identified. An empirical method for the estimation of attainable thrust is presented. The method is based on the use of simple sweep theory to permit a two dimensional analysis, the use of theoretical airfoil programs to define thrust dependence on local geometric characteristics, and the examination of experimental two dimensional airfoil data to define limitations imposed by local Mach numbers and Reynolds numbers. Comparisons of theoretical and experimental aerodynamic characteristics for a series of wing body configurations are examined. A.W.H.

N80-10106*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF SEVERAL AIRFRAME/NOZZLE MODIFICATIONS ON THE DRAG OF A VARIABLE-SWEEP BOMBER CONFIGURATION
Richard J. Re and David E. Reubush Washington 1979 171 p ref
(NASA-TM-80129; L-13043) Avail: NTIS HC A08/MF A01 CSCL 01A

A variable sweep bomber aircraft model was investigated to identify modifications for drag reduction. Modifications included simulated two dimensional nozzles, staggered and extended nozzles; short, long, and no interfairings between the nozzles; partial and complete wing-glove fairings; glove-fuselage sidefairing; fuselage underfairing; and wing pods. The variable wing sweep and variable exhaust nozzles of the scale model are discussed. A.W.H.

N80-10107*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WORKSHOP ON THRUST AUGMENTING EJECTORS
A. E. Lopez, ed., D. G. Koenig, ed., D. S. Green, ed. (Naval Air Development Center, Warminster, Penn.), and K. S. Nagaraja, ed. (Air Force Flight Dynamics Lab) Sep. 1979 509 p Conf. held at Moffett Field, Calif., 28-29 Jun. 1978; Sponsored by NADC and AFFDL
(NASA-CP-2093; A-7887) Avail: NTIS HC A22/MF A01 CSCL 01A

The state of the art of ejector technology is assessed and the desired direction of future studies in all aspects of ejector thrust augmenting systems is deliniated.

N80-10108*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
RECENT DEVELOPMENTS IN EJECTOR TECHNOLOGY IN THE AIR FORCE: AN OVERVIEW
K. S. Nagaraja *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 1-22 refs

Avail: NTIS HC A22/MF A01 CSCL 01A

Basic and applied studies in thrust augmentation conducted at the Aerospace Research Laboratory at Wright-Patterson AFB which led to an effective configuration of the jet flap diffuser ejector, are reviewed. A method for compressible ejector flow analysis, developed in support of the preliminary design of an ejector thrust aircraft, is discussed and applied to single- and two-stage ejectors. A.R.H.

N80-10109*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA OVERVIEW
David G. Koenig *In its* Workshop on Thrust Augmenting Ejectors Sep. 1979 p 23-40 refs

Avail: NTIS HC A22/MF A01 CSCL 01A

The history of NASA efforts at Ames Research Center in researching the performance and application of thrusting augmentors is reviewed. Current objectives include: (1) parametric description of thrust augmentor application to STOL and V/STOL; (2) the use of theoretical and empirical data; (3) aircraft-augmentor integration; and (4) key design considerations for STOL transport and V/STOL fighter aircraft. Test facilities are described and ejector development and performance are assessed. A.R.H.

N80-10119*# Duvvuri Research Associates, Chula Vista, Calif.
INTEGRATION OF EJECTORS INTO HIGH-SPEED AIRCRAFT
Tirumalesa Duvvuri *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 225-238

Avail: NTIS HC A22/MF A01 CSCL 01A
The integration of ejectors into forebodies is considered for transonic and supersonic flight. Topics discussed include mixing flow in ducts, prediction of flow fields and external aerodynamics. K.L.

N80-10120*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SOME TESTS ON SMALL-SCALE RECTANGULAR THROAT EJECTOR
W. N. Dean, Jr. (Air Force Flight Test Center) and M. E. Franke *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 239-251 refs

Avail: NTIS HC A22/MF A01 CSCL 01A
A small scale rectangular throat ejector with plane slot nozzles and a fixed throat area was tested to determine the effects of diffuser sidewall length, diffuser area ratio, and sidewall nozzle position on thrust and mass augmentation. The thrust augmentation ratio varied from approximately 0.9 to 1.1. Although the ejector did not have good thrust augmentation performance, the effects of the parameters studied are believed to indicate probable trends in thrust augmenting ejectors. Author

N80-10121*# Vought Corp., Dallas, Tex.
AUGMENTING EJECTOR ENDWALL EFFECTS
J. L. Porter and R. A. Squyers *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 253-271 refs
Avail: NTIS HC A22/MF A01 CSCL 01A
Rectangular inlet ejectors which had multiple hypermixing nozzles for their primary jets were investigated for the effects of endwall blowing on thrust augmentation performance. The ejector configurations tested had both straight wall and active boundary layer control type diffusers. Endwall flows were energized and controlled by simple blowing jets suitably located in the ejector. Both the endwall and boundary layer control diffuser blowing rates were varied to determine optimum performance. High area ratio diffusers with insufficient endwall blowing showed endwall separation and rapid degradation of thrust performance. Optimized values of diffuser boundary layer control and endwall nozzle blowing rates in an ejector augmenter were shown to achieve high levels of augmentation performance for maximum compactness. K.L.

N80-10122*# Rockwell International Corp., Columbus, Ohio. Columbus Aircraft Div.
AN INVESTIGATION OF CORNER SEPARATION WITHIN A THRUST AUGMENTER HAVING COANDA JETS Final Report
M. R. Seiler *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 273-293 refs

(Contract N62269-76-C-0402)
(NADC-76153-30) Avail: NTIS HC A22/MF A01 CSCL 01A
The development of separation in corners of thrust augmentor wings having Coanda jets was investigated using hot film surface sensors and pressure transducers. Separation on the test augmentor began at a corner very close to the augmentor exit and then rapidly proceeded upstream. Measurements of the pressure fields in the corner region indicated that a modified form of the Stratford criterion could be used to predict the onset of separation. Testing was conducted over a range of nozzle pressure ratios, aspect ratios, diffuser angles, and designs of the boundary layer and Coanda nozzles. K.L.

N80-10124*# Naval Postgraduate School, Monterey, Calif.
ENTRAINMENT CHARACTERISTICS OF UNSTEADY SUBSONIC JETS
M. F. Platzer, J. M. Simmons (Queensland Univ., Brisbane, Australia), and K. Bremhorst (Queensland Univ., Brisbane, Australia) *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 311-324 refs Submitted for publication
Avail: NTIS HC A22/MF A01 CSCL 01A
The effectiveness of jet unsteadiness in enhancing flow entrainment was assessed. It was conducted that entrainment depends on the type and amount of jet unsteadiness. Apparently, the mere introduction of jet unsteadiness by small sinusoidal flow angle variations is insufficient to enhance entrainment but, it should be noted that the results were obtained at measuring stations which are all many nozzle widths downstream of the jet nozzle. Thus, no fully conclusive statement can be made at this time about the entrainment close to the nozzle. The high entrainment of the fluidically oscillated jet was caused by the high-frequency content of this square wave type of oscillation but more detailed measurements are clearly needed, in particular for the fluidically oscillated and the pulsed jets. Practical ejector application requires the proper trade-off between entrainment and primary nozzle thrust efficiency. M.M.M.

N80-10125*# Calgary Univ. (Alberta). Dept. of Mechanical Engineering.
A SIMPLE APPARATUS FOR THE EXPERIMENTAL STUDY OF NON-STEADY FLOW THRUST-AUGMENTER EJECTOR CONFIGURATIONS
J. M. Khare and J. A. C. Kentfield *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejector Sep. 1979 p 325-349 refs
Avail: NTIS HC A22/MF A01 CSCL 01A
A flexible, and easily modified, test rig is described which allows a one dimensional nonsteady flow stream to be generated, economically from a steady flow source of compressed air. This nonsteady flow is used as the primary stream in a nonsteady flow ejector constituting part of the test equipment. Standard piezo-electric pressure transducers etc. allow local pressures to be studied, as functions of time, in both the primary and secondary (mixed) flow portions of the apparatus. Provision is also made for measuring the primary and secondary mass flows and the thrust generated. Sample results obtained with the equipment are presented. M.M.M.

N80-10126*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PRESSURE AND VELOCITY MEASUREMENTS IN A THREE-DIMENSIONAL WALL JET
G. D. Catalano, J. B. Morton (Virginia Univ.), and R. R. Humpris (Virginia Univ.) *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 357-362 refs Presented at the AIAA 17th Aerospace Sciences Meeting, New Orleans, 15-17 Jan. 1979

(Grants NGR-47-005-219; NSF 7522488)
Avail: NTIS HC A22/MF A01 CSCL 01A
The effects on the flow fields of varying the ratio of the velocity at the exit plane of the nozzle to the outer tunnel flow are reported. The pressure-velocity correlations are taken and some trends are discussed. Emphasis is placed on comparing the coherence between the fluctuating pressure and velocity fields at various locations in the different flow configurations. M.M.M.

N80-10127*# Flight Dynamics Research Corp., Van Nuys, Calif.
CONSIDERATIONS OF SOME CRITICAL EJECTOR PROBLEMS

Morton Alperin and Jiunn-Jeng Wu *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 363-384 refs

Avail: NTIS HC A22/MF A01 CSCL 01A

Some aspects of ejector design and application, including, three dimensional effects and cross flow effects are presented. M.M.M.

N80-10129*# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Aeromechanics Div.

INTERFACE CONCERNS OF EJECTOR INTEGRATION IN V/STOL AIRCRAFT

Randall B. Lowry *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 397-415

Avail: NTIS HC A22/MF A01 CSCL 01A

A number of areas which have in the past contributed to weight, complexity, and thrust losses in the ejector-powered V/STOL vehicle were identified. Most of these interfaces taken singly do not represent a severe compromise to the vehicle; however, the bottom line is that the sum of compromises and the subsequent effects on performance, flight operations and maintenance have rendered the ejector V/STOL aircraft unattractive. In addition to some of the unique ejector/aircraft integration problems, the vehicle by virtue of having a V/STOL capability, is compromised in other areas. To be successful and acceptable, the advantages must outweight the disadvantages and simplicity with minimum penalties must be the rule. It is concluded that more emphasis must be placed on the ejector/aircraft interface for the concept to be successful. R.E.S.

N80-10130*# Lockheed-California Co., Burbank.

REACTION CONTROL SYSTEM AUGMENTATION FOR V/STOL AIRCRAFT

H. G. Streiff and R. E. Donham *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 417-436 ref

Avail: NTIS HC A22/MF A01 CSCL 01A

Advantages and problems associated with augmentation of reaction controls are discussed. The current status of compact ejector technology and the expected performance of known efficient designs for reaction control applications are presented. R.E.S.

N80-10131*# Rockwell International Corp., Columbus, Ohio. Columbus Aircraft Div.

DESIGN AND TEST OF A PROTOTYPE SCALE EJECTOR WING

L. A. Mefferd, R. E. Alden, and P. M. Bevilacqua *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 437-448

Avail: NTIS HC A22/MF A01 CSCL 01A

A two dimensional momentum integral analysis was used to examine the effect of changing inlet area ratio, diffuser area ratio, and the ratio of ejector length to width. A relatively wide range of these parameters was considered. It was found that for constant inlet area ratio the augmenation increases with the ejector length, and for constant length: width ratio the augmentation increases with inlet area ratio. Scale model tests were used to verify these trends and to examine th effect of aspect ratio. On the basis of these results, an ejector configuration was selected for fabrication and testing at a scale representative of an ejector wing aircraft. The test ejector was powered by a Pratt-Whitney F401 engine developing approximately 12,000 pounds of thrust. The results of preliminary tests indicate that the ejector develops a thrust augmentation ratio better than 1.65. R.E.S.

N80-10132*# De Havilland Aircraft Co. of Canada Ltd., Ottawa (Ontario).

THE EXTERNAL AUGMENTOR CONCEPT FOR V/STOL AIRCRAFT

D. C. Whittely *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 449-471 refs

Avail: NTIS HC A22/MF A01 CSCL 01A

The beneficial aspects of an ejector powered V/STOL concept were reviewed. The feasibility of satisfactorily incorporating an ejector system in a high performance V/STOL aircraft was investigated. The external augmentor concept, based on the use of chordwise ejector slots, is presented. It is concluded that the external augmentor concept has a basic inherent simplicity and a sufficient augmentor performance potential to make feasible a high performance V/STOL aircraft based on ejectors. R.E.S.

N80-10133*# Naval Air Systems Command, Washington, D. C.

THE XFV-12A THRUST-AUGMENTED WING (TAW) PROTOTYPE AIRCRAFT

Ron Murphy and Ernest L. Lewis *In* NASA. Ames Res. Center Workshop on Thrust Augmenting Ejectors Sep. 1979 p 473-480

Avail: NTIS HC A22/MF A01 CSCL 01A

The XFV-12A, a unique V/STOL technology prototype aircraft being developed for the Navy, is described. The innovative design features a thrust augmented wing and a canard ejector. Structural, functional, and control test performances are discussed. Static tether test results are also discussed. Assessment of test results are given along with projections for future modification areas. R.E.S.

N80-10134*# Douglas Aircraft Co., Inc., Long Beach, Calif.

AN EFFICIENT USER-ORIENTED METHOD FOR CALCULATING COMPRESSIBLE FLOW IN AN ABOUT THREE-DIMENSIONAL INLETS Final Report, Nov. 1977 - Apr. 1979

John I. Hess, Dun-Pok Mack, and Norbert O. Stockman (NASA, Lewis Res. Center) Apr. 1979 117 p refs

(Contract NAS3-21135)

(NASA-CR-159578; MDC-J7733) Avail: NTIS HC A06/MF A01 CSCL 01A

A panel method is used to calculate incompressible flow about arbitrary three-dimensional inlets with or without centerbodies for four fundamental flow conditions: unit onset flows parallel to each of the coordinate axes plus static operation. The computing time is scarcely longer than for a single solution. A linear superposition of these solutions quite rigorously gives incompressible flow about the inlet for any angle of attack, angle of yaw, and mass flow rate. Compressibility is accounted for by applying a well-proven correction to the incompressible flow. Since the computing times for the combination and the compressibility correction are small, flows at a large number of inlet operating conditions are obtained rather cheaply. Geometric input is aided by an automatic generating program. A number of graphical output features are provided to aid the user, including surface streamline tracing and automatic generation of curves of curves of constant pressure, Mach number, and flow inclination at selected inlet cross sections. The inlet method and use of the program are described. Illustrative results are presented. A.R.H.

N80-10135*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LOW-SPEED WIND-TUNNEL TESTS OF A 1/10-SCALE MODEL OF AN ADVANCED ARROW-WING SUPERSONIC CRUISE CONFIGURATION DESIGNED FOR CRUISE AT MACH 2.2

Long P. Yip Aug. 1979 265 p refs

(NASA-TM-80152) Avail: NTIS HC A12/MF A01 CSCL 01A

The low-speed longitudinal and lateral-directional characteristics of a scale model of an advanced arrow-wing supersonic cruise configuration were investigated in tests conducted at a Reynolds number of 4.19 x 10 to the 6th power based on the mean aerodynamic chord, with an angle of attack range from -6 deg to 23 deg and sideslip angle range from -15 deg to 20 deg. The effects of segmented leading-edge flaps, slotted trailing-edge flaps, horizontal and vertical tails, and ailerons and spoilers were determined. Extensive pressure data and flow visualization pictures with non-intrusive fluorescent mini-tufts were obtained. A.R.H.

N80-10136*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A FLIGHT INVESTIGATION OF PERFORMANCE AND LOADS FOR A HELICOPTER WITH NLR-1T MAIN-ROTOR BLADE SECTIONS
Charles E. K. Morris, Jr., Robert L. Tomaine, and Dariene D. Stevens Oct. 1979 176 p refs Prepared in cooperation with Army Research and Technology Labs., Hampton, Va.
(DA Proj. 1L2-62209-AH-76)
(NASA-TM-80165) Avail: NTIS HC A09/MF A01 CSCL 01A

Data on performance and rotor loads for a teetering-rotor, AH-1G helicopter flown with a main rotor that had the NLR-1T airfoil as the blade-section contour are presented. The test envelope included hover, forward-flight speed sweeps from 35 to 85 m/sec, and collective-fixed maneuvers at about 0.25 tip-speed ratio. The data set for each test point described vehicle flight state, control positions, rotor loads, power requirements, and blade motions. Rotor loads are reviewed primarily in terms of peak-to-peak and harmonic content. Lower frequency components predominated for most loads and generally increased with increased airspeed, but not necessarily with increased maneuver load factor. M.M.M.

N80-10139# Tennessee Technological Univ., Cookeville. Dept. of Engineering Science and Mechanics.
USE OF WAGNER FUNCTIONS IN AIRFOIL DESIGN OPTIMIZATION Final Report, 20 Mar. 1978 - 19 Mar. 1979
Vireshwar Sahai and Chen-Pierce Tsao May 1979 57 p refs
(Grant AF-AFOSR-3543-78; AF PROJ. 2307)
(AD-A072634; TTU-ESM-79-2; AFOSR-79-0903TR) Avail: NTIS HC A04/MF A01 CSCL 01/3

The feasibility of using a series of Wagner functions to represent airfoil contours in design procedures was investigated. It was demonstrated that a large class of airfoils can be adequately described by a relatively small number of terms. A least squares type of procedure was used to determine the unknown coefficients in the series representation. The use of Wagner function representation in thin symmetrical airfoil design was investigated. Both the direct method of analysis in which the velocity distribution is calculated for a known shape and the inverse method of design in which the airfoil shape corresponding to a specified velocity distribution is determined were considered. Standard airfoil data was used to test the suitability of the Wagner function representation, and the results were found to be satisfactory. Rapid calculations were possible even in the inverse mode since the use of Wagner functions allowed the determination of all the improper integrals that appear in thin airfoil theory in closed form. GRA

N80-10140# Analytical Methods, Inc., Bellevue, Wash.
PREDICTION OF AERODYNAMIC CHARACTERISTICS OF FIGHTER WINGS AT HIGH LIFT Interim Report, 1 Jan. - 31 Dec. 1978
Balusu M. Rao, Brian Maskew, and Frank A. Dvorak 31 Dec. 1978 57 p refs
(Contract N00014-78-C-0128; RR0141184)
(AD-A072630; ONR-CR215-258-1) Avail: NTIS HC A04/MF A01 CSCL 20/4

A basic viscous/potential flow iterative technique is developed for calculating flow on finite wings up to and beyond the stall. The procedure used is a direct adaptation and extension of successfully validated Analytical Methods, Inc. (AMI) two-dimensional CLMAX separation model to three-dimensional flows. In the potential flow program, the lifting surface is divided into a number of panels with linear and constant vorticity distributions along the chordwise and spanwise directions, respectively. The separation region is modeled in the potential flow analysis using force-free vortex sheets which require an inner iteration to establish their shapes. The program generates a new wake shape using the new separation locations together with the information from the previous iteration and the process is repeated until a convergent solution is obtained. In order to expedite the development process, several simplifying assumptions are made. However, these assumptions do not conflict with the primary objective of the present investigation which is to demonstrate the feasibility of extending the two-dimensional CLMAX separation model to three-dimensional flows. The separation flow model and the developed computer program are validated by comparing the results with wind tunnel test data for some simple cases. GRA

N80-10143# Aeronautical Research Inst. of Sweden, Stockholm.
INVESTIGATION OF THE BOUNDARY CONDITION AT A WIND TUNNEL TEST SECTION WALL FOR A LIFTING WING-BODY MIDEL AT LOW SUPERSONIC SPEED Final Report, 1 Apr. 1977 - 31 Mar. 1979
Sven-Grik Nyuberg, Sevn G. Hedman, Arthur Rizzi, and Hans Sorenson May 1979 99 p refs
(Grant AF-AFOSR-3282-77; AF Proj. 2307)
(AD-A072098; AFOSR-79-0868TR) Avail: NTIS HC A05/MF A01 CSCL 01/3

The purpose of the investigation is to study theoretically and experimentally at low supersonic speed the interference-free flow field around a lifting wing-body wind tunnel model at locations where the tunnel walls are normally situated. The undisturbed flow properties are used to establish criteria for cross flow characteristics of wave-attenuating ventilated wind tunnel walls. The flow field has been calculated theoretically by a relaxation method based on the transonic small perturbation (TSP) equation and for one sample case for the body alone with a method based on the solution of the full gas dynamic equations (the Euler equations) in a time-dependent finite volume formulation. A survey of the flow has been made experimentally with a probe in wind tunnel tests. Pressure and flow deflection in the flow field near a delta-wing-body configuration have been calculated at free stream Mach number 1.2 and at angles of attack of 0 deg and 5 deg. The same properties have been determined in wind tunnel tests at Mach number 1.15, 1.20 and 1.30 and at nominal angles of attack 0 deg, 5 deg, 15 deg and 25 deg. The theoretical results obtained using the TSP method show only qualitative agreement with experimental data and the shocks are smeared out. Theoretical results obtained by the time-dependent finite volume method for the body alone show promising agreement with experiments. GRA

N80-10147# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SYMPOSIUM ON HIGH ANGLE OF ATTACK AERODYNAMICS
Edward C. Polhamus Aug. 1979 20 p refs Symp. held at Sandefjord, Norway, 4-6 Oct. 1978 Prepared in cooperation with NASA, Langley Res. Center
(AGARD-AR-145; ISBN-92-835-1334-7) Avail: NTIS HC A02/MF A01

An overview is presented of 32 formal papers and 7 open session papers. Topics covered include: (1) studies of configurations of practical interest; (2) mathematical modelling and supporting investigations of slender wings, bodies of revolution, and body-wing configurations; (3) design methods; and (4) air intakes. A.R.H.

