NASA SP-7037 (136)

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Aeronautical Engineering
A Continuing Bibliography with Indexes

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June 1981

National Aeronautics and Space Administration

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 136

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 May 1981 in

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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 424 reports, journal articles, and other documents originally announced in May 1981 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.

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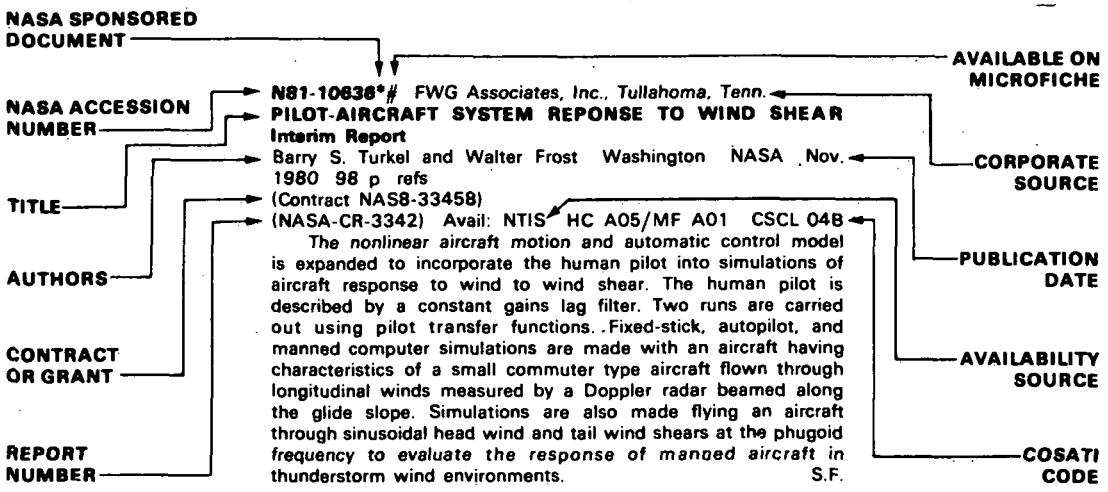

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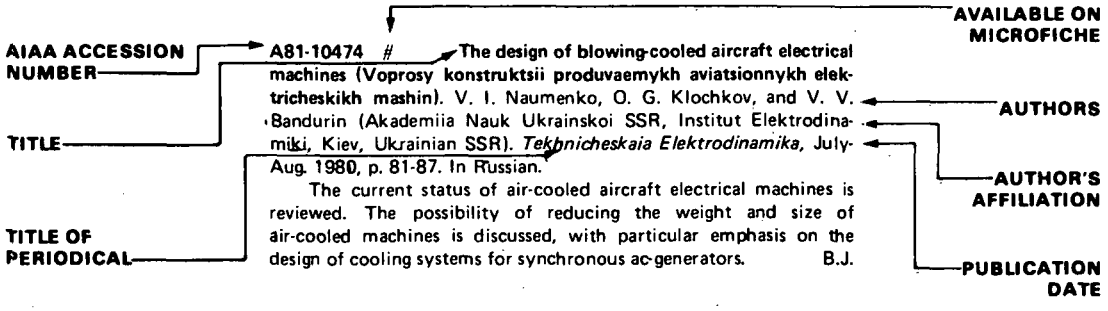

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 136)

IAA ENTRIES

A81-23372 **Modern radar: Theory, operation and maintenance /2nd edition/.** E. L. Safford, Jr. Blue Ridge Summit, Pa., TAB Books, Inc., 1981. 559 p. $15.95.

A compendium on radar systems and theory is presented. The development of the magnetron and the klystron is reviewed along with the methods used to solve the original radar problems. The early display devices are surveyed with a view to their ongoing evolution. The pulse, Doppler, CW, and pulse-Doppler radar systems are detailed. Target reflectivity, pulse calculations, Doppler clutter, signal processing, and bandwidth are discussed. The uses and basic components are examined of the radar systems utilized in military, intruder detection, avionics, aerospace, police, satellite, and guided missile applications. A coverage of radar frequency components, tracking systems, aircraft signatures, and receivers is provided. L.S.