N80-10148*# Northwestern Univ., Evanston, Ill. Transportation Center.
FACTORS AFFECTING THE RETIREMENT OF COMMERCIAL TRANSPORT JET AIRCRAFT
Frank A. Spencer Aug. 1979 296 p refs
(Grant NsG-2149)
(NASA-CR-152308) Avail: NTIS HC A13/MF A01 CSCL 01C

The historical background of the technology and economics of aircraft replacement and retirement in the prejet era is reviewed in order to determine whether useful insights can be obtained applicable to the jet era. Significant differences between the two periods are noted. New factors are identified and examined. Topics discussed include concern over current policies regarding deregulation, regulatory reform, and retroactive noise regulations; financing and compliance legislation; aging; economic environment and inflation; technological progress; fuel efficiency and cost; and a financial perspective of replacement decisions. A.R.H.

N80-10149*# Douglas Aircraft Co., Inc., Long Beach, Calif.
CARGO LOGISTICS AIRLIFT SYSTEMS STUDY (CLASS). VOLUME 4: FUTURE REQUIREMENTS OF DEDICATED FREIGHTER AIRCRAFT TO YEAR 2008
R. J. Burby Oct. 1979 259 p refs
(Contract NAS1-14948)
(NASA-CR-158950-Vol-4) Avail: NTIS HC A12/MF A01 CSCL 01C

The 1978 fleet operations are extended to the year 1992, thus providing an evaluation of current aircraft types in meeting the ensuing increased market demand. Possible changes in the fleet mix and the resulting economic situation are defined in terms of the number of units of each type aircraft and the resulting growth in operational frequency. Among the economic parameters considered are the associated investment required by the airline, the return on investment to the airline, and the accompanying levels of cash flow and operating income. Against this background the potential for a derivative aircraft to enter fleet operations in 1985 is defined as a function of payload size and as affected by 1980 technology. In a similar manner, the size and potential for a new dedicated 1990 technology, freighter aircraft to become operational in 1995 is established. The resulting aircraft and fleet operational and economic characteristics are evaluated over the period 1994 to 2008. The impacts of restricted growth in operational frequency, reduced market demand, variations in aircraft configurations, and military participation, are assessed. A.R.H.

N80-10150*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
NAVIGATION AND METEOROLOGICAL ERROR EQUATIONS FOR SOME AERODYNAMIC PARAMETERS
Michael J. Krikorian, John Rice, and Paul Mitchell Aug. 1979 37 p
(NASA-TM-80804; Rept-79-FM-30; JSC-16074) Avail: NTIS HC A03/MF A01 CSCL 17G

Mathematical equations for the analysis of the errors that are expected in a set of postflight aerodynamic parameters are presented. The errors are due to inaccuracies in the Shuttle best estimate trajectory and in the meteorological data obtained in support of the flights. The error analysis shows that the parameter vector, Z, and its associated error covariance matrix, C sub Z, is calculated from a given state vector, X, and its associated covariance matrix, C sub X. A.W.H.

N80-10151# Civil Aeromedical Inst., Oklahoma City, Okla.
PILOT PERFORMANCE DURING SIMULATED APPROACHES AND LANDINGS MADE WITH VARIOUS COMPUTER-GENERATED VISUAL GLIDEPATH INDICATORS
Mark F. Lewis and Henry W. Mertens Sep. 1978 58 p refs
(AD-A066220; FAA-AM-79-4) Avail: NTIS HC A04/MF A01 CSCL 17/7

The effectiveness, in terms of pilot performance, of four different visual glidepath indicator systems in severely reduced nighttime visual environment is discussed. An aircraft simulator was used with a computer generated image visual system attached for visual simulation of the airport scene. The flight path profile with regard to altitude deviations from a 3 degree path as a function of distance is examined. The instability in approach paths flown with the different types of glidepath indicators is studied. Altitude deviations from the 3 degree glidepath as a function of indicator type, trials, and subjects are analyzed. A.W.H.

N80-10152*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ALGORITHMS AND LOGIC FOR INCORPORATING ILS NASA TCV B-737 AIRPLANE AREA NAVIGATION SYSTEM
Charles E. Knox Sep. 1979 23 p refs
(NASA-TM-80167) Avail: NTIS HC A02/MF A01 CSCL 17G

The algorithms and logic for use in the implementation of instrument landing system (ILS) localizer deviation signals for the generation of navigation and guidance information are presented. The navigation position estimates, based on range information from a randomly chosen distance measuring equipment (DME) and ILS localizer deviation information, are illustrated. The ILS volumetric coverage and DME geometric checks are described and their addition to area navigation systems with minimum software modification are discussed. A.W.H.

N80-10153# Federal Aviation Administration, Washington, D. C. Office of Aviation Policy.
IFR AIRCRAFT HANDLED FORECAST BY AIR ROUTE TRAFFIC CONTROL CENTER, FISCAL YEARS 1979-1990
Bernard Hannan Apr. 1979 54 p
(AD-A070786; FAA-AVP-79-1) Avail: NTIS HC A04/MF A01 CSCL 01/2

The forecasts of instrument flight rule aircraft handled by air route traffic control centers. The forecasts show that total aircraft handled will increase from 28.1 million in 1978 to 45.6 million in 1990. These numbers along with those for the intervening years are broken down by region and by each air route traffic control center. A.W.H.

N80-10173# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
INTEGRATION OF GPS WITH INERTIAL NAVIGATION SYSTEMS
Duncan B. Cox, Jr. *In* AGARD Principles and Operational Aspects of Precision Position Determination Systems 1979 10 p refs
Avail: NTIS HC A20/MF A01

Benefits and means of integrating GPS and inertial systems are described. Emphasis was placed on the data to be transferred and the operations to be performed in attaining varying degrees of integration. An understanding of the mechanisms and degrees of complexities involved was given, as well as a perspective on the technical issues that are involved in the integration problem. It was concluded that very substantial performance improvements can be obtained through integration of GPS and inertial systems in comparison to what can be achieved by either system alone. Some of the improvements are only achieved through substantial increases in system complexity. M.M.M.

N80-10175# Gilbert (Glen A.) and Associates, Washington, D. C.
CIVIL APPLICATIONS OF NAVSTAR GPS
Glen A. Gilbert, E. H. Martin (Magnavox Government and Industrial Electronics Co., Silver Spring, Md.), Denis Symes (Urban Mass Transportation Adminstration), and Carl Matthews (Maritime Administration) *In* AGARD Principles and Operational Aspects of Precision Position Determination Systems 1979 26 p refs
Avail: NTIS HC A20/MF A01

Various aspects of potential civil applications of the U.S. Department of Defense satellite based NAVSTAR Global Positioning System (GPS) are discussed. Land, sea and air applications are covered. It was concluded that the GPS offers many promising potential civil applications. However, certain questions need to be resolved before international civil application of GPS can be implemented. M.M.M.

N80-10192 North Carolina State Univ. at Raleigh.
STRUCTURAL STIFFENING AS AN INTERIOR NOISE CONTROL TECHNIQUE FOR LIGHT TWIN-ENGINE AIRCRAFT Ph.D. Thesis
Clyde Kearney Barton 1979 102 p
Avail: Univ. Microfilms Order No. 7923034

Cabin noise levels in light aircraft due to the transmission of low frequency propeller noise through the fuselage sidewall is examined. The concept of adding stiffness to a light, twin engine aircraft to reduce cabin noise levels is investigated. The attenuation provided by the fuselage sidewall before and after the installation of a suitable treatment is determined. A mass treatment was added and a comparison is presented. Dissert. Abstr.

N80-10193*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTS IN SENSING TRANSIENT ROTATIONAL ACCELERATION CUES ON A FLIGHT SIMULATOR
Russell V. Parrish Oct. 1979 24 p refs
(NASA-TP-1537; L-13030) Avail: NTIS HC A02/MF A01 CSCL 01C

Results are presented for two transient motion sensing experiments which were motivated by the identification of an anomalous roll cue (a 'jerk' attributed to an acceleration spike) in a prior investigation of realistic fighter motion simulation. The experimental results suggest the consideration of several issues for motion washout and challenge current sensory system modeling efforts. Although no sensory modeling effort is made it is argued that such models must incorporate the ability to handle transient inputs of short duration (some of which are less than the accepted latency times for sensing), and must represent separate channels for rotational acceleration and velocity sensing. A.R.H.

N80-10194# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
FLYING QUALITIES RESEARCH FOR HIGHLY AUGMENTED AIRCRAFT
H. T. Breul and R. C. Weston Aug. 1979 104 p refs
(RE-582) Avail: NTIS HC A06/MF A01

An introductory, single degree of freedom experimental study of aircraft roll control was performed to demonstrate the feasibility of doing flying qualities research via direct manipulation of an aircraft's step response on a flight simulator. This is a very attractive approach for studying the flying qualities requirements of modern aircraft that is expected to incorporate new and sophisticated digital fly by wire control schemes for coordinating all control forces to produce nonclassical responses to pilot commands. The development of a digital simulation technique, based on the mathematical concept of convolution, that provides the means for easy manipulation of the simulated vehicle's step-response characteristics is presented. Two experiments were performed that examined several basic characteristics of an aircraft's roll-rate step-response in a simulated tracking task. M.M.M.

N80-10195*# Teledyne Ryan Aeronautical Co., San Diego, Calif.
STUDY OF THE FEASIBILITY ASPECTS OF FLIGHT TESTING AN AEROELASTICALLY TAILORED FORWARD SWEPT RESEARCH WING ON A BQM-34F DRONE VEHICLE
D. J. Mourey 3 Sep. 1979 409 p refs
(Contract NAS1-15624)
(NASA-CR-159149) Avail: NTIS HC A18/MF A01 CSCL 01C

The aspects of flight testing an aeroelastically tailored forward swept research wing on a BQM-34F drone vehicle are examined. The geometry of a forward swept wing, which is incorporated into the BQM-34F to maintain satisfactory flight performance, stability, and control is defined. A preliminary design of the aeroelastically tailored forward swept wing is presented. A.W.H.

N80-10196# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A STUDY TO DEVELOP OPTIMIZATION ALGORITHMS FOR AIRCRAFT WING STRUCTURES M.S. Thesis
Gerald W. Abbott and Robert A. McNamara, Jr. Jun. 1979 135 p refs
(AD-A072668; AFIT-LSSR-23-79A) Avail: NTIS HC A07/MF A01 CSCL 01/3

Increasing cost and complexity of major weapon systems have resulted in many methods that constrain cost while assuring development of weapon systems that meet the military need. Among these methods, the use of cost estimating relationships embodied in computerized mathematical modeling has come to the forefront. This research uses the Vehicle Design Evaluation Program (VDEP), a model which designs a least-weight aircraft. Since a least-weight aircraft may not be a least-cost aircraft, this research examined the feasibility of developing algorithms to relate least-cost to design using VDEP. Various graphic and statistical techniques failed to yield meaningful relationships. Additional analysis revealed apparent discrepancies in VDEP structural synthesis routines. Further research is recommended using more advanced design/cost models which incorporate revised structural synthesis routines. These models should first be validated for proper design/cost estimating properties. Then research should be conducted to identify cost driving parameters and detailed variable relationships. In this way the attainment of minimum cost aircraft structures which meet mission needs will materialize. GRA

N80-10197# Anamet Labs., Inc., San Carlos, Calif. Applied Mechanics Div.
ANGULAR VIBRATION OF AIRCRAFT. VOLUME 1: EXECUTIVE SUMMARY Final Report, Aug. 1977 - Apr. 1979
Conor D. Johnson, Warren C. Gibson, David A. Kienholz, and Ernest B. Paxson Wright-Patterson AFB, Ohio AFFDL Apr. 1979 52 p refs 2 Vol.
(Contract F33615-77-C-3050; AF Proj. 2401)
(AD-A071895; AFFDL-TR-79-3045-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 20/11

This report describes development work in several distinct areas, all related to prediction of angular vibration of aircraft structures. Angular vibration in this context refers to dynamic rotations or changes in slope at specific points on a vibrating structure. It is of interest primarily in connection with high resolution optical and electro-optical systems. Efforts were directed at both low frequency vibration, where individual normal modes are known, as well as high frequency vibration where they are not. For low frequency predictions, improved accuracy per unit cost was sought by an evolutionary improvement to an existing finite element code. A state-of-the-art shell element, the Semi-Loof, was incorporated into NASTRAN by means of pre- and post-processors and DMAP instructions. Its accuracy is tested against both closed form solutions for simple cases and experiment for an actual fuselage. For high frequency predictions the method of Statistical Energy Analysis was pursued. A demonstration case involving two coupled plates is presented to show how SEA may be used to predict angular vibration in a situation where normal modes are too numerous to be predicted individually. Relationships between linear and angular vibration were developed for various structural forms. Theoretical error bounds are also derived for spectral measurements of angular vibration which are obtained by differencing of signals from translational sensors. GRA

N80-10198# Anamet Labs., Inc., San Carlos, Calif. Applied Mechanics Div.
ANGULAR VIBRATION OF AIRCRAFT. VOLUME 2: PREDICTION METHODS FOR ANGULAR VIBRATION Final Report, Aug. 1977 - Apr. 1979
Conor D. Johnson, Warren C. Gibson, David A. Kienholz, and Ernest B. Paxson Wright-Patterson AFB, Ohio AFFDL Apr. 1979 459 p refs 2 Vol.
(Contract F33615-77-C-3050; AF Proj. 2401)
(AD-A071749; AFFDL-TR-TA-3045-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report describes development work in several distinct areas, all related to prediction of angular vibration of aircraft structures. Angular vibration in this context refers to dynamic rotations or changes in slope at specific points on a vibrating structure. It is of interest primarily in connection with high resolution optical and electro-optical systems. Efforts were directed at both low frequency vibration, where individual normal modes are known, as well as high frequency vibration where they are not. For low frequency predictions, improved accuracy per unit cost was sought by an evolutionary improvement to an existing finite element code. For high frequency predictions the method of Statistical Energy Analysis was pursued. GRA

N80-10199# Civil and Environmental Engineering Development Office, Tyndall AFB, Fla.
A LITERATURE SEARCH AND REVIEW OF THE DYNAMICS OF AIRCRAFT-SURFACE INTERACTION Final Report, 1 Oct. 1977 - 31 May 1978

Joseph J. Cox, Jr. (USAF Academy, Colo.), William M. Henghold (USAF Academy, Colo.), and John J. Russell (USAF Academy, Colo.) Jun. 1979 61 p refs
(AF Proj. 2104)
(AD-A070940; CEEDO-TR-78-39) Avail: NTIS HC A04/MF A01 CSCL 01/5

This report presents a literature survey and review of the research concerned with the dynamics of aircraft-surface interaction. Of primary concern is the determination of surface roughness criteria based on how rough the surface can be without inducing structural damage in the aircraft. Attention is concentrated on analytical research in the form of computer simulation that deals with the aircraft response as a function of the input (external excitation), vehicle model, and the output. Basic conclusions include the fact that no current computer code is satisfactory, but that one could be formulated within the state-of-the-art, to correlate with on-going actual aircraft tests. To facilitate correlation the roll, yaw, and lateral degrees of freedom should be included and a fatigue analysis for the test aircraft should be made. GRA

N80-10200# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
LEXICON OF AIRCRAFT TRANSPARENCY TERMS
Cletus J. Muick Dec. 1978 65 p refs
(AF Proj. 7184)
(AD-A071319; AMRL-TR-78-122) Avail: NTIS HC A04/MF A01 CSCL 01/3

This lexicon deals with terms and definitions peculiar to personnel working with aircraft transparent enclosures. All types of material currently used in the fabrication of transparent enclosures (acrylic, glass, polycarbonate) is addressed. Terms are either specific or general when applied to materials; and vision /optics terms, in most instances, are common to windscreens, canopies, and windows. GRA

N80-10201# Air Force Weapons Lab., Kirtland AFB, N. Mex.
AIRBLAST VULNERABILITY ENVELOPES FOR SUPERSONIC AEROSPACE VEHICLES Final Report
Gerald M. Campbell Mar. 1979 30 p
(AF Proj. 8809)
(AD-A072247; AD-E200312; AFWL-TR-78-187) Avail: NTIS HC A09/MF A01 CSCL 19/4

A procedure for constructing airblast vulnerability envelopes for supersonic vehicles has been derived which enables the analyst to determine which portions of the envelope are valid. For simplicity, an overpressure of 1 lb/sq in. is used as a damage criterion throughout this report and nonhomogeneous atmosphere effects are ignored. Maximum and minimum shock front velocities are derived for the catching curve as well as the lower limit for the detonation orientation angle theta. GRA

N80-10202# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AGARD TWO-DIMENSIONAL AEROELASTIC CONFIGURATIONS
S. R. Bland, Comp. Aug. 1979 16 p refs Submitted for publication Prepared in cooperation with NASA Langley Res. Center
(AGARD-AR-156) Avail: NTIS HC A02/MF A01

The development of reliable, efficient methods for the calculation of unsteady aerodynamic forces in the frequency-critical transonic speed regime can be enhanced by the availability of a limited number of test cases for the comparison of competing methods. Seven test cases are presented for airfoils with thickness from 6.0% to 16.5%: a biconvex parabolic arc airfoil, three conventional airfoils, and three cambered supercritical airfoils. The aerodynamic conditions such as Mach number, mean angle of attack, and oscillation amplitude and frequency are also given. Recommendations are made for uniformity in definition and reporting to enhance desired comparison for the aeroelastician. A.R.H.