A81-23405 # **Simulation of apparent acceleration (Ob imitatsii kazhushchegosia uskoreniia).** V. V. Aleksandrov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 256, no. 2, 1981, p. 314-317. 8 refs. In Russian.

Problems associated with the simulation of apparent acceleration during flight simulation on a dynamic test stand are described. A simulation method is developed which is based on a composition approach to the control of the dynamic-test platform. B.J.

A81-23499 **Integrated avionics studies target future technologies.** R. A. Reilly, F. W. Smead (ITT, Nutley, N.J.), and C. R. Ward (ITT, ITT Avionics Div., Nutley, N.J.). *MicroWaves*, vol. 20, Feb. 1981, p. 53-56, 59, 62.

The modular, multifunction, multiband airborne radio system design program (MFBARS) for avionics integration is discussed. The program details a system for all communications, navigation and identification (CNI) functions from 2 MHz to 2 GHz. The first design approach characterized retains the CNI functions as separate entities with size and cost economies coming predominantly from incorporating standardized and miniaturized building blocks in a circuit-level and subsystem-level redesign. The second approach integrates the functions to reduce the total number of circuits and modules with one set of core hardware shared by all or many of the CNI activities. Three system architectures are proposed and schematized. It is noted that the greatest overall savings would be provided by implementing time-sharing, converting signals into digital format early in the signal processing sequence, and using common modules. L.S.

A81-23514 **A low-level wind shear detection system.** G. J. Bell and K. S. Tsui (Royal Observatory, Hong Kong). *Weather*, vol. 36, Feb. 1981, p. 42-46. 5 refs.

Wind shear is identified as a major aviation hazard and the prototype wind shear detection system installed at Hong Kong International Airport in 1978-79 is described. The system consists of a microprocessor and five cup anemometers, one at each end (SE and NW) of the runway and three additional ones covering the two approaches to the airport. The readings from the five anemometers are telemetered to a microprocessor at the airport meteorological office which computes two-minute mean winds for the five locations. Wind shear in knots per 30 m of altitude change for the two ends of the runway are calculated from the two-minute mean winds and the height differences between the anemometer pairs. The application of the anemometer array in tracking gust fronts associated with showers or thunderstorms is discussed. L.S.

A81-23671 # **Pulsed laser mapping system for light aircraft.** C. McDonough, G. Dryden, T. Sofia, S. Wisotsky, and P. Howes (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings. Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p. 1711-1720. 5 refs.

A demonstration airborne laser mapping system for light aircraft has been tested in a Cessna 206 single-engine aircraft. Data from the test runs compare favorably with the ground truth data. Preliminary assessments indicate that vertical profiles and horizontal positions are accurate to within 2 m. V.L.

A81-23726 # **An approximate analytical method for vortex-lift and centre of pressure on the slender wing.** X. Yin (China University of Science and Technology, Hofei, Communist China). *Acta Aeronautica et Astronautica Sinica*, vol. 1, no. 1, 1980, p. 1-6. 7 refs. In Chinese, with abstract in English.

This paper presents a simplified approximate analytical method for predicting vortex-lift and center of pressure on the slender wing at high angle of attack, and proposes two empirical correlations as well. In comparison with other methods and experimental data, this method provides good accuracy and is suitable for preliminary aerodynamic design. (Author)

A81-23727 # **A penalty function method for structural optimum design with aeroelastic constraints.** X. Wang (Aerodynamic Research Centre of China, Communist China). *Acta Aeronautica et Astronautica Sinica*, vol. 1, no. 1, 1980, p. 7-15. 5 refs. In Chinese, with abstract in English.

An interior penalty function method is applied to minimize the weight of a wing structure under the constraints of flutter, strength and minimum gage. Three unconstrained optimization methods: steepest descent method, DFP variable metric algorithm and BFGS variable metric algorithm, are compared with each other. The quadratic interpolation method with the constraints approximated by quadratic polynomials is used in the one-dimensional search.

Convergent criteria used in the interior penalty function are presented. Several ways to reduce computer time are pointed out and discussed. (Author)

A81-23728 # **An aeronautical structural analysis system for static analysis /HAJIF-I/.** Z. Feng (Chinese Aeronautical Establishment, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, no. 1, 1980, p. 16-26. In Chinese, with abstract in English.