N80-10203# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
MANOEUVRE LIMITATIONS OF COMBAT AIRCRAFT
Aug. 1979 33 p refs
(AGARD-AR-155A; ISBN-92-835-1336-3) Avail: NTIS HC A03/MF A01

The choice of aircraft detail arrangement and configuration is closely related to desired flight speed, altitude and maneuverability. The maneuver limitations that are directly related to configuration, flight speed and attitude are reasonably independent of airplane size and engine thrust. These limiting flight characteristics include pitchup, wing rock, wing drop, nose slice, and buffeting. These configuration and detail-sensitive limitations and the aircraft characteristics that cause them are discussed for 15 NATO aircraft. A.R.H.

N80-10204*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
AERO-ACOUSTIC TESTS OF DUCT-BURNING TURBOFAN EXHAUST NOZZLES
Hilary Kozlowski and Allan B. Packman Jul. 1976 142 p refs
(Contract NAS3-17866)
(NASA-CR-162254; PWA-5296) Avail: NTIS HC A07/MF A01 CSCL 01E

The acoustic and aerodynamic characteristics of several exhaust systems suitable for duct burning turbofan engines are evaluated. Scale models representing unsuppressed coannular exhaust systems are examined statically under varying exhaust conditions. Ejectors with both hardwall and acoustically treated inserts are investigated. A.W.H.

N80-10205*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROPROPULSION 1979
1979 464 p Proceedings of conf. held at Cleveland, Ohio, 1-16 May 1979
(NASA-CP-2092; E-079) Avail: NTIS HC A20/MF A01 CSCL 21E

State of the art technology in aeronautical propulsion is assessed. Noise and air pollution control techniques, advances in supersonic propulsion for transport aircraft, and composite materials and structures for reliable engine components are covered along with engine design for improved fuel consumption.

N80-10206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT ENERGY EFFICIENCY (ACEE) STATUS REPORT
Donald L. Nored, James F. Dugan, Jr., Neal T. Saunders, and Joseph A. Ziemianski *In its* Aeropropulsion 1979 1979 p 1-58 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

Fuel efficiency in aeronautics, for fuel conservation in general as well as for its effect on commercial aircraft operating economics is considered. Projects of the Aircraft Energy Efficiency Program related to propulsion are emphasized. These include: (1) engine component improvement, directed at performance improvement and engine diagnostics for prolonged service life; (2) energy efficient engine, directed at proving the technology base for the next generation of turbofan engines; and (3) advanced turboprop, directed at advancing the technology of turboprop powered aircraft to a point suitable for commercial airline service. Progress in these technology areas is reported. J.M.S.

N80-10207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMISSION REDUCTION
Donald A. Petrash, Larry A. Diehl, Robert E. Jones, and Edward J. Mularz *In its* Aeropropulsion 1979 1979 p 59-84

Avail: NTIS HC A20/MF A01 CSCL 21E

Control of the gaseous pollutant emissions of aircraft engines is considered in terms of the emission standards for six classes of aircraft engines. Emphasis is placed on combustor design concepts to significantly reduce emissions levels and lean-burning techniques to lower flame temperature, to reduce the oxides of nitrogen in the gaseous emissions. J.M.S.

N80-10208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE REDUCTION
Charles E. Feiler, John F. Groeneweg, Francis J. Montegani, John P. Raney (NASA. Langley Research Center), Edward J. Rice, and James R. Stone *In its* Aeropropulsion 1979 1979 p 85-128 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

The turbofan engine's noise-producing components are discussed in terms of efficient and economical noise reduction techniques that do not penalize the engine performance or weight significantly. Specific topics covered include fan noise, acoustic suppression, jet noise technology, combustor noise, and aircraft noise prediction. J.M.S.

N80-10209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALTERNATIVE JET AIRCRAFT FUELS
Jack Grobman *In its* Aeropropulsion 1979 1979 p 129-148 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

Potential changes in jet aircraft fuel specifications due to shifts in supply and quality of refinery feedstocks are discussed with emphasis on the effects these changes would have on the performance and durability of aircraft engines and fuel systems. Combustion characteristics, fuel thermal stability, and fuel pumpability at low temperature are among the factors considered. Combustor and fuel system technology needs for broad specification fuels are reviewed including prevention of fuel system fouling and fuel system technology for fuels with higher freezing points. J.M.S.

N80-10210*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIALS AND STRUCTURES TECHNOLOGY
Robert A. Signorelli, Thomas K. Glasglow, Gary R. Halford, and Stanley R. Levine *In its* Aeropropulsion 1979 1979 p 149-186 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

Materials and structures performance limitations, particularly for the hot section of the engine in which these limitations limit the life of components, are considered. Failure modes for components such as blades, vanes, and combustors and how they are affected by the environment for such components are discussed. Methods used to improve the materials used for such components are: (1) application of directional structures to turbine components for high strength at high temperatures; (2) improved coatings to increase oxidation and corrosion resistance; (3) increase strength and stiffness with reduced weight by applying higher specific properties of composite materials; and (4) cost effective processing such as near net shape powder methods applied to disks. Life prediction techniques developed to predict component life accurately in advance of service and progress in improving the intermediate and cold section components of turbine engines are covered. J.M.S.

N80-10211*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTATIONAL FLUID MECHANICS OF INTERNAL FLOW
David N. Bowditch, William D. Mcnally, Bernhard H. Anderson, John J. Adamczyk, and Peter M. Sockol *In its* Aeropropulsion 1979 1979 p 187-230 refs

Avail: NTIS HC A20/MF A01 CSCL 21E

Major solution techniques for internal computational fluid mechanics are discussed and some examples are presented. The major steps involved in developing a large computer code are then discussed. R.E.S.

N80-10212*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TURBOMACHINERY TECHNOLOGY
Cavour H. Hauser, Jeffrey E. Haas (U.S. Army Res. and Technol. Labs., Cleveland, Ohio), Lonnie Reid, and Francis S. Stepka *In its* Aeropropulsion 1979 1979 p 231-272
Avail: NTIS HC A20/MF A01 CSCL 21E

A technology assessment of turbomachinery is presented. The design of the fan, compressor, and turbine components for future advanced aircraft engines is discussed. Basic flow characteristics in compressors and turbines and the heat transfer phenomena in cooled turbines are also discussed. R.E.S.

N80-10213*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANICAL COMPONENTS
William J. Anderson, Robert C. Bill, John J. Coy, and David Fleming *In its* Aeropropulsion 1979 1979 p 273-308 ref

Avail: NTIS HC A20/MF A01 CSCL 21E

Research on bearings, gears, seals, and rotor dynamics (specifically high speed balancing and dampers) is presented. The research pertains to problems in both aircraft turbine engines and helicopter transmissions. R.E.S.

N80-10215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTROL TECHNOLOGY
John R. Szuch *In its* Aeropropulsion 1979 1979 p 329-344 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

An overview of engine control technology is presented with emphasis on gas turbine engine controls. The role of the government, and NASA in particular, in advancing this technology is discussed. R.E.S.

N80-10216*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC PROPULSION TECHNOLOGY
Albert G. Powers, Robert E. Coltrin, Leonard E. Stitt, Richard J. Weber, and John B. Whitlow, Jr. *In its* Aeropropulsion 1979 1979 p 345-386
Avail: NTIS HC A20/MF A01 CSCL 21E

Propulsion concepts for commercial supersonic transports are discussed. It is concluded that variable cycle engines, together with advanced supersonic inlets and low noise coannular nozzles, provide good operating performance for both supersonic and subsonic flight. In addition, they are reasonably quiet during takeoff and landing and have acceptable exhaust emissions. K.L.

N80-10217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYPERSONIC PROPULSION
H. Lee Beach, Jr. *In its* Aeropropulsion 1979 1979 p 387-408 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

Research on hydrogen fueled scramjet engines for hypersonic flight is reviewed. Component developments, computational methods, and preliminary ground tests of subscale scramjet engine modules at Mach 4 and 7 are emphasized. Airframe integration, structures, and flow diagnostics are also discussed. It is shown that mixed-mode perpendicular and parallel fuel injection controls heat release over a wide Mach range and the fixed geometry inlet gives good performance over a wide range of Mach numbers. K.L.

N80-10218*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VERTICAL TAKEOFF AND LANDING (VTOL) PROPULSION TECHNOLOGY
Carl C. Ciepluch, John M. Abbott, Royce D. Moore, and James F. Sellers *In its* Aeropropulsion 1979 1979 p 409-444 refs

Avail: NTIS HC A20/MF A01 CSCL 21E

Propulsion problems and advanced technology requirements of VTOL aircraft are discussed. Specific topics covered include inlets with high angle of attack capability, rapid thrust modulation fans, and propulsion-system/aircraft-control integration. K.L.

N80-10219*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-PERFORMANCE-VEHICLE TECHNOLOGY

Louis A. Povinelli *In its* Aeropropulsion 1979 1979 p 445-462 refs
Avail: NTIS HC A20/MF A01 CSCL 21E

Propulsion needs of high performance military aircraft are discussed. Inlet performance, nozzle performance and cooling, and afterburner performance are covered. It is concluded that nonaxisymmetric nozzles provide cleaner external lines and enhanced maneuverability, but the internal flows are more complex. Swirl afterburners show promise for enhanced performance in the high altitude, low Mach number region. K.L.

N80-10220*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
FLIGHT EFFECTS ON THE AERO/ACOUSTIC CHARACTERISTICS OF INVERTED PROFILE COANNULAR NOZZLES
Hilary Kozlowski and Allan B. Packman Feb. 1978 195 p refs
(Contract NAS3-17866)
(NASA-CR-162419; PWA-5501) Avail: NTIS HC A09/MF A01 CSCL 21E

The effect of simulated flight speed on the acoustic and aerodynamic characteristics of coannular nozzles is examined. The noise and aerodynamic performance of the coannular nozzle exhaust systems over a large range of operating flight conditions is presented. The jet noise levels of the coannular nozzles are discussed. The impact of fan to primary nozzle area ratio and the presence of an ejector on flight effects are investigated. The impact of flight speed on the individual components of the coannular jet noise was ascertained. A.W.H.

N80-10221*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
EXPERIMENTAL EVALUATION OF A LOW EMISSIONS HIGH PERFORMANCE DUCT BURNER FOR VARIABLE CYCLE ENGINES (VCE) Final Report
R. P. Lohman and R. J. Mador 1979 117 p refs
(Contract NAS3-20602)
(NASA-CR-159694; PWA-5513-32) Avail: NTIS HC A05/MF A01 CSCL 21E

A three-stage Vorbix duct burner was evaluated to determine the performance and emissions characteristics of this concept and to refine the configuration to provide acceptable durability and operational characteristics for its use in the VCE Testbed Program. The tests were conducted at representative takeoff, transonic climb and supersonic cruise inlet conditions for the VSCE-502B study engine. The carbon monoxide and unburned hydrocarbon emissions were low at all three operating conditions with combustion efficiencies in excess of 99.7 percent, as compared to the goal of 99.0 percent. Nitric oxide emissions were moderate but in excess of the program goal of 1 gm/kg at takeoff. The thrust efficiency exceeded the goal level of 94.5 percent reaching a value of 97 percent at supersonic cruise. Soft ignition, the absence of combustion generated acoustic instabilities and liner temperature levels acceptable for experimental hardware were also demonstrated. The total pressure loss across the duct burner, at 6.76 the loss mechanisms have been indentified and, in one configuration 40 percent of this excess loss was eliminated without comprising the emissions or thrust efficiency. A.R.H.

N80-10222*# Pratt and Whitney Aircraft, East Hartford, Conn. Chemical Products Div.
VSCE TECHNOLOGY DEFINITION STUDY Final Report
R. A. Howlett and R. B. Hunt Aug. 1979. 114 p refs
(Contract NAS3-21389)
(NASA-CR-159730; PWA-5630-11) Avail: NTIS HC A06/MF A01 CSCL 21E

Refined design definition of the variable stream control engine (VSCE) concept for advanced supersonic transports is presented. Operating and performance features of the VSCE are discussed, including the engine components, thrust specific fuel consumption, weight, noise, and emission system. A preliminary engine design is presented. A.W.H.

N80-10223# Southwest Research Inst., San Antonio, Tex.
MECHANISM OF TURBINE ENGINE LUBRICANT DEPOSITION Final Report, 31 Mar. 1978 - 2 Feb. 1979
J. P. Cuellar, Jr. May 1979 64 p refs
(Contract F33615-76-C-2020; AF PROJ. 3048)
(AD-A072557; SwRi-RS-662; AFAPL-TR-79-2037) Avail: NTIS HC A04/MF A01 CSCL 11/8

An investigation of the degradation and deposition mechanisms for inhibited polyol ester and diester lubricant basestocks is described. Basestocks trimethylolpropane triheptanoate and di(2-ethylhexyl) adipate containing antioxidants p, p,p' dioctyldiphenylamine and/or phenyl-alpha-naphtylamine were studied in a dynamic thin-film condition with a moist-air atmosphere. Experiments were conducted with a device known as the rotating cylinder rig for the formation of controlled-thickness thin films (0.004 in.) at temperatures in the range of 350 to 550 F. Analytical techniques for detection of lubricant or additive consumption and degradation products included gas liquid chromatography, principally, and gas chromatography/mass spectroscopy. Experiments showed that the antioxidants effectively retarded oxidation and deposition for both ester basestocks up to the time of complete additive consumption. A beneficial synergistic effect on deposition was noted at one concentration using the antioxidants in combination. Findings strongly suggest that an interaction between the ester oxidation products and system wearmetals is a significant factor in the deposition mechanism for both ester types. GRA

N80-10224*# Delco Electronics, Santa Barbara, Calif.
ELECTROMECHANICAL FLIGHT CONTROL ACTUATOR Final Report
Feb. 1979 129 p
(Contract NAS9-14952)
(NASA-CR-160348; R79-2) Avail: NTIS HC A07/MF A01 CSCL 01C

The feasibility of using an electromechanical actuator (EMA) as the primary flight control equipment in aerospace flight is examined. The EMA motor design is presented utilizing improved permanent magnet materials. The necessary equipment to complete a single channel EMA using the single channel power electronics breadboard is reported. The design and development of an improved rotor position sensor/tachometer is investigated. A.W.H.

N80-10225*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
COMPARISON OF STABILITY AND CONTROL PARAMETERS FOR A LIGHT, SINGLE-ENGINE, HIGH-WINGED AIRCRAFT USING DIFFERENT FLIGHT TEST AND PARAMETER ESTIMATION TECHNIQUES
William T. Suit and Robert L. Cannaday Sep. 1979 54 p refs
(NASA-TM-80163) Avail: NTIS HC A04/MF A01 CSCL 01C

The longitudinal and lateral stability and control parameters for a high wing, general aviation, airplane are examined. Estimations using flight data obtained at various flight conditions within the normal range of the aircraft are presented. The estimations techniques, an output error technique (maximum likelihood) and an equation error technique (linear regression), are presented. The longitudinal static parameters are estimated from climbing, descending, and quasi steady state flight data. The lateral excitations involve a combination of rudder and ailerons. The sensitivity of the aircraft modes of motion to variations in the parameter estimates are discussed. A.W.H.

N80-10226# Salford Univ. (England). Dept. of Aeronautical and Mechanical Engineering.
MULTIVARIABLE DIGITAL CONTROL SYSTEMS Final Report, 1 Jun. 1976 - 31 May 1979
B. Porter Jun. 1979 180 p refs
(Grant AF-AFOSR-3005-76)
(AD-A071662; USAME/DC/101/79) Avail: NTIS HC A09/MF A01 CSCL 09/2

The fundamental system-theoretic research and the parallel development of design techniques which have led to the production of the comprehensive software package EIGENFORTRAC are outlined. The capability of EIGENFORTRAC in relation to the computer-aided design of high-performance digital control systems whose functions are simultaneously to reject the unmeasurable

disturbances and to track multiple command inputs is described. Numerous references are provided to the system-theoretic research and to the computer algorithms embodied in EIGENFORTRAC. GRA

N80-10227# California Univ., Los Angeles. School of Engineering and Applied Science.
METHOD OF CONJUGATE GRADIENTS FOR OPTIMAL CONTROL PROBLEMS WITH STATE VARIABLE CONSTRAINTS Final Report, May 1977 - May 1978
T. S. Fong and C. T. Leondes Jul. 1976 94 p refs
(Contracts F33615-77-C-3013; AF Proj. 3207)
(AD-A072258; AFFDL-TR-78-85) Avail: NTIS HC A05/MF A01 CSCL 12/1

A review of the computational method of conjugate gradients for linear and nonlinear operator equations is given with emphasis in applying this technique to state variable constraint control problems. The first and second Frechet derivatives of the performance functional are derived. The search directions generated in the iteration process for the optimal control are locally conjugate with respect to the second Frechet derivative. The convergence is along the expanding sequence of sets, the intersection of the linear spaces spanned by the search directions and the set of admissible controls. The computational technique is applied to two state variable constraint problems, in one of which a penalty function is employed to convert the constraint problem to an unconstrained one in addition to the approach considering the constraints directly. For this same problem the method of steepest descent also is studied, and comparison of the results obtained is made and discussed. GRA

N80-10228# Kaman Aerospace Corp., Bloomfield, Conn.
DESIGN CRITERIA FOR DRY LUBRICATED FLIGHT CONTROL BEARINGS Final Report, 22 Jun. 1976 - Mar. 1978
Edward J. Nagy May 1979 180 p
(Contract DAAJ02-76-C-0035; DA Proj. 1F2-62209-AH-76)
(AD-A071322; R-1456; USARTL-TR-79-17) Avail: NTIS HC A09/MF A01 CSCL 01/3

The objective of this program was to develop analytical methods for the selection of dry lubricated helicopter control bearings for specific conditions of use. The conditions of use include static radial pressure, cyclic radial pressure, speed of ball oscillation, angle of ball oscillation, static axial load, contamination, and combinations of these variables. Performance was measured by radial clearance which was directly related to wear. Sixty-one bearings were tested in three wear test rigs. The wear test results were used to develop wear life equations. Three approaches to equation development were utilized in this report: empirical, deterministic, and theoretical. GRA

N80-10229# California Univ., Los Angeles. School of Engineering and Applied Science.
MAXIMUM LIKELIHOOD IDENTIFICATION OF LINEAR DISCRETE STOCHASTIC SYSTEMS Final Report, May 1977 - May 1978
A. J. Glassman and C. T. Leondes Wright-Patterson AFB, Ohio AFFDL Jul. 1978 205 p refs
(Contract F33615-77-C-3013; AF Proj. 2307)
(AD-A072147; AFFDL-TR-78-84) Avail: NTIS HC A10/MF A01 CSCL 12/2

The method of maximum likelihood is applied to the identification of parameters in systems described by linear difference equations. The equations are assumed to be completely known except for the state variable coefficients, i.e., the state transition matrix, and, in certain situations, the initial conditions. The estimates are based on known normal operating input and on output measurements corrupted by additive Gaussian noise. Maximum likelihood estimators of the parameters are developed for the following four cases: initial condition known, initial condition unknown parameter, initial condition unknown random variable, and an equivalent equation-error model configuration. Finite sample and asymptotic properties of the estimators as well as computational aspects are investigated. The study is oriented toward real time applications. Application of maximum likelihood to the above four cases differs from the classical situation in statistics because the measurements are not identically distributed, or are not independent, or both. The resulting estimates are roots or cumbersome nonlinear equations. GRA