The HAJIF-I aeronautical structural analysis system for static analysis is the first large software system developed by the Chinese Aeronautical Establishment. By using multilevel substructure analysis and the finite element displacement method, this system is suitable for various linear static analyses of aeronautical structures. The maximum capacity of the system is 3000 nodal DOF of each substructure, 99 substructures, and 10 levels of substructures. The system provides some statements for automatic data generation; and there are several special statements for structural analysis, enabling the user to organize his own computation flow. A user's specification for stress analysis of an aircraft is presented as an example. B.J.

A81-23730 # **Calculation of internal and external flow field and cowl pressure drag in the supersonic axisymmetric nose inlets.** W. Zhou and S. Xu (Peking Research Institute, Peking, Precision Machinery Corporation of China, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, no. 1, 1980, p. 42-53. 9 refs. In Chinese, with abstract in English.

A general program using finite-difference method is written to calculate the flow field of supersonic axisymmetric nose inlet. This program is suitable to the direct problem of aerodynamic design of inlets (e.g., pitot-type, single-cone, bicone, triple-cone, and isentropic cone). Since 'separation singularity' difference method and implicit-explicit difference scheme are adopted in the calculation of inviscid flow field in the inlet, results of calculation are obtained with second order accuracy at boundary points and internal points, as well as near singular points. This program can offer required internal and external flow characteristics of inlets. (Author)

A81-23731 # **The method for calculating the fuel concentration field in the downstream positions of the pressure jet atomizer in the high temperature gas-stream.** W. Fu (Tsinghua University, Peking, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, no. 1, 1980, p. 54-62. In Chinese, with abstract in English.

A81-23732 # **A vehicle attitude control system forming the error signal by way of the optimal rotation axis.** Z. Dai, R. Shi (Control Engineering Institute, Peking, Communist China), and D. Bi (Academia Sinica, System Science and Mathematical Science Institute, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, no. 1, 1980, p. 63-73. In Chinese, with abstract in English.

This paper deals with a method forming the error signal to control the direction of the longitudinal axis of a vehicle by way of the optimal rotation axis. In order to control rotation around the longitudinal axis, the ways to form the error signals in the case of roll stability and slope stability are considered. The analytical formulae are developed in detail. As examples of application of this method we have also discussed how to form the error signals sensored by a three gimbal platform or a group of strapdown rate gyros mounted in the vehicle. Corresponding block diagrams are presented. (Author)

A81-23733 # **On the application of self-adaptive flight control system based on energy balance theory.** L. Li (Institute of Automatic Flight Control System, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, no. 1, 1980, p. 74-81. In Chinese, with abstract in English.

An adaptive flight control system for the longitudinal axis based on energy balance theory is described. A practical improved scheme and design details are presented, and preliminary evaluation from simulation and flight tests is made. The system exhibits better convergence in adjusting parameters and better performance of following up without testing signal. The system's architecture is simple and practicable. Selection of the scheme, design analysis, and brief results of the flight test for the open loop system, especially convergence of adjusting parameters and how to improve the effect of the input signal types are discussed. (Author)

A81-23813 **Rotating blades radio interference in a helicopter-borne CW Doppler radar.** M. K. Moaveni and H. Yazifeh-doost (Shiraz University, Shiraz, Iran). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-17, Jan. 1981, p. 72-82. 8 refs.

Radio interference generated in a helicopter-borne continuous wave (CW) Doppler radar system due to the rotating blades is analyzed. This problem has been previously treated for the case of pulse Doppler radar systems with very narrow (near zero) beamwidth. In this case, the strong interference component returning directly from the blades (with no ground reflection) need not be considered as it reaches the receiver when it is still blinded. In the case of a CW Doppler radar, however, this interference component must be included. Numerical calculations show that the total blade interference power level, dominated by the direct component, is higher than that of the direct ground clutter in the radar clutter region. It decreases approximately as (f-fo) to the -4th in the radar clear region. It stays, however, well above the thermal noise level which might cause false alarm and degrade the radar performance. (Author)

A81-23835 # **The distributed parameter system theory of the autopilot design of the slender vehicle.** J. Song, J. Yu, G. Zhu, and D. Bi. *Chinese Society of Astronautics, Journal (Yuhang Xuebao),* no. 2, 1980, p. 1-20. 7 refs. In Chinese, with abstract in English.

A review of the engineering approximation method for the design of slender vehicles and the spectra of aerodynamic elasticity, gain feedback, and the compensator is presented. The evolution and the critical stability equations are derived assuming that the real flight mode is a complex intercouple system of elasticity-aerodynamic-controls; the mode shapes and frequencies vary when the automatic pilot system is in effect. A.T.

A81-23837 # **Analysis and synthesis of the digital attitude control system of the aerospace vehicle.** K. Xie. *Chinese Society of Astronautics, Journal (Yuhang Xuebao),* no. 2, 1980, p. 34-49. In Chinese, with abstract in English.

The paper presents approximate analysis and synthesis methods for the digital attitude control system of an aerospace vehicle in the P-domain and D-domain. The method is shown to be suitable for the design of control systems, particularly when they contain nonlinear elements. Simulation results for a digital attitude control system are presented. B.J.

A81-23844 **Empirical method for the prediction of business executive jet cabin noise levels.** N. M. Moses and T. Roxner (Israel Aircraft Industries, Ltd., Acoustics Dept., Lod, Israel). *Applied Acoustics,* vol. 14, Jan.-Feb. 1981, p. 33-42.

As a result of flight noise measurements made at various locations in the cabin of the standard lined/no interior Westwind model 1124 business executive jet, it was possible to develop an empirical method for predicting the overall sound pressure level at any required location in the cabin. The cabin overall sound level in decibels (linear) may be found from nomographs related to aircraft altitude, Mach number or velocity. The noise spectrum at any location may be found from a reference spectrum shape corrected for local parameters. The accuracy of the prediction method, verified by additional tests, was found to be + or - 1dB. (Author)

A81-23851 # **Lifting surface theory and the numerical method of wings with small angles of sideslip at subsonic and supersonic speeds.** M. Huang (Nanking Aeronautical Institute, Nanking, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, Dec. 1980, p. 1-10. 12 refs. In Chinese, with abstract in English.

Fundamental solutions were obtained for the flow over semi-infinite angular wings with constant load, of which the side-edge is not parallel to the free stream. The feature of the solutions is that the vortices from the leeward side-edge go along this edge rather than in the direction of the free stream. These solutions can be used to overcome the difficulties Dillenius and Nielson have experienced in using symmetrical subdivisions to construct the finite elements for sideslipping wings, and to extend Woodward's method so that it is applicable to wings with small angles of sideslip for subsonic and supersonic speeds. The problem is divided into symmetrical and asymmetrical parts, thus allowing a great saving of computer storage and operation time. (Author)

A81-23853 # **Calculation of nonlinear compressibility effects of airfoils in subcritical conditions.** X. Bei (Chinese Aerodynamics Research and Development Centre, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, Dec. 1980, p. 22-27. In Chinese, with abstract in English.

A method to calculate nonlinear compressibility effects of airfoils in subsonic flow based on the method of finite elementary solution (MFES) is presented. Using the progressive iterative, the method allows direct extension of MFES to nonlinear inviscid compressible flow. Thus it provides a new approach to the solution of the nonlinear equations. A computer program was completed in FORTRAN IV. The comparison of the results obtained with those of exact and other theoretical solutions shows superiority of this method to the ordinary method of finite differences, especially in the airfoil nose region. (Author)

A81-23854 # **Supermatrix method for multi-substructure analysis.** Z. Yue (Aircraft Structure Strength Research Institute, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, Dec. 1980, p. 28-35. 5 refs. In Chinese, with abstract in English.

This paper summarized the basic mathematical method used in the Aeronautical Structural Analysis System HAJIF-I - the supermatrix method and its application in analysis of multi-substructures. The supermatrix method is powerful for the processing of large sparse matrices. This method is adaptable and versatile to the third and fourth generations of computers. Emphasis is placed here on the multi-level supermatrix and their algorithms, and complicated aircraft structure analysis. (Author)

A81-23855 # **Conforming element with out-element nodes.** S. Wang (Peking Institute of Aeronautics and Astronautics, Peking, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, Dec. 1980, p. 36-44. In Chinese, with abstract in English.