N80-10233# Air Force Human Resources Lab., Brooks AFB, Tex.
ADVANCED SIMULATOR FOR PILOT TRAINING (ASPT): G-SEAT OPTIMIZATION Interim Report, May 1977 - Apr. 1978
Dan C. McGuire (Williams AFB, Ariz.) and David R. Lee (Williams AFB, Ariz.) Feb. 1979 35 p refs
(AF Proj. 1123)
(AD-A068475; AFHRL-TR-78-92) Avail: NTIS HC A03/MF A01 CSCL 05/9

This report documents Phase I (of III) of a project to optimize the effectiveness of the ASPT g-seat in terms of both hardware and software performance. The transport lag was reduced to 20 ms by moving the Conoflow valves to the platform and using higher diameter hoses. The time constant was reduced to 150 ms by using larger diameter hoses, changing the needle valve location, and optimizing the settings of the booster and needle valve adjustments. The software has been reorganized, improved, streamlined and documented so that it may be more readily used to determine the most effective drive techniques. The optimized system will be used in a Phase II to determine the most effective drive technique and in a Phase III which will emulate new g-cueing devices, geometries, and drive schemes. GRA

N80-10235# Systems Technology, Inc., Hawthorne, Calif.
MANNED ENGINEERING FLIGHT SIMULATION VALIDATION, PART 1. SIMULATION REQUIREMENTS AND SIMULATOR MOTION SYSTEM PERFORMANCE Final Report, Aug. 1977 - Nov. 1978
L. G. Hoffman and Susan A. Riedel Feb. 1979 209 p
(Contract F33615-77-C-2065)
(AD-A071394; AFFDL-TR-78-192-Pt-1; STI-TR-1110-1) Avail: NTIS CSCL 14/2

The goal of this research is to establish an orderly, relatively simple method for optimizing the presentation of motion cues in moving base simulations. This is accomplished via choice of the drive logic parameters for a given simulator and flying task. The method developed here is based upon use of motion fidelity criteria. It has been applied to optimize the LAMARS motion base drive logic parameters for an air-to-ground scenario. The methods and procedures of this report can be applied for any given motion base and any desired scenario. Criteria for discerning fidelity of motion reproduction are developed. These criteria are composed of various mean-square error measures which reflect differences between simulated and actual in-flight motion. The criteria can be used to answer three questions which arise for every motion base simulation program: is moving base simulation appropriate for the flying tasks to be investigated, how can motion base drive logic parameters be optimized for the flying tasks to be investigated, and will this set of motion drive logic parameters result in motion within simulator capabilities for the flying tasks to be investigated. GRA

N80-10236# Army Research Inst. for the Behavioral and Social Sciences, Arlington, Va.
TRAINING EFFECTIVENESS OF THE CH-47 FLIGHT SIMULATORS
Garvin L. Holman May 1979 91 p refs
(DA Proj. 2Q2-63743-A-772)
(AD-A072317; ARI-RR-1209) Avail: NTIS HC A05/MF A01 CSCL 05/9

The training effectiveness of the CH-47 helicopter flight simulator was evaluated in two parts: Part I used a classical two-group transfer-of-training design using aviators undergoing transition training to the CH-47 helicopter, and Part II assessed the training benefits of periodic training of operational CH-47 aviators in the CH-47 flight simulator using a pretest-train-post test design. Cumulative transfer effectiveness ratios and learning curves are presented for 24 maneuvers taught in the simulator and the aircraft. It was concluded that the CH-47 flight simulator is an effective training device for all maneuvers tested except for those, such as hovering maneuvers, that require extensive

visual group referencing at very low altitudes. The simulator was also found to be inadequate for training night operations and terrain flights. GRA

N80-10237# Air Force Human Resources Lab., Brooks AFB, Tex.
SIMULATOR FOR AIR-TO-AIR COMBAT MOTION SYSTEM INVESTIGATION Final Report
John A. Seevers (Calif. State Polytech. Univ., Pomona) and Robert L. Makinney (Williams AFB, Ariz.) Jul. 1979 19 p refs
(AF Proj. 1123)
(AD-A072612; AFHRL-TR-79-18) Avail: NTIS HC A02/MF A01 CSCL 05/9

This investigation was conducted to evaluate the Simulator for Air-to-Air Combat (SAAC) motion system response to known input signals, to observe platform movements, to measure leg extension velocities and accelerations, and to establish delay lags through the system electronics and hydraulics. Signal voltages at pre-established levels were input by a signal generator at the analog-to-digital converter simulating pilot's control stick movements. Resulting platform movement was recorded on strip chart recorder measuring accelerations and final positioning from six linear and angular accelerometers mounted beneath the motion platform. Several noticeable factors were revealed that contribute to the status of the motion platform being less than representative of motion of the aircraft. First, the motion platform lags the input command by a noticeable amount. The platform's motion is about a multiple set of axes rather than a single axis as the command would direct. Also, because of physical constraints on the size of the system, the magnitude and deviation of the motion are limited. A fourth major problem is that when the excursion is near the maximum allowable, the motion is stopped too abruptly, and this stopping is readily perceived by the pilot (the washout problem). GRA

N80-10238# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DYNAMIC CHARACTERISTICS OF FLIGHT SIMULATOR MOTION SYSTEMS
Sep. 1979 40 p refs
(AGARD-AR-144; ISBN-92-835-1338-X) Avail: NTIS HC A03/MF A01

A uniform method of measuring and reporting motion performance characteristics is presented. Such a uniform method, in addition to aiding system comparison, can assist in system diagnosis and might be used in writing performance specifications. The definitive characteristics selected for system description are excursion limits, describing function, linearity and acceleration noise, hysteresis, and dynamic threshold, definitions and methods of measurement and display are given, illustrated by measurements on particular motion systems. R.E.S.

N80-10344*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF THE RESPONSE OF A THERMAL BARRIER COATING TO SODIUM AND VANADIUM DOPED COMBUSTION GASES
Robert A. Miller 1979 23 p refs Presented at 8th Midwest High Temperature Chemistry Conf., Milwaukee, Wis., 4-6 Jun. 1979 Sponsored in part by DOE
(Contract EF-77-A-01-2593)
(NASA-TM-79205; DOE/NASA/2593-79/7; E-090) Avail: NTIS HC A02/MF A01 CSCL 11F

Published data on the behavior of zirconia-based thermal barrier coatings exposed to combustion gases doped with sodium and vanadium were analyzed with respect to calculated condensate dew points and melting points. Coating temperatures, failure locations, and depths were reasonably well correlated. Author

N80-10391# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF GAS TURBINE FUELS AND COMBUSTION; AN OVERVIEW
A. A. Fejer 1979 12 p refs Presented at New Fuels and Advances in Combustion Technologies, New Orleans, 26-30 Mar. 1979
(Contract EX-76-C-01-2433)
(CONF-790337-4) Avail: NTIS HC A02/MF A01

The characteristic features of gas turbine engines are described contrasting them with their chief competitor, the steam cycle. The focus is on the aerodynamic processes in the combustion chambers of traditional engines and includes an outline of the changes that are to be expected with the introduction of the synthetic and coal derived fuels. DOE

N80-10397# New Mexico Univ., Albuquerque. Technology Application Center.
HYDROGEN AS A FUEL CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1977 - Jul. 1979
Gerald F. Zollars Aug. 1979 24 p Sponsored in part by NTIS
(NTIS/PS-79/0771/0) Avail: NTIS HC $28.00/MF $28.00 CSCL 21D

The 219 citations concern the use of hydrogen as a fuel for aircraft and automobiles. Topics covered include storage, fuel combustion studies, gas mixtures, and energy conversion efficiency. GRA

N80-10420# Ohio State Univ., Columbus. Electroscience Lab.
SWEPT FREQUENCY SCATTERING MEASUREMENTS OF AIRCRAFT
K. A. Shubert and D. L. Moffatt May 1979 127 p refs
(Contract F19628-77-C-0125; AF Proj. 2305)
(AD-A071474; RADC-TR-79-110) Avail: NTIS HC A07/MF A01 CSCL 20/14

Measured swept frequency complex scattering data are presented for six 1/72 scale models of aircraft and one model of a typical pencil or aerospace vehicle-type target with various vertical stabilizer and simple cavity attachments. The measured data span the model frequency bands 2.2 to 4.0 GHz and/or 4.0 to 7.6 GHz. The measured data are predominantly for vertical polarization (perpendicular to a horizontal plane containing the wings and fuselage of the aircraft) at selected sparse aspects. The measurement system, which utilizes somewhat unique background subtraction techniques, has a bistatic angle of either 30 degrees (most targets) or eight degrees (a few pencil-type target orientations). Synthetic pulse response waveforms (only pulse envelopes are shown) are generated from the measured spectral data. Features of both the spectral and temporal responses are used to extrapolate the potential of substructure target features such as tail stabilizers and cavities in prediction-correlation type identification schemes. GRA

N80-10439# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
PROGRAM FOR THE DEVELOPMENT OF A SUPERCONDUCTING GENERATOR, PHASE 2 AND 3 Final Report, Jan. 1974 - Jan. 1979
J. L. McCabria Feb. 1979 327 p refs
(Contract F33615-71-C-1591; AF Proj. 3145)
(AD-A072093; AFAPL-TR-79-2012) Avail: NTIS HC A15/MF A01 CSCL 10/2

This report summarizes work completed in Phase II and Phase III of a Program for the Development of a Superconducting Generator. A 5MW, 400 Hz, 12000 rpm generator was designed and built during Phase II. The oil cooled stator contained a 3-phase, wye connected, 5 kV, flooded winding within a laminated iron shield. The rotor contained a winding of 0.094 cm x 0.14 cm wire with 438 36 micrometers filaments of Nb-Ti superconducting alloy. A rotating dewar with a cold electro-thermal shield was used. The Phase III work consisted of a warm spin-up of the generator to design speed followed by cool-downs of the rotor. A superconducting state was not obtained in a generator configuration due to high pressure in the vacuum space which resulted in excessive gas conduction into the field winding compartment. A continuous pump-down system was incorporated into the test set-up but the helium leakage rate exceeded the capability of this system. Partial disassembly of the rotor was performed to define the areas of leakage. Further disassembly and work is required to correct this problem. GRA

N80-10476*# ITT Aerospace/Optical Div., Fort Wayne, Ind.
STUDY OF A STEREO ELECTRO-OPTICAL TRACKER SYSTEM FOR THE MEASUREMENT OF MODEL DEFORMATIONS AT THE NATIONAL TRANSONIC FACILITY Final Report
Richard J. Hertel Oct. 1979 82 p refs
(Contract NAS1-15629)
(NASA-CR-159146) Avail: NTIS HC A05/MF A01 CSCL 14B

An electro-optical method to measure the aeroelastic deformations of wind tunnel models is examined. The multi-target tracking performance of one of the two electronic cameras comprising the stereo pair is modeled and measured. The properties of the targets at the model, the camera optics, target illumination, number of targets, acquisition time, target velocities, and tracker performance are considered. The electronic camera system is shown to be capable of locating, measuring, and following the positions of 5 to 50 targets attached to the model at measuring rates up to 5000 targets per second. A.W.H.

N80-10503# Lockheed-Georgia Co., Marietta.
RELIABILITY OF NONDESTRUCTIVE INSPECTIONS Final Report, Jul. 1974 - Dec. 1978
William H. Lewis, William H. Sproat, Bruce D. Dodd, and James M. Hamilton Dec. 1978 429 p refs
(Contracts F41608-76-D-A005; F41608-77-D-A021)
(AD-A072097; LG79ER0011; SA-ALC/MME-76-6-38-1) Avail: NTIS HC A19/MF A01 CSCL 01/3

The results of a four-year Air Force Logistics Command program to determine the reliability of Air Force nondestructive inspection capability are presented. The report completely describes the program-its objectives, scope, planning and logistics, participants, data collection, analysis, conclusions and recommendations. Actual aircraft structural samples containing fatigue damage were transported to 21 different Air Force bases and depots, where approximately 300 Air Force technicians performed ultrasonic, eddy current, penetrant and radiographic nondestructive inspections (NDI) on the samples. The same detailed NDI procedures were followed by all participating technicians. The individual results were recorded and accumulated in terms of 'finds', 'misses' and 'false calls', compared to a preliminary knowledge of actual flaw locations. A detailed teardown inspection of the samples at the end of the program verified and refined actual flaw tabulations. Results were computerized for data storage and retrieval and analyzed for each NDI method and structure sample type to provide detection probability versus flaw size (POD) curves. Other analyses provide POD curves for years training, experience, age, etc. The program results indicate that Air Force NDI needs improvement in several specific areas in order to meet existing requirements for inspection of Air Force hardware. Some conclusions were derived concerning factors that apparently affect Air Force inspection reliability. Recommendations for making both short-term and long-term improvements in NDI proficiency are presented. GRA

N80-10512*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
LIGHT AIRPLANE CRASH TESTS AT THREE ROLL ANGLES
Claude B. Castle and Emilio Alfaro-Bou Washington Oct. 1979 77 p refs
(NASA-TP-1477; L-12778) Avail: NTIS HC A05/MF A01 CSCL 01C

Three similar twin engine general aviation airplanes were crash tested at the Langley impact dynamics research facility at 27 m/sec and at nominal roll angles of 0 deg, -15 deg, and -30 deg. Other flight parameters were held constant. The test facility, instrumentation, test specimens, and test method are briefly described. Structural damage and accelerometer data for each of the three impact conditions are presented and discussed. Author

N80-10515*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
EFFECT OF TIME DEPENDENT FLIGHT LOADS ON JT9D-7 PERFORMANCE DETERIORATION
A. Jay and B. L. Lewis 21 Aug. 1979 73 p refs
(Contract NAS3-20632)
(NASA-CR-159681; PWA-5512-45) Avail: NTIS HC A04/MF A01 CSCL 01C

The results of a modal transient analysis of the engine/aircraft system are presented. The response of the JT9D to analytically simulated vertical gusts and landings was predicted using a NASTRAN finite element mathematical model of the JT9D/747 propulsion system. The NASTRAN finite element model of the propulsion system included engine structural models of the fan, low/high pressure compressors, diffuser/turbine cases, and high/low pressure rotors, as well as nacelle models of the inlet cowl, tailcone, and wing pylon. The analysis conducted predicts that an insignificant level of JT9D-7 performance deterioration would occur due to a typical vertical gust encounter or a typical revenue service landing. Analysis of a high sink rate landing with a heavy fuel load indicates the possibility of local wear, however, the lack of an accurate dynamic rotor/seal interference model precludes an accurate quantitative evaluation of performance change for this once-per-airframe-life event. J.M.S.

N80-10516*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
COUPLED ROTOR AND FUSELAGE EQUATIONS OF MOTION
William Warmbrodt Oct. 1979 82 p refs
(NASA-TM-81153) Avail: NTIS HC A05/MF A01 CSCL 20K

The governing equations of motion of a helicopter rotor coupled to a rigid body fuselage are derived. A consistent formulation is used to derive nonlinear periodic coefficient equations of motion which are used to study coupled rotor/fuselage dynamics in forward flight. Rotor/fuselage coupling is documented and the importance of an ordering scheme in deriving nonlinear equations of motion is reviewed. The nature of the final equations and the use of multiblade coordinates are discussed. A.W.H.

N80-10668# New Mexico Univ., Albuquerque. Technology Application Center.
AIRCRAFT FUEL. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Jul. 1979
Gerald F. Zollars Jul. 1979 43 p Sponsored in part by NTIS, Springfield, Va.
(NTIS/PS-79/0764/5) Avail: NTIS HC $28.00/MF $28.00 CSCL 10A

These 160 citations concern means to conserve fuel in airline operations. Articles dealing with aircraft design, fuels, engine design, propulsion efficiency, and operating procedures which conserve fuel are included. GRA

N80-11006 Allerton Press, Inc., New York, N. Y.
STATISTICAL DIAGNOSTICS AIRCRAFT ENGINES
Yu. V. Kozhevnikov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 20-25 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 30-35

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The linear formulation of the statistical problem for engine parametric diagnostics is examined in a discrete system of steady-state aircraft engine operating regimes. F.O.S.

N80-11007 Allerton Press, Inc., New York, N. Y.
OPTIMAL THERMOGASDYNAMIC DESIGN OF GAS TURBINE ENGINES USING ELEMENT PROTOTYPES, 1
Yu. V. Kozhevnikov, V. O. Borovik, V. S. Ivanov, V. A. Talyzin, I. N. Agliullin, and Yu. V. Meluzov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 26-32 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 36-43
Copyright. Avail: Allerton Press, Inc. 150 Fifth Ave., N.Y. 10011; $45.00

The problem of optimal thermogasdynamic design of gas turbine engines (GTE) is examined on the basis of a systematic mathematical model of a two-spool bypass GTE, containing the characteristics of the engine element prototypes in similarity parameters. The multiregime nature of GTE application is considered in the statistical formulation. Some GTE design parameter optimization criteria are presented. J.M.S.

N80-11009 Allerton Press, Inc., New York, N. Y.
SELECTION OF GEOMETRIC PARAMETERS AND LOCATION OF NOSE FLAP ON SWEPT WING ROOT PROFILE FROM TUNNEL TEST DATA, 1
A. I. Matyazh, V. A. Sterlin, V. A. Popov, V. V. Isaev, and G. A. Cheremukhin *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 37-41 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 49-54

The influence of nose flap geometric parameters (curvature and location on profile nose) on the basic aerodynamic coefficients of a mechanized wing segment whose profile corresponds to the typical profile used on swept wings of civil aircraft were examined. Recommendations are made on selection of the curvature and location of a nose flap used in conjunction with a two element slotted trailing-edge flap. R.E.S.

N80-11010 Allerton Press, Inc., New York, N. Y.
ANALYTIC FORMULAS FOR WING PROFILE AERODYNAMIC CHARACTERISTICS IN INCOMPRESSIBLE FLOW
N. M. Monakhov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 42-47 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 55-61

The conformal mapping method was used to construct in the third approximation the equations for determining the abscissa of the conformal center of gravity of a profile, the mapping circle radius, and the points of the circle corresponding to the profile leading and trailing edges. Analytic formulas for the lift and moment coefficients, aerodynamic center and center of pressure coordinates, and profile surface velocity were obtained with accuracy to quantities of fourth order of smallness. An example (cambered lune) calculation shows that the proposed formulas have very high accuracy. R.E.S.

N80-11011 Allerton Press, Inc., New York, N. Y.
ON A SMOOTH APPROXIMATION METHOD AND ITS APPLICATION TO MATHEMATICAL DESCRIPTION OF WING AERODYNAMIC CHARACTERISTICS
V. A. Ovchinnikov, V. D. Osorgin, V. G. Pavlov, and E. Ya. Fedorov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 48-51 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 62-65

A method for smooth epsilon approximation of a function of many variables with discontinuities of the first order derivatives at the points of some hypersurface is presented. The method makes it possible to represent any function, specified in the region of smoothness by suitable relations, in the form of a differentiable envelope lying in the epsilon vicinity of the original function. An example is given of specification of the aerodynamic characteristics of a wing with two element trailing-edge flap by the envelope. It is shown that the definition of the function epsilon introduced herein makes it possible with existing limits on its magnitude to obtain an approximation accuracy which is adequate for practical calculations. R.E.S.

N80-11012 Allerton Press, Inc., New York, N. Y.
INFLUENCE OF WING DEFORMATION ON TRAILING-EDGE FLAP DEFLECTIONS
V. A. Pavlov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 52-53 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 66-67

The interaction of a three hinge trailing-edge flap with a wing is described. The influence of wing bending deformations on displacements of the flap carriages along the rails is also described. An analogy between trailing-edge flap analysis and multihinge control surface analysis is presented. Analysis procedures for various flap extension and retraction mechanism locations are examined. R.E.S.