A grid division with uneven spacing at different parts is often required for stress analysis by the finite element method, especially when optimal grid analysis is carried out with the so-called 'selective grid enrichment'. In that case the displacements are incompatible on the dividing line between the regions with sparser and denser grids. An interpolation scheme using out-element nodes so as to establish the entirely conforming elements is proposed in the present paper. The construction of shape functions, applicability, and merits of this element are discussed. (Author)

A81-23856 # **The digital simulation of stability for multi-stage axial compressor.** D. Tang, W. Li, and M. Cong (Northwestern Polytechnical University, Communist China). *Acta Aeronautica et Astronautica Sinica,* vol. 1, Dec. 1980, p. 52-61. 13 refs. In Chinese, with abstract in English.

The 'actuator-lag-volume' is adopted as a physical model for stage of compressor instead of 'actuator-lumped volume' model used by other authors in recent years. For comparison the stall lines of a multi-stage axial flow compressor have been predicted with these two models respectively. In addition to comparing the simulation with experimental results of compressor rig, the experiments on forcing the engine into stall have been conducted to verify the simulation. It is obvious that the stall line obtained from the new model is in better agreement with the stall points from engine test, but the stall line predicted with the old model is located at the right side below the stall line of compressor rig. (Author)

A81-23868 **Laser-gyro strapdown inertial navigation (L'inertie sans plate-forme à gyrolaser).** H. Kergoat (SV2 Crouzet-Sfena, Boulogne-Billancourt, Hauts-de-Seine, France) and M. Perbet (Société Française d'Equipements pour la Navigation Aérienne, Vélizy-Villacoublay, Yvelines, France). *Navigation* (Paris), vol. 29, Jan. 1981, p. 11-23. In French.

After brief reviews of strapdown navigation and the principles of laser gyros, the paper discusses the advantages and applications of laser-gyro strapdown systems. Performance data are given for hybrid systems and civil and military air navigation systems, and the utilization of laser gyros in such programs as Boeing 757 and 767, and Airbus A310 is briefly considered. B.J.

A81-23869 **New definition of areas of protection for instrument landing (Nouvelle définition des aires de protection pour l'atterrissage aux instruments).** D. Galibert. *Navigation* (Paris), vol. 29, Jan. 1981, p. 49-68. In French.

The ICAO has prepared a document (scheduled to come into force on November 25, 1982) concerning the definition of protection areas in instrument approach and landing. This paper reviews the main innovations in instrument landing protection introduced by the new document. Emphasis is placed on the Collision Risk Model and the ILS approach. B.J.

A81-23889 # **Unsteady subsonic motion of a wing near a screen (Neustanovivsheesia dvizhenie kryla s dozvukovoi skorost'iu vblizi ekrana).** E. A. Krasil'shchikova (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Doklady,* vol. 256, no. 3, 1981, p. 543-547. In Russian.

A theoretical analysis is presented of the rectilinear translational subsonic motion of a thin slightly curved wing of infinite span near a screen in an ideal compressible fluid, at rest at infinity. Computational results are presented and discussed. B.J.

A81-23908 # **Slightly blunted cone in a supersonic flow at angle of attack (Konus s malym zatupleniem v sverkhzvukovom potoke pod uglom ataki).** P. I. Chushkin. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki,* vol. 20, Nov.-Dec. 1980, p. 1525-1535. 16 refs. In Russian.

A three-dimensional supersonic flow around slightly blunted conical bodies with an angle of taper larger than the critical value is investigated numerically. The solution is obtained by the method of integral relations using a scheme with trigonometric interpolation relative to the meridional angle. The effects of the body shape, Mach number, and angle of attack of the undisturbed flow are examined. V.L.

A81-23909 # **Transonic flows of a multireacting gas mixture through a Laval nozzle (O transzvukovykh techeniiakh mnogokomponentnoi relaksiruiushchei smesi cherez soplo Lavalia).** A. L. Ni and O. S. Ryzhov. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki,* vol. 20, Nov.-Dec. 1980, p. 1536-1553. 16 refs. In Russian.

The paper is concerned with plane-parallel and axisymmetric flows of a gas mixture with an arbitrary number of chemical reactions through the throat of a Laval nozzle. The mathematical analysis is based on an asymptotic equation system which is valid within the framework of the nonlinear theory of small disturbances for properly transonic regimes. V.L.

A81-23923 * **Drag reduction - Jet breakup correlation with kerosene-based additives.** J. W. Hoyt (Rutgers University, Piscataway, N.J.), R. L. Altman (NASA, Ames Research Center, Moffett Field, Calif.), and J. J. Taylor. *Journal of Rheology,* vol. 24, no. 5, 1980, p. 685-699. 6 refs.

The drag-reduction effectiveness of a number of high-polymer additives dissolved in aircraft fuel has been measured in a turbulent-flow rheometer. These solutions were further subjected to high elongational stress and breakup forces in a jet discharging in air. The jet was photographed using a high-resolution camera with special lighting. The object of the work was to study the possible

spray-suppression ability of high-polymer additives to aircraft fuel and to correlate this with the drag-reducing properties of the additives. It was found, in fact, that the rheometer results indicate the most effective spray-suppressing additives. Using as a measure the minimum polymer concentration to give a maximum friction-reducing effect, the order of effectiveness of eight different polymer additives as spray-suppressing agents was predicted. These results may find application in the development of antimisting additives for aircraft fuel which may increase fire safety in case of crash or accident. (Author)

A81-23949 The influence of a wake splitter plate on the aerodynamic characteristics of a two-dimensional cylinder. R. C. Nelson (Notre Dame, University, Notre Dame, Ind.). *Israel Journal of Technology*, vol. 17, no. 3, 1979, p. 131-138. 10 refs. Grant No. AF-AFOSR-77-3299.

Results from an experimental study of a splitter plate on the wake and pressure drag coefficient of a right circular cylinder are presented. The data includes pressure distributions around the cylinder and the pressure drag coefficient for Mach numbers above and below the critical Mach number at subcritical Reynolds numbers. The influence of the plate position, size and angle of inclination to the cylinder on the pressure drag coefficient were examined. The results indicate that the splitter plate can alter the wake pattern significantly and, as a consequence, reduce the pressure drag coefficient. Finally, these data are used to provide some insight into the complicated aerodynamic interference that may be present when testing a slender aerodynamic model at large angles of attack with a strut support system. (Author)

A81-23999 Requirements and possibilities - Rotorcraft powerplants /The 15th Halford Memorial Lecture/. R. R. Lynn (Bell Helicopter Textron, Fort Worth, Tex.). *Aeronautical Journal*, vol. 85, Jan. 1981, p. 7-16. 6 refs.

A background to the rotary wing aircraft industry is presented, and the requirements for rotorcraft powerplants are outlined with a view toward sizing and contingency power. Flight and test cell data for the stabilization effect are given. It is noted that a stall margin of 20% in pressure ratio over the entire gas producer speed range is acceptable in conjunction with a particle separator. The projections indicate that future medium sized turbine engines can operate at temperatures of 2400 F with a specific fuel consumption reduction of 10% from present day values at the optimum pressure ratio for such a temperature. Variable geometry and cooling schemes as well as recuperative systems promise to further the capability of rotorcraft. L.S.

A81-24000 Performance of aircraft pneumatic tyres in soft soil. D. H. Shanks (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Victoria, Australia) and R. V. Barrett (Bristol, University, Bristol, England). *Aeronautical Journal*, vol. 85, Jan. 1981, p. 20-28. 18 refs.

The rolling resistance of an unpowered pneumatic-tired wheel rolling at high velocities in soft soil is investigated. The data from 16 series of wheel tests are presented and used to test a predictive method proposed by Turnage (1975). The tests of the two solid wheels provided evidence that the undrained shear strength and bulk density of near-saturated clay together give a satisfactory description of the soil for the purposes of study of wheel-soil interaction at high velocities using test models. A set of dimensionless variables was derived on this basis for application to the pneumatic wheel-soil problem. It is noted that a model/prototype comparison is required to verify the analysis directly. The experimental procedure, test facility, soil, and accuracy of the work are detailed. L.S.

A81-24002 A new approach to the solution of the boundary layer equations of an ideal compressible flow over a flat plate. A. Yakhot, G. Ben-Dor, Z. Rakib, and O. Igra (Negev, University, Beersheba, Israel). *Aeronautical Journal*, vol. 85, Jan. 1981, p. 34, 35. 5 refs.