N80-11019 Allerton Press, Inc., New York, N. Y.
HARMONIC OSCILLATIONS OF ANNULAR WING IN STEADY IDEAL FLUID FLOW
Z. N. Shesternina *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 93-98 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 115-121

A method is presented to solve the problem of the annular wing with thick profile, performing small harmonic oscillations in ideal incompressible fluid flow. Two cases are examined: axisymmetric flow with oscillations along the axis of symmetry; and flow with periodically varying small angle of attack. M.M.M.

N80-11022 Allerton Press, Inc., New York, N. Y.
OVERALL AERODYNAMIC CHARACTERISTICS OF CARET AND DELTA WINGS AT SUPERSONIC SPEEDS
Yu P. Gunko and I. I. Mazhul *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 107-110 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 129-132

The influence of caret angle, design Mach number, and free stream Mach number on the aerodynamic characteristics of caret wings are studied experimentally and theoretically. Caret wings and their equivalent delta wings are compared in the class with constant volume coefficient and aspect ratio. The results obtained relate basically to the flow regimes around caret wings with free stream Mach number less than design Mach number. K.L.

N80-11024 Allerton Press, Inc., New York, N. Y.
SELECTING THE PASSENGER AIRPLANE FUSELAGE
Yu. N. Egorov *In its* Soviet Aeron., Vol. 21, No. 2 1978 p 114-116 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), v. 21, no. 2, 1978 p 135-138

The problem of selecting fuselage parameters is examined. A simple approach allows early selection of fundamental regions of goodness for a particular fuselage as a function of its passenger capacity. K.L.

N80-11030*# United Technologies Research Center, East Hartford, Conn.
A COMPARISON OF THE PITCHING AND PLUNGING RESPONSE OF AN OSCILLATING AIRFOIL Final Report
Franklin O. Carta Washington NASA Oct. 1979 158 p refs (Contract NAS1-14012)
(NASA-CR-3172) Avail: NTIS HC A08/MF A01 CSCL 01A

An oscillating SC1095 airfoil model was tested for its aerodynamic stability in a rigid body with a single degree of freedom pitch about its quarter chord, and also in a rigid body with single degree of freedom plunge. The ability of pitching data to model plunging motions was evaluated. A one to one correspondence was established between pairs of pitching and plunging motions according to the potential flow transformation formula alpha = ikh. The imposed variables of the experiment were mean incidence angle, amplitude of motion, free stream velocity, and oscillatory frequency. Results indicate that significant differences exist between the aerodynamic responses to the motions, particularly at high load conditions. At high load

conditions, the normal force for equivalent pitch is significantly greater than that for true pitch at the geometric incidence angle. R.C.T.

N80-11031*# Kentron International, Inc., Hampton, Va.
AIRCRAFT CONTROL BY PROPELLER CYCLIC BLADES
John DeYoung Washington NASA Nov. 1979 61 p refs (Contract NAS1-13500)
(NASA-CR-3212) Avail: NTIS HC A04/MF A01 CSCL 01A

A theory is developed for aircraft control obtained from the propeller forces and moments generated by blade angle variation during a blade revolution. The propeller blade is pitched harmonically one cycle per propeller revolution which results in vehicle control forces and moments, termed cyclic-control. Using a power series respresentation of an arbitrary function of cyclic-blade angle, cyclic-control theory is developed which leads to exact solutions in terms of derivatives of steady-state thrust and power with respect to blade angle. An alternative solution, when the cyclic-blade angle function is limited to a sinusoidal cycle, is in terms of Bessel functions. An estimate of non-steady azimuth angle change or lag is presented. Cyclic-control analysis applied to the counter-rotating propeller shows that control forces or moments can be uniquely isolated from each other. Thus the dual rotor, in hovering mode, has propulsion without rotor tilt or moments, or, when in propeller mode at the tail of an air ship or submarine, vehicle control with no vehicle movement. Control isolation is also attainable from three or more propellers in-line. Author

N80-11032# Aeronautical Research Labs., Melbourne (Australia).
PREDICTION OF HELICOPTER ROTOR DOWNWASH IN HOVER AND VERTICAL FLIGHT
K. R. Reddy Jan. 1979 31 p refs
(ARL-AERO-Rept-150; AR-001-335) Avail: NTIS HC A03/MF A01

A vortex-wake method to calculate the rotor downwash in hovering and vertical flight is presented. The blade is represented by a lifting line. The rotor wake is simulated by a vortex sheet and a series of rolled up root and tip vortices, similar in form to that of a classical fixed wing. The concept of rectangularization of the rotor wake is used in obtaining a formula for the normal component of induced velocity. Wake contraction based on experimental data is introduced into the calculations. Numerical calculations are performed for two rotor configurations. Computed induced velocities and blade loadings are compared with the available flight data. A.W.H.

N80-11033*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC INTERACTIONS FROM REACTION CONTROLS FOR LATERAL CONTROL OF THE M2-F2 LIFTING-BODY ENTRY CONFIGURATION AT TRANSONIC AND SUPERSONIC AND SUPERSONIC MACH NUMBERS
Rodney O. Bailey and Jack J. Brownson Washington Nov. 1979 125 p refs
(NASA-TM-78534; A-7624) Avail: NTIS HC A06/MF A01 CSCL 01A

Tests were conducted in the Ames 6 by 6 foot wind tunnel to determine the interaction of reaction jets for roll control on the M2-F2 lifting-body entry vehicle. Moment interactions are presented for a Mach number range of 0.6 to 1.7, a Reynolds number range of 1.2 x 10 to the 6th power to 1.6 x 10 to the 6th power (based on model reference length), an angle-of-attack range of -9 deg to 20 deg, and an angle-of-sideslip range of -6 deg to 6 deg at an angle of attack of 6 deg. The reaction jets produce roll control with small adverse yawing moment, which can be offset by horizontal thrust component of canted jets. A.R.H.

N80-11034*# Pennsylvania State Univ., University Park.
CHARACTERISTICS OF LIGHTLY LOADED FAN ROTOR BLADE WAKES Final Report
B. Reynolds and B. Lakshminarayana Washington NASA Oct. 1979 192 p refs
(Grant NsG-3012)
(NASA-CR-3188; PSU-TURBO-R-78-4) Avail: NTIS HC A09/MF A01 CSCL 01A

Low subsonic and incompressible wake flow downstream of lightly loaded rotor was studied. Measurements of mean velocity, turbulence intensity, Reynolds stress, and static variations across the rotor wake at various axial and radial locations were investigated. Wakes were measured at various rotor blade incidences to discern the effect of blade loading on the rotor wake. Mean velocity and turbulence measurements were carried out with a triaxial hot wire probe both rotating with the rotor and stationary behind the rotor. Results indicate that increased loading slows the decay rates of axial and tangential mean velocity defects and radial velocities in the wake. The presence of large radial velocities in the rotor wake indicate the extent of the interactions between one radius and another. Appreciable static pressure variations across the rotor wake were found in the near wake region. Similarity in the profile shape was found for the axial and tangential components of the mean velocity and in the outer layer for axial, tangential, and radial turbulence intensities. R.C.T.

N80-11035*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
FLIGHT-MEASURED AFTERBODY PRESSURE COEFFICIENTS FROM AN AIRPLANE HAVING TWIN SIDE-BY-SIDE JET ENGINES FOR MACH NUMBERS FROM 0.6 TO 1.6
Louis L. Steers Washington Nov. 1979 88 p refs
(NASA-TP-1549; H-1066) Avail: NTIS HC A05/MF A01 CSCL 01A

Afterbody pressure distribution data were obtained in flight from an airplane having twin side-by-side jet exhausts. The data were obtained in level flight at Mach numbers from 0.60 to 1.60 and at elevated load factors for Mach numbers of 0.60, 0.90, and 1.20. The test altitude varied from 2300 meters (7500 feet) to 15,200 meters (50,000 feet) over a speed range that provided a matrix of constant Mach number and constant unit Reynolds number test conditions. The results of the full-scale flight afterbody pressure distribution program are presented in the form of plotted pressure distributions and tabulated pressure coefficients with Mach number, angle of attack, engine nozzle pressure ratio, and unit Reynolds number as controlled parameters. Author

N80-11036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FUSELAGE AND NOZZLE PRESSURE DISTRIBUTIONS ON A 1/12-SCALE F-15 PROPULSION MODEL AT TRANSONIC SPEEDS
Odis C. Pendergraft, Jr. Nov. 1979 140 p refs
(NASA-TP-1521; L-12948) Avail: NTIS HC A07/MF A01 CSCL 01A

Static pressure coefficient distributions on the forebody, afterbody, and nozzles of a 1/12 scale F-15 propulsion model were determined. The effects of nozzle power setting and horizontal tail deflection angle on the pressure coefficient distributions were investigated. A.W.H.

N80-11037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF LOW ASPECT RATIO COMPRESSOR BLADING
Lonnie Reid and Royce D. Moore 1979 19 p refs Proposed for presentation at the 25th Ann. Intern. Gas Turbine Conf., New Orleans, La., 9-13 Mar. 1980; sponsored by Am. Soc. of Mech. Engr.
(NASA-TM-79280; E-217) Avail: NTIS HC A02/MF A01 CSCL 01A

The effects of low aspect ratio blading on aerodynamic performance were examined. Four individual transonic compressor stages, representative of the inlet stage of an advanced high pressure ratio core compressor, are discussed. The flow phenomena for the four stages are investigated. Comparisons of blade element parameters are presented for the two different aspect ratio configurations. Blade loading levels are compared for the near stall conditions and comparisons are made of loss and diffusion factors over the operating range of incidence angles. A.W.H.

N80-11038*# Old Dominion Univ. Research Foundation, Norfolk, Va.
LEADING EDGE VORTEX-FLAP EXPERIMENTS ON A 74 DEG DELTA WING
Dhanvad M. Rao Nov. 1979 53 p refs
(Grant NsG-1315)
(NASA-CR-159161) Avail: NTIS HC A04/MF A01 CSCL 01A

Exploratory wind tunnel tests are reported on a 74 deg. delta wing model. The potential of a vortex flap concept in reducing the subsonic lift dependent drag of highly swept, slender wings is examined. The suction effect of coiled vortices generated through controlled separation over leading edge flap surfaces to produce a thrust component is discussed. A series of vortex-flap configurations were investigated to explore the effect of some primary geomtric variables. A.W.H.

N80-11040# Tennessee Univ. Space Inst., Tullahoma.
THE ANALYSIS OF WING-BODY COMBINATIONS AT MODERATE ANGLES OF ATTACK
N. Ucniyama (Japan Defense Agency, Tokyo), R. P. Mikkilineni, and J. M. Wu 1978 7 p refs Presented at the AIAA 16th Aerospace Sci. Meeting, Huntsville, Ala., 16-18 Jan. 1978
(Contract DAAG29-77-G-0108)
(AD-A074284; ARO-14966.1-A-E) Avail: NTIS HC A02/MF A01 CSCL 20/4

A computational scheme is developed to predict the flow over wing-body combinations at moderate angles of attack and the results of computation are presented for two different wing-body combinations. The wing is represented by a system of discrete non-intersecting vortex lines. Each vortex line in the wake is composed of a series of straight finite segments and a semi-infinite segment. The body is represented by a system of source/sink elements distributed on the surface of the body. The effect of lifting nose is taken into account by a horseshoe vortex system, the strength and the location of which are based on the empirical relations. The basic unknowns in the problem are the strengths of the vortex elements and the source/sink elements, and the direction of the vortex elements in the wake. The problem is solved using an iterative approach. The shape of the trailing vortex sheet is shown at different stations along the body. A.R.H.

N80-11044# Aeronautical Research Inst. of Sweden, Stockholm.
MEASUREMENTS ON A THREE-DIMENSIONAL SWEPT WING AT LOW SPEEDS. PART 1: THE FLOW AROUND THE LEADING EDGE
Arild Bertelrud Sep. 1977 112 p refs Sponsored by Swed. Defence Mat. Admin. 2 Vol.
(FFA-130-Pt-1; PB-294203/5) Avail: NTIS HC A06/MF A01

As a part of a project on extrapolation from wind tunnel to flight, measurements in the boundary layer of a three dimensional swept wing were made in a low speed wind tunnel. The flow in the region close to the leading edge was studied. Two different flow patterns were investigated; natural transition and bubble transition. The wing tested is outer part of the actual wing of a SAAB 32 Lansen with a NACA 64A010 profile normal to the 25 percent line and a leading edge sweep of 39 deg. It is found that for the present wing the pressure distribution in the leading edge region back to 30 percent of the chord is well described by two-dimensional calculations of attack close to start of separation the attachment line flow probably becomes transitional/turbulent in the tested speed range, followed by relaminarization and bubble. According to calculations there should not be relaminarization in the flight case, despite strong indications from earlier flight tests of bubble separation. Author (ESA)

N80-11045# Aeronautical Research Inst. of Sweden, Stockholm.
MEASUREMENTS ON A THREE-DIMENSIONAL SWEPT WING AT LOW SPEEDS. PART 2: THE FLOW IN THE BOUNDARY LAYER ON THE MAIN WING
Arild Bertelrud Sep. 1977 85 p refs Sponsored by Swed. Defence Mat. Admin. 2 Vol.
(FFA-131-Pt-2; PB-294204/3) Avail: NTIS HC A05/MF A01

As a part of a project on extrapolation from wind tunnel to flight, measurements in the boundary layer of three-dimensional swept wing were made in a low speed tunnel. The flow on the main part of the wing is discussed and essentially time-averaged information is given. The experimental investigation consists of measurements of the static distribution and also of measurements with total head/static probes. These also provide skin friction data. As the flow visualizations and the preliminary measurements indicated that the flow was close to two dimensional, boundary layer rakes were used to get streamwise information on the boundary layer profiles. Calculations of the static pressure distribution and the turbulent boundary layer characteristics were performed and show good agreement with the experimental results. Author (ESA)

N80-11049# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
A SURVEY OF THE LITERATURE ON SURFACE ROUGHNESS EFFECTS ON THE DRAG OF SUBSONIC AIRCRAFT Final Report
A. Bertelrud Sep. 1978 131 p refs
(Contracts SWEDBTD-75-4494; SWEDBTD-76-4505)
(FFA-AU-1224) Avail: NTIS HC A07/MF A01

A survey of selected investigations concerning drag associated with isolated or distributed roughness elements in laminar and turbulent flow is given. Basic roughness types tested in laboratory experiments are covered and the results are related to conditions on wings of subsonic aircraft. Whereas considerable information is available on zero-pressure-gradient two-dimensional turbulent flows with roughness effects can be incorporated in current routines for assessing overall drag of aircraft based on wind tunnel and flight tests is demonstrated. It is suggested to develop a computer code which will allow the determination of allowable roughness size, or the effect of given roughness size on drag for new aircraft. This program would also make possible predictions of the degradation in performance associated with maintenance procedures, structural modifications, etc. Such a program involves a detailed analysis of the flow field around wing and body instead of the over-simplified methods based on flat plate relations now in use. Author (ESA)

N80-11050# National Aviation Facilities Experimental Center, Atlantic City, N. J.
CABIN HAZARDS FROM A LARGE EXTERNAL FUEL FIRE ADJACENT TO AN AIRCRAFT FUSELAGE Final Report
Louis J. Brown, Jr. Aug. 1979 59 p refs
(FAA Proj. 181-521-100)
(AD-A073494; FAA-NA-79-27) Avail: NTIS HC A03/MF A01 CSCL 13/12

Fourteen fire tests were conducted with a surplus, fire hardened DC 7 fuselage. The flame penetration and resulting accumulation of heat and smoke inside an aircraft cabin, produced by a large external fuel fire adjacent to a fuselage door opening, was measured and studied. Temperatures, light transmittances, and heat fluxes were measured. The effect of wind direction and velocity on the flame propagation and penetration were investigated. A.W.H.

N80-11051# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT - UNITED AIRLINES, INC., MCDONNELL-DOUGLAS DC-8-61, N8082U, PORTLAND, OREGON, DECEMBER 28, 1978
7 Jun. 1979 63 p
(NTSB-AAR-79-7) Avail: NTIS HC A04/MF A01

The crash of flight 173, a DC 8 aircraft, is investigated. The cause of the accident is listed as flight crew error in responding to the low fuel state of the aircraft due to a malfunction in the landing gear. Damage to the aircraft and injuries to persons are reported. Wreckage information, an aircraft systems examination, a fuel control test, and a report of the main landing gear retract cylinder assembly are discussed. A.W.H.

N80-11052*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCREW DISPLAYS AND AVIONICS FOR APPLICATION IN A FUTURE NATIONAL AIRSPACE SYSTEM

Seymour Salmirs Nov. 1979 28 p refs
(NASA-TM-80095) Avail: NTIS HC A03/MF A01 CSCL 01D

A concept for increased pilot involvement in a future National Airspace System was evolved during the FAA New Initiatives in Engineering and Development Users responsibilities and ways in which they might interact. The technical feasibility of the system is indicated by the sophisticated level of presently manufactured digital computers and display avionics, and the application of that technology under design by the major airframe manufacturers. Data collected during simulations and flights with the Terminal Configured Vehicle Program B-737 airplane are shown to have direct application to the new system concept. The adoption of the operational changes envisioned, offers some potentially significant advantages to the user. Author

N80-11053*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIROLE CARGO AIRCRAFT OPTIONS AND CONFIGURATIONS
D. William Conner and John C. Vaughan, III (USAF) Oct. 1979 15 p refs Presented at 1979 SAE Aerospace Meeting, 3-9 Dec. 1979
(NASA-TM-80177) Avail: NTIS HC A02/MF A01 CSCL 01C

A future requirements and advanced market evaluation study indicates derivatives of current wide-body aircraft, using 1980 advanced technology, would be economically attractive through 2008, but new dedicated airfreighters incorporating 1990 technology, would offer little or no economic incentive. They would be economically attractive for all payload sizes, however, if RD and T costs could be shared in a joint civil/military arrangement. For the 1994-2008 cargo market, option studies indicate Mach 0.7 propfans would be economically attractive in trip cost, aircraft price and airline ROI. Spanloaders would have an even lower price and higher ROI but would have a relatively high trip cost because of aerodynamic inefficiencies. Dedicated airfreighters using propfans at Mach 0.8 cruise, laminar flow control, or cryofuels, would not provide any great economic benefits. Air cushion landing gear configurations are identified as an option for avoiding runway constraints on airport requirements and/or operational constraints are noted. Author

N80-11054# Douglas Aircraft Co., Inc., Long Beach, Calif.
EJECTION SEAT FOR HIGH G ESCAPE Final Technical Report, 1 Jun. 1978 - Apr. 1979
Orville E. Howland Apr. 1979 184 p refs
(Contract F33615-78-C-3416; AF Proj. 2402)
(AD-A072444; MDC-J8434; AFFDL-TR-79-3044) Avail: NTIS HC A09/MF A01 CSCL 06/7

Advanced flight vehicles operating at acceleration loads beyond human functional capabilities require a new reclining seat design. An ejection seat compatible with this requirement must provide safe ejection and aircraft clearances under high-G conditions as well as the requirements associated with high dynamic pressures and low altitudes. Design criteria and interface requirements have been established. Ejection seat subsystems have been developed and seat design concepts generated to meet criteria and interface requirements. Candidate seat concepts have been analyzed to determine cockpit integration effects, accelerations, ejection clearances, escape performance, structural requirements and weights. A final design concept has been selected to meet all requirements of an ejection seat for high-G escape. The final report includes a parametric study of tail clearances and discusses technical design details and conclusions of the work performed. GRA

N80-11055# Rockwell International Corp., El Segundo, Calif. Los Angeles Div.
EXPLORATORY DEVELOPMENT OF AIRCREW WINDBLAST PROTECTION CONCEPTS Final Report, May 1978 - Jan. 1979
Robert J. Cummings and Frank E. Drsata Jun. 1979 100 p refs
(Contract F33615-78-C-0514; AF Proj. 7231)
(AD-A072013; RI/LAD-NA-79-77; AMRL-TR-79-16) Avail: NTIS HC A05/MF A01 CSCL 06/7

Design requirements for windblast limb protection systems to be used in current ejection seats were defined. The ACES II system was used as a baseline system. Using the baseline seat and the requirements, three arm and three leg restraint concepts were defined. A proposed program was then defined to evaluate and develop the proposed systems. Design requirements were derived from a list of criteria or constraints for the system as defined in the reference to the escape, aircraft, crew flight conditions and using commands' needs. Resulting requirements were then rank ordered and significant interactions between them identified. Identification of negative interactions highlights the significant trades necessary to design a successful windblast protection system. Ejection events and the resulting environment the crew is exposed to were then analyzed to define the physical actions the men and system must contend with. Review of previous ejection injuries and limb restraint systems was included to further refine the understanding of injury mechanisms. Specific injujry mechanisms of the knees, shoulder, elbow, and spinal column are presented. Using the requirements and injury mechanisms the six candidate protection systems were defined. A proposed program for concept refinement and final selection is presented. GRA

N80-11057# Sterling Systems, Inc., Washington, D. C.
AN ASSESSMENT OF TERMINAL AIR TRAFFIC CONTROL SYSTEM PERFORMANCE WITH AND WITHOUT BASIC METERING AND SPACING AUTOMATION Final Report
H. C. Wintermoyer, William Pailen, and Donald Meyer Mar. 1979 134 p refs
(Contract DOT-FA79WAI-012)
(AD-A073548; FAA-RD-79-81) Avail: NTIS HC A07/MF A01 CSCL 17/7

Basic arrival metering and spacing (M&S), developed as an ARTS (automated radar terminal system) 3 enhancement, is discussed. The functions of metering arrival aircraft prior to their acceptance in terminal airspace, sequencing them according to their estimated time at the runway, scheduling each aircraft at fix points along the arrival path to the runway arrival gate, and providing control commands to assure precise and proper spacing for aircraft on final approach to the runway are examined. Simulation tests to determine the landing time interval error, the potential safe landing rate, and the potential excessive delay are described. A.W.H.