A81-24003 Israel Annual Conference on Aviation and Astronautics, 21st, Tel Aviv and Haifa, Israel, February 28-March 1, 1979, Proceedings. *Israel Journal of Technology*, vol. 17, no. 5-6, 1979. 140 p. (For individual items see A81-24004 to A81-24011)

Papers are presented in the areas of structural mechanics and fluid dynamics as they relate to aviation and astronautics, as well as commercial air transportation. Specific topics include the development of commercial air transportation in the next three decades, recent developments in fracture mechanics, the calculation of the aerodynamic forces and moments on aircraft external stores, boundary layer transition with a null or positive pressure gradient, the quasi-linear behavior of eccentrically stiffened compressed annular plates near the buckling point, the stability of the vibrations of rectangular plates with initial defects, and the modification of wing sections to optimize transonic performance. A.L.W.

A81-24006 A method for calculating the aerodynamic forces and moments on external stores of aircraft. T. Ronen and M. Hanin (Technion - Israel Institute of Technology, Haifa, Israel). *(Israel Annual Conference on Aviation and Astronautics, 21st, Tel Aviv and Haifa, Israel, Feb. 28-Mar. 1, 1979.) Israel Journal of Technology*, vol. 17, no. 5-6, 1979, p. 295-301. 11 refs.

This paper presents a method for predicting the aerodynamic forces and moments on external stores near aircraft, assuming potential incompressible flow. The flow due to angle of attack is calculated using slender wing and body assumptions: the bodies are represented by doublets and the wings by a set of vortex panels, each panel having constant vorticity per unit length. Thickness effects of the bodies and the wings are represented by source distributions. The mutual interference between the bodies is accounted for by use of images, and the flow tangency conditions on the planar surfaces are then satisfied at several control points on the wings and fins. Corrections for aspect ratio and wing-tail interference were applied. The predictions were found to agree well with other analytical solutions and with wind tunnel results. (Author)

A81-24009 Prediction of structural fatigue response under aircraft loads from material stress-strain behavior. A. Berkovits (Technion - Israel Institute of Technology, Haifa, Israel). *(Israel Annual Conference on Aviation and Astronautics, 21st, Tel Aviv and Haifa, Israel, Feb. 28-Mar. 1, 1979.) Israel Journal of Technology*, vol. 17, no. 5-6, 1979, p. 347-353. 15 refs.

A finite element program was developed for estimating fatigue behavior of notched structures based on properties of unnotched material. Fatigue crack initiation life, crack propagation rate, and fatigue failure were determined in terms of applied load spectrum. Fatigue response can be predicted for load spectra typical of aircraft. (Author)

A81-24011 Modification of wing sections to optimize transonic performance. A. Luntz, Y. Barnett, and I. Darel (Israel Aircraft Industries, Ltd., Lod, Israel). *(Israel Annual Conference on Aviation and Astronautics, 21st, Tel Aviv and Haifa, Israel, Feb. 28-Mar. 1, 1979.) Israel Journal of Technology*, vol. 17, no. 5-6, 1979, p. 360-364.

This paper deals with the application of modern computer techniques that are now available for analyzing airfoils in the transonic speed regime. The particular application dealt with here concerns the modification of an airfoil. Modification of the airfoil was by an optimization technique where the criterion chosen was to maximize the drag divergence Mach number while changing the shape of the upper and lower surfaces of the airfoil. Drag coefficients were calculated by means of Korn's two-dimensional transonic flow analysis program. Within the structural constraints, two modified airfoils were designed, one with only a leading edge modification, and one with both leading and trailing edge modifications. Analytical calculations indicated that an increase in the drag divergence Mach number of up to 0.03-0.04 could be achieved at a design lift coefficient of 0.4. A wind tunnel model was built and tested at transonic speeds. These tests confirmed the analytical results and predicted increases in the drag divergence Mach number of up to

0.04-0.05 M. Off-design performance was checked and found to be completely acceptable. (Author)

A81-24044 New storage medium - Greater safety. II - Testing, fabrication, implementation. W. Bond, S. Lazecki (Norden Systems, Inc., Norwalk, Conn.), and H. Ask (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Mantech Journal,* vol. 5, no. 1, 1980, p. 3-15.