N80-11058*# Sperry Flight Systems, Phoenix, Ariz.
STUDY FOR INCORPORATING TIME-SYNCHRONIZED APPROACH CONTROL INTO THE CH-47/VALT DIGITAL NAVIGATION SYSTEM
Walter J. McConnell, Jr. Oct. 1979 226 p refs
(Contract NAS1-14238)
(NASA-CR-159151) Avail: NTIS HC A11/MF A01 CSCL 17G

Techniques for obtaining time synchronized (4D) approach control in the VALT research helicopter is described. Various 4D concepts and their compatibility with the existing VALT digital computer navigation and guidance system hardware and software are examined. Modifications to various techniques were investigated in order to take advantage of the unique operating characteristics of the helicopter in the terminal area. A 4D system is proposed, combining the direct to maneuver with the existing VALT curved path generation capability. A.W.H.

N80-11061# Boeing Aerospace Co., Seattle, Wash. Military Airplane Development Organization.
EVALUATION OF DAIS TECHNOLOGY APPLIED TO THE INTEGRATED NAVIGATION SYSTEM OF A TACTICAL TRANSPORT Final Report, Sep. 1977 - May 1979
Donald Dewey, Richard Bousley, Stephen Behnen, and James Mason May 1979 181 p refs
(Contract F33615-77-C-1233; AF Proj. 2003)
(AD-A073068; AFAL-TR-79-1061) Avail: NTIS HC A09/MF A01 CSCL 17/7

This effort has provided an independent contractor assessment of the DAIS executive software, industry exposure to the J-73

level one compiler and DAIS software development tools, and a definition of the interface between DAIS and integrated navigation systems. A combination of INS, GPS and air data was used to demonstrate the usefulness of the DAIS/integrated navigation system for tactical air drop and terminal area operations w/transport aircraft. A Boeing Aerospace Lab Simulation jointly managed by AFAL and Boeing, was conducted for the purposes of evaluating the DAIS/integrated navigation system software performance capabilities in a simulated tactical air drop and terminal area navigation flight profile. A 'Hot Bench' simulation was conducted using contractor developed sensor software modules and navigation filter, and the DAIS executive software and processing hardware. Outputs of the program include: Verification of the overall DAIS concept, measurements of executive software overhead and suggestions for improving the DAIS executive software GRA

N80-11064# New Mexico Univ., Albuquerque. Technology Application Center.
INERTIAL NAVIGATION AND GUIDANCE. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1976 - Jul. 1979
Samuel C. Mauk Aug. 1979 50 p Sponsored in part by NTIS
(NTIS/PS-79/0825/4) Avail: NTIS HC $28.00/MF $28.00 CSCL 17G

This bibliography cites 208 articles from the international literature concerning air naviagation, navigation instruments and aids, aircraft guidance, missile control, strapdown inertial guidance, gyroscopes, stabilized platforms, position and instrument error, error analysis, and accelerometers. Civil, commercial, and military applcations are covered. GRA

N80-11065*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A HYDRAULIC ACTUATOR MECHANISM TO CONTROL AIRCRAFT SPOILER MOVEMENTS THROUGH DUAL INPUT COMMANDS Patent Application
Stephen C. Irick, inventor (to NASA) Filed 17 Aug. 1979 11 p
(NASA-Case-LAR-12412-1; US-Patent-Appl-SN-067595) Avail: NTIS HC A02/MF A01 CSCL 10C

A conventional, primary spoiler control system retains its operational characteristics while accommodating a secondary input controlled by a conventional computer system to supplement the settings made by the primary input. This is achieved by interposing springs between the primary input and the spoiler control unit. The springs are selected to have a stiffness intermediate to the greater force applied by the primary control linkage and the lesser resistance offered by the spoiler control unit. Thus, operation of the primary input causes the control unit to yield before the springs, yet, operation of the secondary input, acting directly on the control unit, causes the springs to yield and absorb adjustments before they are transmitted into the primary control system. NASA

N80-11066# National Aerospace Lab., Tokyo (Japan). V/STOL Div.
FUEL MINIMAL TAKE-OFF PATH OF JET LIFT VTOL AIRCRAFT, LOG NO. C3558
Hiroshi Nishimura 7 Aug. 1979 40 p refs Backup document for AIAA synoptic scheduled for publication in Journal of Aircraft on Feb. 1980
Avail: NTIS HC A03/MF A01

The fuel minimal take-off path analysis for jet lift type VTOL aircraft is presented. The study is made of two basic configurations, namely, separate type and swivel type. The fuel minimal take-off path problems of the two configurations are analyzed as nonlinear systems with the controls constrained by their magnitude. The solutions for both types are generally composed of two or three discontinuous segments connected by switching points. For the separate type, the singular part is analytically deterministic and unique, and plays a decisive role; but for the swivel type, the singular part is not unique. Two methods of solution involving different handling of singular parts are considered. Author

N80-11067*# United Technologies Research Center, East Hartford, Conn.
NOISE OF A MODEL HELICOPTER ROTOR DUE TO INGESTION OF TURBULENCE Final Report
Robert W. Paterson and Roy K. Amiet Nov. 1979 131 p refs
(Contract NAS1-15094)
(NASA-CR-3213) Avail: NTIS HC A07/MF A01 CSCL 01C

A theoretical and experimental investigation of the noise of a model helicoper rotor due to ingestion of turbulence was conducted. Experiments were performed with a 0.76 m dia, articulated model rotor for a range of inflow turbulence and rotor operating conditions. Inflow turbulence levels varied from approximately 2 to 19 percent and tip Mach number was varied from 0.3 to 0.52. Test conditions included ingestion of a atmospheric turbulence in outdoor hover as well as ingestion of grid generated isotropic turbulence in the wind tunnel airstream. In wind tunnel testing, both forward flight and vertical ascent (climb) were simulated. Far field noise spectra and directivity were measured in addition to incident turbulence intensities, length scales, and spectra. Results indicate that ingestion of atmospheric turbulence is the dominant helicopter rotor hover noise mechanism at the moderate to high frequencies which determine perceived noise level. R.C.T.

N80-11068*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND-TUNNEL/FLIGHT CORRELATION STUDY OF AERODYNAMIC CHARACTERISTICS OF A LARGE FLEXIBLE SUPERSONIC CRUISE AIRPLANE CXB-70-1). 1: WIND-TUNNEL TESTS OF A 0.03-SCALE MODEL AT MACH NUMBERS FROM 0.6 TO 2.53
James Daugherty, C. Nov. 1979 222 p refs
(NASA-TP-1514; A-7712) Avail: NTIS HC A10/MF A01 CSCL 01C

The longitudinal and lateral forces and moments for a 0.03 scale deformed rigid, static force model of the XB-70-1 airplane were determined. Control effectiveness was determined for the elevon in pitch and roll, for the canard, and for the rudders. Component effects of the canard, deflected with tips, variable position canopy, bypass doors, and bleed dump fairing were measured. The effects of small variations in inlet mass flow ratio and small amounts of asymmetric deflection of the wing tips were assessed. A.W.H.

N80-11069*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF MODIFIED PROFILE ANALYSIS TO FUNCTION TESTING OF SIMULATED CTOL TRANSPORT TOUCHDOWN-PERFORMANCE DATA
Russell V. Parrish and Burnell T. McKissick Nov. 1979 19 p refs
(NASA-TP-1541; L-13091) Avail: NTIS HC A02/MF A01 CSCL 01C

The modification to the methodology of profile analysis to accommodate the testing of differences between two functions with a single test, rather than multiple tests at various values of the abscissa, is described and demonstrated for two sets of simulation-performance data. The first application was to a flight-simulation comparison of pilot-vehicle performance with a three-element refractive display to performance with a more widely used beam-splitter-reflective-mirror display system. The results demonstrate that the refractive system for out-the-window scene display provides equivalent performance to the reflective system. The second application demonstrates the detection of significant differences by modified profile-analysis procedures. This application compares the effects of two sets of pitch-axis force-feel characteristics on the sink rate at touchdown performance utilizing the refractive system. This experiment demonstrates the dependence of simulator sink-rate performance on force-feel characteristics. Author

N80-11070# Rockwell International Corp., El Segundo, Calif. Los Angeles Div.
IMPROVED METHODS FOR PREDICTING SPECTRUM LOADING EFFECTS, PHASE 1 REPORT. VOLUME 2: TEST DATA Interim Report, 15 Feb. 1978 - 15 Jan. 1979
James B. Chang and John H. Stolpestad 31 Jan. 1979 330 p
(Contract F33615-77-C-3121)
(AD-A072387; NA-78-491-3-Vol-2; AFFDL-TR-79-3036-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 01/3

This report presents the interim status of a program which is aiming to upgrade the crack growth prediction technology required for the implementation of the damage-tolerance and durability control procedures throughout the life cycle of any weapon system. The controlling damage parameters in flight-by-flight loading for all classes of aircraft have been identified. Methodologies which characterize the flight spectra have been developed. Guidelines for development of three levels of crack growth analysis used for detail design, individual aircraft tracking, and preliminary design have been established. Crack growth data generated from the test program has been summarized. GRA

N80-11071# Rockwell International Corp., El Segundo, Calif. Los Angeles Div.
IMPROVED METHODS FOR PREDICTING SPECTRUM LOADING EFFECTS, PHASE 1 REPORT, VOLUME 1: RESULTS AND DISCUSSION Interim Report, 15 Feb. 1978 - 15 Jan. 1979
James B. Chang, John H. Stolpestad, Masanobic Shinozuka, and Rimas Vaicaitis 31 Jan. 1979 333 p refs Prepared in cooperation with Modern Analysis, Inc.
(Contract F33615-77-C-3121)
(AD-A072386; NA-78-491-3-Vol-1; AFFDL-TR-79-3036-Vol-1) Avail: NTIS HC A15/MF A01 CSCL 01/3

This report presents the interim status of a program which aims to upgrade the crack growth prediction technology required for the implementation of the damage-tolerance and durability control procedures throughout the life cycle of any weapon system. The controlling damage parameters in flight-by-flight loading for all classes of aircraft have been identified. Methodologies which characterize the flight spectra have been developed. Guidelines for development of three levels of crack growth analysis used for detail design, individual aircraft tracking, and preliminary design have been established. GRA

N80-11073# Neilsen Engineering and Research, Inc., Mountain View, Calif.
PREDICTION OF LATERAL AERODYNAMIC LOADS ON FIGHTER AIRCRAFT AT HIGH ANGLES OF ATTACK Summary Technical report, 1 May 1977 - 31 Jul. 1978
S. B. Spangler and S. C. Perkins, Jr. 31 Jul. 1978 86 p refs
(Contract N00014-74-C-0344)
(AD-A071893; NEAR-TR-173; ONR-CR212-225-4F) Avail: NTIS HC A05/MF A01 CSCL 20/4

This report presents a brief summary of methods and experimental data developed over a four year period, to predict the static lateral forces acting on a modern fighter-type aircraft at high angles of attack, and small angles of sideslip characteristic of a departure flight attitude. The major part of the report is devoted to application of the methods to two aircraft configurations on which detailed data exist, comparison of the predicted and measured results, and evaluation of the comparisons. The configurations are a research V/STOL fighter configuration and the F-5 aircraft. Comparisons are made on nose vortex positions, circulation distributions in the separated region above the nose, flow velocities in the same region, and loads on the nose alone and complete configuration. Generally, the methods predict all of the correct behavior of these highly nonlinear and complicated flows. However, the agreement in many cases is not sufficiently good to consider the methods as satisfactory design or analysis techniques. Additional work is suggested to provide further verification and improvements. GRA

N80-11074# Polar Research Lab., Inc., Santa Barbara, Calif.
FEASIBILITY TESTS OF USE OF THE TRI TURBO-3 AIRCRAFT FOR ARCTIC AXBT DROPS Interim Report
B. M. Buck 25 Jul. 1979 17 p
(Contract N00014-79-C-0002; RR0320501)
(AD-A073159; PRL-TR-19) Avail: NTIS HC A02/MF A01 CSCL 08/10

Field feasibility trials of the new Arctic Tri Turbo-3 Aircraft were conducted as part of ONR's Arctic East Program in the Eurasian Basin. One of these trials was a test of its usefulness to collecct temperature profiling data in the Greenland-Svalbard Strait in support of underwater acoustics studies. This report describes the aircraft facilities, dropping techniques and results of trial drops. GRA

N80-11075# Kuhn (Richard E.), Newport News, Va.
HEIGHT OF SPRAY PRODUCED BY VERTICAL TAKEOFF AND LANDING (VTOL) AIRCRAFT
Richard E. Kuhn Apr. 1979 30 p refs
(Contract N00167-78-M-2599)
(AD-A073099; DTNSRDC/ASED-79/04) Avail: NTIS HC A03/MF A01 CSCL 01/2

The flow phenomenon involved in the production of spray by a vertical takeoff and landing aircraft hovering over smooth water is examined, and a method for predicting spray height is developed from a correlation of the limited amount of large-scale data available. The method is limited to conditions where the spray height does not exceed the nozzle or rotor height and includes VTOL concepts ranging from the helicopter to jet VTOL'S. Application of the method shows that the spray height is primarily dependent on the operating weight of the aircraft and is only slightly dependent on the disk loading. GRA

N80-11076# Pisa Univ. (Italy). Ist. di Aeronautica.
A METHOD FOR EVALUATING AIRCRAFT TAKE-OFF PERFORMANCE [UN METODO PER LA VALUTAZIONE DELLE PRESTAZIONI DEI VELIVOLI]
C. Casarosa, A. Mancino, and N. Motroni Jun. 1978 74 p refs In ITALIAN; ENGLISH summary
(Contracts CNR-76-00442.07; CNR-76-01620.07)
(Rept-1663; AIA-78-1) Avail: NTIS HC A04/MF A01

A theoretical method and a computation program for aircraft takeoff performance evaluation are presented. The method is based on the integration of the center of gravity motion equation and allows for the evaluation of takeoff performance in function of the main aerodynamic and propulsive characteristics of the aircraft as well as of the takeoff procedure used. Performance evaluation in the case of critical engine failure after a critical point is also possible. The method was tried for the takeoff performance evaluation of a typical executive aircraft having two turbojet engines. Theoretical results were compared with experimental ones and good agreement is shown. Results show that the use of this computerized simulation method for determining aircraft to airfield compatibility is reliable.
Author (ESA)

N80-11078# National Transportation Policy Study Commission, Washington, D. C.
NEW AIRCRAFT TECHNOLOGY: REPORT ON THE FARNBOROUGH INTERNATIONAL AIR SHOW
Samuel Colwell Aug. 1979 12 p
(PB-298345/0; NTPSC-WP-79/06) Avail: NTIS HC A02/MF A01 CSCL 01C

Aircraft displayed at the air show are described with emphasis on those that are likely to have significant impact on nonmilitary aviation market for the rest of the century. Categories of aircraft considered include commercial, light transport, general aviation, and helicopters. The Mountbatten (SR.N4) MK.3 hovercraft is also discussed. Of particular interest is the number of STOL aircraft and the reduced noise characteristics. A.R.H.

N80-11079*# Old Dominion Univ., Norfolk, Va.
AVIONICS: PROJECTIONS FOR CIVIL AVIATION, 1995-2000
Griffith J. McRee (Old Dominion Univ.), Russell E. Lueg (Ala. Univ., Tuscaloosa, Ala.), Patricia A. Carlson, ed. (Rose-Hulman Inst. of Tech.), Yearn H. Choi (Jackson State Univ.), John Barrett Crittenden (Va. Polytech. Inst. and State Univ.), Jeffrey C. Dozier

(Coll. of William and Mary), Robert M. Eastman (Missouri-Columbia Univ.), Jerry W. Gravander, ed. (Clarkson Coll. of Tech.), Andrew Hargrove (Hampton Inst.), Alvin E. Keaton, ed. (New Mexico State Univ.) et al Sep. 1979 205 p refs Sponsored by NASA
(NASA-CR-159035) Avail: NTIS HC A10/MF A01 CSCL 10D

A view of the 1995-2000 civil aviation avionics system is summarized. Descriptions of the scenarios considered, the avionics technologies, the 1995-2000 avionics system, and an evaluation of the impacts are presented. Recommendations are also presented. R.E.S.

N80-11080# Semcor, Inc., Moorestown, N. J.
AVIONIC SYSTEM ARCHITECTURE INVESTIGATION (AVSAR II)
D. Davino, R. Mereday, M. Minnich, R. Noble, and L. Sorenson 20 Mar. 1979 246 p
(Contract DAAB07-78-C-2445; DA Proj. 1L1-62202-AH-85)
(AD-A071743) Avail: NTIS HC A11/MF A01 CSCL 09/2

The objective of the Avionic System Architecture Investigation (AVSAR II) was to investigate the extent to which multiplex technology and integrated control/display techniques could be applied to the AH-1S Night Cobra (Step 4). The primary purpose of the study was to determine if the integration of a multiplex data bus system would have a significant impact on aircraft system weight. Secondary objectives were to determine whether a reduction of crew workload and a reduction of cockpit real estate requirements could be effected through implementation of the new architecture. This technical report describes the system analysis, system definition, and system integration considerations that resulted in a Step 4 Night Cobra avionic system with integrated controls/displays and a multiplex data bus. GRA

N80-11083# Arinc Research Corp., Annapolis, Md.
AVIONICS MASTER PLAN DATA BASE MECHANIZATION ARCHITECTURE
J. Maquire and M. Berger Jun. 1979 56 p
(Contract F33657-79-C-0475)
(AD-A071545; PUBL-1743-01-1-1963) Avail: NTIS HC A04/MF A01 CSCL 05/1

This report addressed the development of the architecture for mechanizing the program tracking system used by the Deputy for Avionics Control ASD/AX in the Avionics Master Plan AMP preparation and in the avionics control function. The effort described is to be utilized by the ASD Data Processing facility ADP in its coding and implementation of the AMP data base storage and retrieval program on the DEC PDP 11T60 computer. GRA

N80-11084# Army Aeromedical Research Lab., Fort Rucker, Ala.
IN-FLIGHT PERFORMANCE EVALUATION OF EXPERIMENTAL INFORMATION Final Report
Michael Lees, Michael G. Sanders, Raymond T. Burden, Jr., and Kent A. Kimball May 1979 27 p refs
(DA Proj. 3E7-62773-A-819)
(AD-A071701; USAARL-79-8) Avail: NTIS HC A03/MF A01 CSCL 01/4

The objective of this investigation was to evaluate a method of displaying information which, permits rapid transmission of flight data to the operator under three viewing conditions: (1) day flights with the unaided eye, (2) night flights with the unaided eye, and (3) night flights using the AN/PVS-5 night vision goggles (40 deg field of view focused at infinity). Information obtained from the analyses of aviator performance data demonstrated the potential of presenting flight information to the aircrew via prototype displays for all viewing modes. GRA

N80-11085# Tactical Air Command, Langley AFB, Va.
F-4 RADAR ALTIMETER AURAL WARNING
29 Jun. 1979 4 p
(AD-A072870) Avail: NTIS HC A02/MF A01 CSCL 01/4

The F-4 radar altimeter has a red warning light that lights up when the aircraft goes below a selected altitude. This light is small and will not attract the pilot's attention if it is not in his field of view. Numerous accidents have occurred in which aircraft have struck the ground in level terrain when the mission required primarily straight and level flight. It has been postulated that an aural warning supplied by the radar altimeter would have alerted the aircrew in sufficient time to avoid contact with the ground. GRA

N80-11088# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Directorate of Management scienties.
OPPORTUNISTIC MAINTENANCE ENGINE SIMULATION MODEL: OMENS 2 Final Report
John L. Madden, Philip A. Persensky, Virginia L. Williamson, and Robert A. Novak Jun. 1979 133 p
(AD-A072516; AFLC/XRS-79-137-1) Avail: NTIS HC A08/MF A01 CSCL 21/5

This model simulates the operation of a single engine through a very long period of future time. In operating over this extended period, the engine must be removed for repair from time to time. Repairs become necessary on the engine when one of the modules fails prematurely or whenever it requires replacement of an internal life-limited part. The model tracks all the engine removals and all replacements of each module and offending life-limited part through future simulated time. Records are kept through simulated time of the number of removals and the reasons for removal for each module and for the engine. Reasons for removal include (1) premature failure of one or more parts, (2) reaching the scheduled operating time limit, or (3) being screened out due to the opportunistic maintenance policy. The model also computes maintenance, pipeline, parts costs, and transportation costs associated with the forecasted removals and aggregates the costs for any desired life cycle period (in years) to aid in selecting that optimal maintenance policy which produces the least total cost. GRA

N80-11089# Naval Air Test Center, Patuxent River, Md. Air Vehicle Technology Dept.
SIMULATED MISSION ENDURANCE TEST (SMET) FOR AN AIRCRAFT ENGINE TO BE USED IN A FIGHTER/ATTACK ROLE Final Report
S. M. Cote and J. L. Birkler 23 Apr. 1979 130 p refs
(AD-A071907; NADC-77051-30) Avail: NTIS HC A07/MF A01 CSCL 21/5

A 750 hour simulated mission endurance test (SMET) cycle which will closely represent the expected in-service engine duty cycle for the F18 power plant has been developed. The test cycle evolved from an extensive investigation of Navy and Marine fleet engine operating conditions experienced in fighter and attack aircraft during shorebased and carrier operations. The test cycles reflect power lever movements that are an order of magnitude greater than originally thought, and incorporate a representative distribution of time at intermediate and augmented power. It is concluded that this SMET will aid the overall development process to substantiate the suitability of a new engine for service introduction. GRA

N80-11090# Ford Motor Co., Dearborn, Mich.
BRITTLE MATERIALS DESIGN, HIGH TEMPERATURE GAS TURBINE Interim Report, 30 Sep. 1977 - 31 Mar. 1978
Arthur F. Mclean and John R. Secord Army Materials and Research Center, Watertown, Mass. Army Materials and Research Center, Watertown, Mass. May 1979 77 p refs
(Contracts DAAG46-71-C-0162; ARPA Order 1849)
(AD-A071750; AMMRC TR-79-12) Avail: NTIS HC A05/MF A01 CSCL 21/5

Modifications in the procedure for hot spin testing ceramic rotors resulted in several changes. Of twenty-five rotors being proposed for hot testing, ten were inspected by dye-penetrant methods, dimensionally inspected, and curvic coupling contact patterns checked. Five have now completed hot testing; six are ready for test, and the remainder are in processing. Four ceramic turbine rotors and one rotor hub were qualified for hot testing in the cold spin pit at 55,000 rpm, and three rotors and two rotor hubs were qualified to 70,000 rpm. Blades were lost on all rotors qualified to 70,000 rpm because of gross flaws in the blade cross section. From four to eleven blades per rotor were lost in qualification testing. Six rotors was subjected to a twenty-five hour durability test in the hot spin test rig at

50,000 rpm and 1800 F rim temperature. Four rotors completed the test and two failed during acceleration to test speed. In several instances, post test rotor inspection revealed presence of curvic tooth cracking after disassembly from the test shaft. One of the successful rotors was operated an additional 175 hours to complete the objective of 200 hours at 1800 F rim temperature over a simulated duty cycle speed schedule. GRA

N80-11092# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.
THE EFFECT OF INTERBLADE PHASE ANGLE AND SOLIDITY ON THE TIME VARIANT AERODYNAMIC RESPONSE OF A COMPRESSOR STATOR Interim Report, 1 May 1978 - 1 May 1979
R. R. Allran Jun. 1979 55 p
(Contract F49620-78-C-0070; AF Proj. 2307)
(AD-A071878; DDA-EDR-9930; AFOSR-79-0853TR) Avail: NTIS HC A04/MF A01 CSCL 21/5

The overall objective of this experimental program was to quantify the effects of the reduced frequency as well as the interblade phase angle and associated solidity variations on the fundamental time-variant aerodynamics relevant to forced response in turbomachinery. This was accomplished in a large, low speed, single-stage research compressor which permitted variation of the interblade phase angle and solidity by varying the number of rotor to stator blades. A single value of interblade phase angle, 36 degrees and a corresponding value of solidity of .758, the aerodynamically induced fluctuating surface pressure distributions on the downstream vane row, with the primary source of excitation being the upstream rotor wakes, were measured over a wide range of compressor operating conditions. The individual vane surface data were investigated to determine the effect of interblade phase angle and solidity on the overall unsteady pressure magnitude as well as to determine the dynamic pressure coefficient and aerodynamic phase lag for the unsteady pressure differential across the vanes. The unsteady pressure differential data were correlated with predictions from a state-of-the-art flat plate cascade transverse gust analysis. GRA

N80-11093# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
DESIGN AND PERFORMANCE EVALUATION OF SUPER-CRITICAL AIRFOILS FOR AXIAL FLOW COMPRESSORS Final Report
H. E. Stephens and D. E. Hobbs Jun. 1979 45 p refs
(Contract N00019-77-C-0546)
(AD-A071206; PWA-FR-11455) Avail: NTIS HC A03/MF A01 CSCL 20/4

Pratt Whitney Aircraft has developed an analytical design procedure for producing supercritical cascade airfoils satisfying practical aerodynamic and structural requirements. The purpose of this research is to demonstrate the potential for substantial efficiency improvements in compressor stages incorporating these airfoil designs. The midspan section of a fan exit stator was selected for the design application. An airfoil was designed, fabricated, and tested in a transonic cascade tunnel. Test conditions were varied over a wide range of inlet flow angles and inlet Mach numbers to determine design and off-design performance. Test point information included inlet and exit conditions and airfoil surface pressure distribution. GRA

N80-11094# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF AN EJECTOR POWERED ENGINE SIMULATOR AT TRANSONIC MACH NUMBERS Final Report
C. E. Robinson AEDC Jul. 1979 248 p refs Sponsored by the Air Force
(AD-A071607; AEDC-TR-78-69) Avail: NTIS HC A11/MF A01 CSCL 20/4

An experimental program was conducted to evaluate an air-driven ejector for use as a turbo-engine simulator in wind tunnel testing. The use of an engine simulator will provide the capability to simultaneously simulate inlet and afterbody flow fields of a turbo-powered vehicle. The ejector-powered engine simulator (EPES) was fitted to the right-wing nacelle of a 0.06 scale B-1 aircraft model. The B-1 model was chosen for the investigation because of the availability for comparisons of inlet and nozzle afterbody data previously obtained in the Arnold Engineering Development Center (AEDC) Propulsion Wind Tunnel Facility Propulsion Wind Tunnel (16T) using conventional test techniques. A limited amount of flight data from the B-1 flight to wind tunnel correlation program was also available to aid in determining the effectiveness of the EPES as a wind tunnel test tool. GRA

N80-11095# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
THE USE OF THE MAURER FACTOR FOR ESTIMATING THE COST OF A TURBINE ENGINE IN THE EARLY STAGES OF DEVELOPMENT Final Report, Jun. 1978 - Jun. 1979
Charles W. Barrett, Jr. and Michael J. Koenig Jun. 1979 165 p refs
(AD-A073018; AFIT-LSSR-19-79A) Avail: NTIS HC A08/MF A01 CSCL 14/1

Military managers are faced with increasing systems costs. One area where this increasing cost is especially true is in the acquisition of aircraft weapon systems. A driving factor in the aircraft cost is the turbine engine, and therefore, acquisition managers have been tasked with developing cost estimating methods that will more accurately predict turbine engine cost. At present, several parametric costing models available are briefly discussed in this report. However, the primary objective of this report, is to evaluate a costing technique used extensively by the Navy--the Maurer Factor (MF) technique. The MF technique is a parametric costing technique based on the materials in a turbine engine. The report includes the following: (a) a detailed description of the MF technique; (b) a validation of the MF technique; (c) the development of an estimated MF (EMF) model using engine performance parameters; and (d) statistical analysis and validation of the EMF models. GRA

N80-11096# Defence Research Information Centre, Orpington (England).
ON THE DEVELOPMENT OF THE RB 199
Mariano Gubitosi London Dec. 1978 22 p Transl. into ENGLISH from Rivista Aeron. (Rome), v. 54, no. 3, May-Jun. 1978 p 32-39
(DRIC-Trans-5429; BR67500) Avail: NTIS HC A02/MF A01

The development of the RB 199 engine as a tailor-made solution for the MRCA 'Tornado' project is discussed. Operational requirements, such as very high thrust under combat flight conditions and low fuel consumption under other flight conditions, are considered. Design technological alternatives, principally thrust/weight ratio, and as built characteristics are examined. The triple-shaft configuration is treated in light of the performance principles of a jet engine. Among functional choices, afterburn, the double flow solution, and the setting of the by-pass ratio are particularly detailed. Finally, the RB 199 turbofan is described and a short synopsis of the design evolution of this engine is given. Author (ESA)

N80-11097*# Systems Technology, Inc., Mountain View, Calif.
A COMPILATION AND ANALYSIS OF HELICOPTER HANDLING QUALITIES DATA. VOLUME 1: DATA COMPILATION Report, Sep. 1976 - Feb. 1978
Robert K. Heffley, Wayne F. Jewell, John M. Lehman, and Richard A. VanWinkle Aug. 1979 387 p refs
(Contract NAS2-9344)
(NASA-CR-3144; TR-1087-1) Avail: NTIS HC A17/MF A01 CSCL 01C

A collection of basic descriptive data, stability derivatives and transfer functions for six degrees of freedom, quasi-static model is introduced. The data are arranged in a common, compact format for each of the five helicopters represented. The vehicles studied include the BO-105, AH-1h, and the CH53D. R.C.T.

N80-11099# Naval Surface Weapons Center, White Oak, Md.
INEQUALITIES AND APPROXIMATION WITH APPLICATIONS TO VSTOL AIRCRAFT
William W. Hager and John W. Wingate 3 Dec. 1978 24 p refs

(AD-A071807; NSWC/WOL/TR-78-210) Avail: NTIS HC A02/MF A01 CSCL 01/3

A class of inequalities are discussed that are related to the following topics: (1) error estimates for variational inequality and optimal control approximation; (2) stability for mathematical programs; and (3) solution regularity for optimal control problems. These results are used to study the error in the semidual method for approximating the solution to optimal control problems. The application of the semidual to optimize VSTOL flight trajectories is discussed. GRA

N80-11100# California Univ., Los Angeles. School of Engineering and Applied Science.

ENTROPHY ANALYSIS OF FEEDBACK FLIGHT DYNAMIC CONTROL SYSTEMS Final Report, May 1977-May 1978

Henry Lawrence Weidemann and C. T. Leondes Jan. 1979 165 p refs

(Contract F33615-77-C-3013; AF Proj. 2307)

(AD-A072259; AFFDL-TR-78-123) Avail: NTIS HC A98/MF A01 CSCL 01/2

This report is a study of the application of the entropy function of Information Theory to the analysis of sampled data systems so characteristic of the evolving and important field of digital flight control, including multimode systems. The systems studied are both feed-forward and feedback with the emphasis placed on the regulator problem. The feature common to all the configurations is the presence of a sensor which measures the input signal and which has an output that is usually some random function of the input. For the purposes of the analysis it is convenient to describe the behavior of the sensor by its Sensor Channel Transmittance, which is defined as the mutual information between the input and output of the measuring device. This quantity is not independent of the properties of the input signal; however, in any given problem it need only be calculated once. This research is important because it imbeds the control problem in the communication problem and clearly demonstrates the manner in which the information handling capability of the system elements limits performance, and is, therefore, of considerable potential significance to advanced flight dynamic systems. GRA

N80-11101# Rodden (William P.), La Canada, Calif.

AERO-SERVO-ELASTIC STABILITY ANALYSIS Final Report, 6 Apr. 1976 - 21 Jul. 1977

William P. Rodden, Mildred R. Zeifman, and John M. Powers, Jr. Apr. 1979 205 p refs

(Contract N00019-76-C-0346)

(AD-A072797) Avail: NTIS HC A19/MF A01 CSCL 14/2

A general matrix formulation of the aero-servo-elastic stability problem is presented based on the British method of flutter analysis. The analysis applies to the closed-loop system, and the digital computer program (MPASES) developed to perform the analysis is described. An application is made to a typical air-to-air missile with three feedback loops. GRA

N80-11102*# Virginia Univ., Charlottesville.

EXPERIMENTAL FEASIBILITY STUDY OF THE APPLICATION OF MAGNETIC SUSPENSION TECHNIQUES TO LARGE-SCALE AERODYNAMIC TEST FACILITIES

R. N. Zapata, Robert R. Humphris, and Karl C. Henderson 1975 10 p refs Submitted for publication

(Grants NGR-47-005-029; NGR-47-005-110; NGR-47-005-112; NsG-1010)

(NASA-CR-146761) Avail: NTIS HC A02/MF A01 CSCL 14B.

Based on the premises that magnetic suspension techniques can play a useful role in large scale aerodynamic testing, and that superconductor technology offers the only practical hope for building large scale magnetic suspensions, an all-superconductor 3-component magnetic suspension and balance facility was built as a prototype and tested sucessfully. Quantitative extrapolations of design and performance characteristics of this prototype system to larger systems compatible with existing and planned high Reynolds number facilities at Langley Research Center were made and show that this experimental technique should be particularly attractive when used in conjunction with large cryogenic wind tunnels. A.R.H.

N80-11103*# San Jose State Univ., Calif. Dept. of Psychology.

PERCEPTION AND PERFORMANCE IN FLIGHT SIMULATORS: THE CONTRIBUTION OF VESTIBULAR, VISUAL, AND AUDITORY INFORMATION Final Report

Oct. 1979 20 p refs

(Grant NsG-2269)

(NASA-CR-162129) Avail: NTIS HC A02/MF A01 CSCL 14B

The pilot's perception and performance in flight simulators is examined. The areas investigated include: vestibular stimulation, flight management and man cockpit information interfacing, and visual perception in flight simulation. The effects of higher levels of rotary acceleration on response time to constant acceleration, tracking performance, and thresholds for angular acceleration are examined. Areas of flight management examined are cockpit display of traffic information, work load, synthetic speech call outs during the landing phase of flight, perceptual factors in the use of a microwave landing system, automatic speech recognition, automation of aircraft operation, and total simulation of flight training. A.W.H.

N80-11105# Systems Technology, Inc., Hawthorne, Calif.

MANNED ENGINEERING FLIGHT SIMULATION VALIDATION, PART 2: SOFTWARE USER'S GUIDE Final Report, Aug. 1977 - Nov. 1978

Susan A. Riedel Feb. 1979 57 p

(Contract F33615-77-C-206518)

(AD-A071395; STI-TR-1110-2; AFFDL-TR-78-192-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 14/2

The goal of this research is to establish an orderly, relatively simple method for optimizing the presentation of motion cues in moving base simulations. This is accomplished via choice of the drive logic parameters for a given simulator and flying task. The method developed here is based upon use of motion fidelity criteria. It has been applied to optimize the LAMARS motion base drive logic parameters for an air-to-ground scenario. The methods and procedures can be applied for any given motion base and any desired scenario. This report describes the FORTRAN computer program used for evaluating and optimizing motion base drive logic. GRA

N80-11106# Little (Arthur D.), Inc., Cambridge, Mass.

SYSTEMS ANALYSIS OF ARCTIC FUELS DISPENSING EQUIPMENT Final Report, 1 Jan. - 30 Jun. 1979

Donald B. Rosenfield, Edgar A. Gilbert, III, and John S. Howland 30 Jun. 1979 174 p

(Contract DAAK70-77-D-0024)

(AD-A071815; ADL-80260-18) Avail: NTIS HC A08/MF A01 CSCL 21/4

A systems analysis was performed to evaluate military fuel dispensing systems for arctic applications. The present systems, the Forward Area Refueling Equipment (FARE) and Fuels System Supply Point (FSSP), encounter problems in the areas because engines fail to start and elastomerics become brittle at temperatures of -60 F. The systems analysis consisted of two phases of evaluating and scoring system attributes for numerous combinations of systems concepts and components. The systems with the highest evaluations were the basic designs with gas turbine drives, state-of-the-art elastometrics, and either state-of-the-art batteries or a compressed gas start. It was also concluded that additonal development should be undertaken in the area of cold weather elastomerics. GRA

N80-11110# Fondazione Ugo Bordoni, Rome (Italy).

SURVEILLANCE AND COMMUNICATION SYSTEMS USING MOBILE MEDIA ON THE AIRPORT SURFACE [SISTEMI DI SORVEGLIANZA E DI COMUNICAZIONE CON MEZZI MOBILI SULLA SUPERFICIE AEROPORTUALE]

Tullio Corzani (Trieste Univ., Italy) and Gabriele Falciasecca (Bologna Univ.) Sep. 1978 10 p refs In ITALIAN Presented at 79th A.E.I. Ann. Reunion, Catanzaro, Italy, Sep. 1978 Sponsored by CNR

(FUB-13-1978) Avail: NTIS HC A02/MF A01

The problems of an airport surface traffic control system developed in Italy are examined. A selection among possible

systems is discussed, starting with solutions which use primary radar (now being adopted in many airports) and arriving at a completely automated system for surveillance and control of the airport surface, based on the use of secondary surveillance radar equipment on the ground. Author (ESA)

N80-11201# Failure Analysis Associates, Palo Alto, Calif.
FRACTURE AND FATIGUE PROPERTIES OF 1Cr-Mo-V BAINITIC TURBINE ROTOR STEELS
I. Roman, C. A. Rau, Jr., A. S. Tetelman, and K. Ono Mar. 1979 268 p refs
(EPRI Proj. 700-1)
(EPRI-NP-1023) Avail: NTIS HC A12/MF A01

The deformation, fracture and fatigue properties of 1Cr-Mo-V turbine rotor steel have been evaluated for a wide range of loading conditions and metallurgical structures controlled by melting and heat treatment practice. The mechanical property differences and corresponding metallurgical differences between older, air-melted steels and newer heats that are vacuum degassed were determined. The effects of prior fatique cycling on fracture toughness were measured, and a model was developed to predict the effect for various materials and loading conditions. Irrespective of the fracture mode, materials which soften under strain cycling, like this rotor steel, show a toughness which increases with number and magnitude of prior fatigue cycling. DOE

N80-11238*# Union Carbide Corp., Tonawanda, N.Y. Linde Div.
ECONOMICS OF HYDROGEN PRODUCTION AND LIQUEFACTION UPDATED TO 1980
C. R. Baker Nov. 1979 41 p refs
(Contract NAS1-14698)
(NASA-CR-159163) Avail: NTIS HC A03/MF A01 CSCL 21D

Revised costs for generating and liquefying hydrogen in mid-1980 are presented. Plant investments were treated as straight-forward escalations resulting from inflation. Operating costs, however, were derived in terms of the unit cost of coal, fuel gas and electrical energy to permit the determination of the influence of these parameters on the cost of liquid hydrogen. Inflationary influence was recognized by requiring a 15% discounted rate of return on investment for Discounted Cash Flow financing analysis, up from 12% previously. Utility financing was revised to require an 11% interest rate on debt. The scope of operation of the hydrogen plant was revised from previous studies to include only the hydrogen generation and liquefaction facilities. On-site fuel gas and power generation, originally a part of the plant complex, was eliminated. Fuel gas and power are now treated as purchased utilities. Costs for on-site generation of fuel gas however, are included. A.R.H.

N80-11244# Exxon Research and Engineering Co., Linden, N.J.
FUNDAMENTAL CHARACTERIZATION OF ALTERNATE FUEL EFFECTS IN CONTINUOUS COMBUSTION SYSTEMS
W. S. Blazowski, R. B. Edelman (Science Applications, Inc., Woodland Hills, Calif.), and P. T. Harsha (Science Applications, Inc., Woodland Hills, Calif.) 11 Sep. 1978 86 p refs
(Contract EC-77-C-03-1543)
(SAN-1543-12) Avail: NTIS HC A05/MF A01

The development of fuel-flexible combustion systems for gas turbines as well as Rankine and Stirling cycle engines is presented. An improved understanding was developed of relationships between alternate fuel properties and continuous combustion system effects, and to provide analytical modeling/correlation capabilities to be used as design aids for development of fuel-tolerant combustion systems. Experimental procedures were evaluated for studying alternate fuel combustion effects and to determine current analytical capabilities for prediction of these effects. Jet Stirred Combustor studies during this period produced new insights into soot formation in strongly back-mixed systems and have provided much information for comparison with analytical predictions. Applications of quasi-global modeling techniques were included as well as comparison of prediction with the experimental results generated. DOE

N80-11247# California Univ., Livermore. Lawrence Livermore Lab.
BEHAVIOR OF LIGHTLY CONFINED HIGH EXPLOSIVES IN A JET-FUEL FIRE
K. J. Scribner and G. J. Tanaka 2 Feb. 1979 23 p
(Contract W-7405-eng-48)
(UCRL-52659) Avail: NTIS HC A02/MF A01

The effects of a jet-fuel fire on the behavior of several plastic-bonded explosives of military interest were investigated. Eight small spherical explosive assemblies cased in stainless steel and containing thermocouples to record the ambient flame temperature at several points inside the assembly were fabricated. The explosive formulations contained HMX, TATB, NO, or combinations of HMX with either TATB or NQ. When these units were tested, similar behavior for all formulations was observed. There were no detonations. Decomposition began at the outer surface of the high-explosive charge and proceeded slowly toward the center, and all casings vented under the pressure of the decomposition products. Thermograms showed that, under the test conditions, TATB is the most thermally stable and NQ is the least stable of the three explosives tested. DOE

N80-11273# National Aviation Facilities Experimental Center, Atlantic City, N. J.
VOICE DATA ENTRY IN AIR TRAFFIC CONTROL Report, May 1975 - Dec. 1978
Donald W. Connolly Aug. 1979 76 p refs
(FAA Proj. 219-151-100)
(AD-A073670; FAA-NA-79-20) Avail: NTIS HC A05/MF A01 CSCL 17/2

The potential operational utility of state-of-the-art word recognition technology in air traffic control applications were studied. Experiment 1, employing 12 operators or talkers, secured baseline data representing the inherent best case recognition accuracy of the system. Three of the subvocabularies of an operational data entry language were tested exhaustively to a total of over 46,000 spoken words. On the average, across all speakers and all three subvocabularies, only 1 percent of the words spoken were erroneously recognized. Subsequent tuning of the recognition algorithm reduced the error rate to less than 0.4 percent. Experiment 2 compared the quality and efficiency of the voice system versus the existing keyboard method of entering complete operational messages. The voice system produced 64 percent fewer errors of all kinds than the keyboard in the messages entered, but showed no advantage (or disadvantage) in rate of entry. Voice entry, however, did demonstrate an advantage in the overall time consumed by the data entry process - less time was required to translate entry requirements into the spoken language than into the keyboard code. Other influential factors were also examined, including the effects of microphone type, individual differences between operators, the stability of operators' word-prints over time, and operator adaptation to the voice entry system. F.O.S.

N80-11275# IIT Research Inst., Annapolis, Md.
EVALUATION OF TRANSPONDER ANTENNA COVERAGE/ATCRBS DURING SIMULATED FLIGHTS OF AIRCRAFT Final Report
Thomas Gibson Apr. 1979 73 p refs
(Contracts DOT-FA70WAI-175; F19628-78-C-0006)
(AD-A073547; ECAC-PR-76-019; FAA-RD-77-122) Avail: NTIS HC A04/MF A01 CSCL 17/9

A computer model was used to analyze the effect of aircraft orientation on the performance of the Air Traffic Control Radar Beacon System (ATCRBS). Flights by Cessna 150, Boeing 727, Boeing 747, and F-4H aircraft over a common flight route out of La Guardia Airport were simulated. Transponder/antenna performance for various aircraft attitudes and locations along the flight path was analyzed with respect to interrogators located at JFK airport. This performance was compared to a transponder having ideal, omni-directional antenna coverage to illustrate the degree to which the combination of aircraft orientation and transponder antenna pattern may affect ATCRBS performance. Author

N80-11309# Rome Air Development Center, Griffiss AFB, N.Y.
HEMISPHERICAL COVERAGE OF FOUR-FACED AIRCRAFT ARRAYS
Robert J. Mailloux and William G. Mavroides May 1979 19 p refs
(AF Proj. 4600)
(AD-A073079; RADC-TR-79-176) Avail: NTIS HC A02/MF A01 CSCL 17/1

This report describes the radiating characteristics of a four-faced array with faces arranged in a streamlined configuration for hemispherical coverage. The report presents new experimental and theoretical results giving coverage for a side array in the plane perpendicular to the cylinder and shows that the structure radiates both polarizations efficiently for angles from the zenith to the horizon. In the absence of mutual coupling effects, the circularly polarized radiation remains within approximately 1 dB of the array projection factor. Finally, the report presents coverage contours for a four-faced array with the front and back faces half the size of the side faces. In this case, the proper choice of front array tilt angle can result in a hemispherical gain projection factor within 3.5 dB of peak gain over nearly the whole hemisphere. GRA

N80-11399# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
A STUDY OF COHERENT STRUCTURES IN AXISYMMETRIC JETS USING AN OPTICAL TECHNIQUE
Gautam T. Kalghatgi Jun. 1979 38 p refs
(Contract MIN-DEF/AT/2040/084)
(AASU-341) Avail: NTIS HC A03/MF A01

Coherent structures in the first six diameters of five axisymmetric jets of different velocities and densities were studied by an optical method using the deflection of laser beams caused by density gradients in the flow. Results show that the average interval between succesive events increases with axial distance independently of the density, velocity, or Reynolds number of the jets and that near the nozzle exit plane the interval is very similar to that found for two dimensional mixing layers. The proposition that there are random interactions between the coherent structures as they are convected downstream is used to explain many of the observations. Author (ESA)

N80-11474# Brunswick Corp., Deland, Fla. Technetics Div.
DEVELOPMENT OF IMPROVED ABRADABLE COMPRESSOR GAS PATH SEAL Final Report, 20 Sep. 1976 - 19 May 1978
W. P. Jarvi and A. R. Erickson Jul. 1978 140 p
(Contract F33615-76-C-5302; AF Proj. 7312)
(AD-A072171; ER-382; AFML-TR-78-101) Avail: NTIS HC A07/MF A01 CSCL 21/5

A number of fiber metal systems were evaluated by rig testing in comparison with the base line material, FM-521 - a 19% dense, Haynes 188, 8 micron fiber metal - which is the standard production material used for the highest temperature compressor blade tip seals in the P and WA F-100 engine. A range of densities and strengths of alternative materials were evaluated including Haynes 188, FeCrAlY, NiCrAlY, and FeNiCrAlY employing fiber diameters in the range of 8 - 23 microns with fiber aspect ratios in the range of 45 - 80. Rig tests employed were high speed rub testing, cyclic static oxidation, cyclic dynamic oxidation, and hot particulate erosion. These data were supplemented with measurements of mechanical, thermal, and chemical properties. The best material tested was a 20.5% dense FeNiCrAlY fiber metal employing 17 micron fibers. This had at least equivalent abradability and improved oxidation and erosion resistance in comparison with the base line material. GRA

N80-11505*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LIGHT AIRPLANE CRASH TESTS AT THREE-PITCH ANGLES
Victor L. Vaughan, Jr. and Emilio Alfaro-Bou Nov. 1979 62 p refs
(NASA-TP-1481) Avail: NTIS HC A04/MF A01 CSCL 01C

Three similar twin-engine general aviation airplane specimens were crash tested at an impact dynamics research facility at 27 m/sec, a flight path angle of -15 deg, and pitch angles of -15 deg, 0 deg, and 15 deg. Other crash parameters were held constant. The test facility, instrumentation, test specimens, and test method are briefly described. Structural damage and accelerometer data for each of the three impact conditions are presented and discussed. Author

N80-11513# Northrop Corp., Hawthorne, Calif. Aircraft Group.
EFFECT OF MULTIAXIAL LOADING ON CRACK GROWTH. VOLUME 1: TECHNICAL SUMMARY Final Report, 15 Sep. 1976 - 15 Sep. 1978
A. F. Liu and D. F. Dittmer Dec. 1978 238 p refs
(Contract F33615-76-C-3121; AF Proj. 486U)
(AD-A072122; NOR-78-161-Vol-1; AFFDL-TR-78-175-Vol-1)
Avail: NTIS HC A11/MF A01 CSCL 20/11

An exploratory research program has been conducted to systematically evaluate the effects of biaxial stress ratio on constant amplitude and variable amplitude fatigue crack growth rates. A series of experiments and analyses have been carried out on the cyclic crack growth behavior of center-cracked cruciform specimens under various biaxial loading conditions. The results may be summarized as follows. Cracks will grow straight in a biaxial stress field when the stress component parallel to the crack is equal to or smaller than the stress component normal to the crack. Elastic K factors are obtainable for both straight and curved cracks and are adequate for correlating the biaxial growth rate data. At a given stress intensity level, the constant amplitude crack growth rates are the same in all the biaxial loading conditions. In out-of-phase loading conditions, the crack growth rate and crack growth directions are the same as those in the in-phase loading conditions. Crack tip plastic zone size variations with biaxial ratio appeared to have no effect on constant-amplitude crack growth rate. As for the variable amplitude tests, it is very evident that cracks grow faster at positive biaxial stress states, but slower at negative biaxial loading conditions. GRA

N80-11524# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FLIGHT SIMULATION FATIGUE CRACK PROPAGATION EVALUATION OF CANDIDATE LOWER WING SKIN MATERIALS WITH PARTICULAR CONSIDERATION OF SPECTRUM TRUNCATION
R. J. H. Wanhill 15 Jan. 1979 34 p refs
(Contract NIVR-1806)
(NLR-TR-77092-U) Avail: NTIS HC A03/MF A01

Flight simulation fatigue crack propagation tests were carried out on 2024-T3, 7475-T761, and mill annealed Ti-6Al-4V sheet in thicknesses up to 3 mm. These materials are representative of transport aircraft lower wing skin stiffened panels of end load capacities 1.5 and 3 MN/m. Results show that the performance of 2024-T3 is much superior, owing mainly to greater retardation of crack growth after severe flights. The effect of load truncation is also greater for 2024-T3. The significance of the results in the choice of advanced structural concepts and materials as well as in the choice of truncation level is discussed. A recommendation for further investigation is given. Author (ESA)

N80-11715# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
WIND SHEAR HAZARD DEFINITION FOR A WIDE BODY JET Final Report
Herbert W. Schlickenmaier Jun. 1979 80 p ref
(FAA-RD-79-90) Avail: NTIS HC A05/MF A01

A computer program is developed to simulate the flight dynamics and automatic flight control system (AFCS) of a three engine jumbo jet following a 3 deg glideslope during final approach. Wind shear profiles representative of actual encounters are used. The simulation uses both autopilot and autothrottle. An initial effort is made to define specific wind shear conditions that

pose hazards to aircraft. Parameter values are analyzed for each of four categorized wind shear environments and performance scores achieved on computer simulations are assigned for each of the four wind shear types. The most severe situations that can be accommodated by a jumbo tri-jet with current configuration are described for each of the four wind shear types. Conservative controllability criteria is applied and a hazardous condition is presumed to exist when the control action demanded and provided by the simulator exceeds the control limits of the actual aircraft, or when the airspeed and/or touchdown dispersion exceed limit values. Definition of these criteria provide a basis for the formulation of procedures allowing aircraft to anticipate and avoid hazardous wind shear conditions. A.R.H.

N80-11746# New Mexico Univ., Albuquerque. Technology Application Center.
CLEAR AIR TURBULENCE. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Jul. 1979
Samuel C. Mauk Sep. 1979 37 p Sponsored in part by NTIS
(NTIS/PS-79/0858/5) Avail: NTIS HC $28.00/MF $28.00 CSCL 01C

Articles covering research and analysis, theories and experiments, detection and measurement equipment, simulation modeling, and CAT accidents involving aircraft are presented. (Contains 121 citations) GRA

N80-11868*# Kentron International, Inc., Hampton, Va. Technical Center.
A METHOD FOR PREDICTING THE NOISE LEVELS OF COANNULAR JETS WITH INVERTED VELOCITY PROFILES
James W. Russell Washington NASA Oct. 1979 156 p refs
(Contract NAS1-13500)
(NASA-CR-3176) Avail: NTIS HC A08/MF A01 CSCL 20A

A coannular jet was equated with a single stream equivalent jet with the same mass flow, energy, and thrust. The acoustic characteristics of the coannular jet were then related to the acoustic characteristics of the single jet. Forward flight effects were included by incorporating a forward exponent, a Doppler amplification factor, and a Strouhal frequency shift. Model test data, including 48 static cases and 22 wind tunnel cases, were used to evaluate the prediction method. For the static cases and the low forward velocity wind tunnel cases, the spectral mean square pressure correlation coefficients were generally greater than 90 percent, and the spectral sound pressure level standard deviation were generally less than 3 decibels. The correlation coefficient and the standard deviation were not affected by changes in equivalent jet velocity. Limitations of the prediction method are also presented. R.C.T.

N80-11870*# Lockheed-Georgia Co., Marietta.
STUDIES OF THE ACOUSTIC TRANSMISSION CHARACTERISTICS OF COAXIAL NOZZLES WITH INVERTED VELOCITY PROFILES, VOLUME 1 Final Report
P. D. Dean, M. Salikuddin, K. K. Ahuja, H. E. Plumblee, and P. Mungur Cleveland, Ohio NASA May 1979 186 p refs
(Contract NAS3-20797)
(NASA-CR-159698; LG79ER0178-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 20A

The efficiency of internal noise radiation through coannular exhaust nozzle with an inverted velocity profile was studied. A preliminary investigation was first undertaken to: (1) define the test parameters which influence the internal noise radiation; (2) develop a test methodology which could realistically be used to examine the effects of the test parameters; (3) and to validate this methodology. The result was the choice of an acoustic impulse as the internal noise source in the in the jet nozzles. Noise transmission characteristics of a nozzle system were then investigated. In particular, the effects of fan nozzle convergence angle, core extention length to annulus height ratio, and flow Mach number and temperatures were studied. The results are presented as normalized directivity plots. R.C.T.

N80-11953*# National Aeronautics and Space Administration, Washington, D. C.
SMALL TRANSPORT AIRCRAFT TECHNOLOGY. A REPORT FOR THE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION, UNITED STATES SENATE Interim Report
Oct. 1979 77 p refs
(NASA-TM-80813) Avail: NTIS HC A05/MF A01 CSCL 05A

A preliminary assessment of the research and technology that NASA could undertake to improve small transport aircraft is presented. The advanced technologies currently under study for potential application to the small transport aircraft of the future are outlined. Background information on the commuter and shorthaul local service air carriers, the regulations pertaining to their aircraft and operations, and the overall airline system interface is included. A.R.H.

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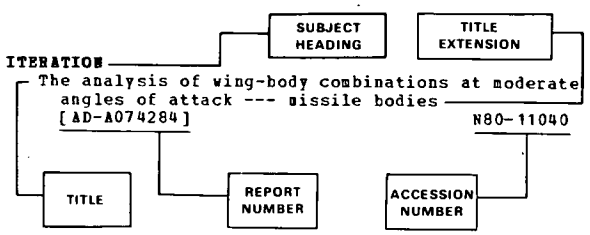

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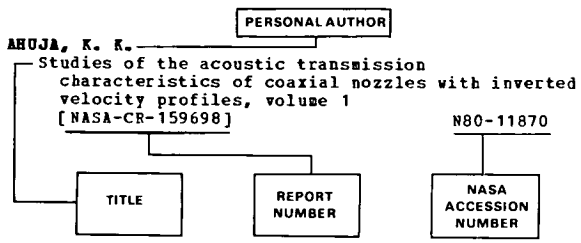

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	6. Performing Organization Code
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