The paper discusses quality test procedures for metal-nitride-oxide semiconductor (MNOS) block oriented random-access memory (BORAM) circuits, which are used in the Accident Information Retrieval System (AIRS) for the Blackhawk helicopter and in a mass storage system for the Marine Integrated Fire and Support System (MIFASS). The AIRS is described with respect to the battery bus, flight history storage capacity, and crash-survivable memory module. Electrical and endurance-stress tests for the BORAM transistors, memory cells, semiconductor wafers, and hybrid circuits are outlined. Fabrication of the MNOS BORAM hybrid circuits is examined, and the MIFASS is briefly described. F.G.M.

A81-24045 Plasma arc improves PM process - Tungsten free Ti powder. P. Loewenstein (Nuclear Metals, Inc., Concord, Mass.). *Mantech Journal,* vol. 5, no. 1, 1980, p. 16-19.

The problem of eliminating tungsten contamination of titanium alloy powders produced by the rotating electrode process (REP) is discussed. The basic REP for producing spherical powders is reviewed, along with contamination of titanium alloy powders by eroded tungsten and a tungsten-titanium alloy from tungsten cathodes and by ultrafine powders from dual titanium electrodes, which were employed unsuccessfully in an attempt to eliminate the tungsten contamination. The use of a transfer-plasma-arc heat source to solve the problem of tungsten contamination is outlined; the heat source includes a plasma gun with a tungsten cathode and a helium plasma. A dedicated production facility using the plasma-arc approach to the REP is described which has a powder producing capacity of 6000 to 10,000 lb/month for one-shift operation. F.G.M.

A81-24046 Features improved cooling - Turbine blade redesign boosts life. G. S. Irons (General Electric Co., Aircraft Engine Group, Lynn, Mass.). *Mantech Journal,* vol. 5, no. 1, 1980, p. 35-39.

A small-turbine-blade advancement study is described which was aimed at: (1) the development of coring techniques to minimize machining, improve producibility, and reduce the cost of the T700 Stage 2 turbine blade and (2) the development of an advanced core technology for small air-cooled turbine blades, applicable to the T700 Stage 1 blade. Advancements discussed include the use of bent quartz rods to obtain radial-convection cooling passages and the use of a highly alloyed gamma-prime strengthened nickel-base superalloy for the blades. Results are reported for computerized heat-transfer analyses and for qualification tests of the two blades. The manufacture of the Stage 2 blade and the production of the Stage 1 blade are briefly reviewed. F.G.M.

A81-24047 Isothermal rolling of aircraft parts - Versatile process saves costly materials. A. G. Metcalfe (Solar Turbines International, San Diego, Calif.). *Mantech Journal,* vol. 5, no. 1, 1980, p. 40-44.

Isothermal rolling processes for the production of supersonic military aircraft parts are described. Attention is given to isothermal roll forging of second-stage compressor blades, isothermal rolling of aircraft engine rings, isothermal rolling processes for the custom fabrication of T sections, and the square bend process of isothermal rolling. Cost reductions afforded by the use of such processes are noted. F.G.M.

A81-24048 * # **Design for supercommuters.** L. J. Williams (NASA, Langley Research Center, Hampton, Va.) and T. L. Galloway (NASA, Ames Research Center, Moffett Field, Calif.). *Astronautics and Aeronautics,* vol. 19, Feb. 1981, p. 20-23, 26-30. 15 refs.

Action to be taken to prepare to implement efficient, modern commuter aircraft for the 1990s is outlined. The increase in the contribution of jet fuel costs to aircraft direct operating costs (DOC) is noted as the motivation for the introduction of turboprop-powered commuter aircraft, which use 15-20% less fuel per seat mile at short stage lengths, to replace larger jet transports. Designs proposed by various manufacturers which will make use of existing technology for 19-, 30- and 50-seat aircraft capable of carrying a full payload of passengers and baggage for 600 n mi and optimized for minimum DOC over a 100-n mi stage length are presented, and the improvements in fuel usage, DOC and passenger comfort to be obtained with the use of advanced technology are pointed out. The goals and considered technologies of the dedicated small-transport aircraft technology program recommended by a commuter air transport subcommittee of the NASA Advisory Council Aeronautics Advisory Committee to speed the development of commuter technology are then presented, with attention given to efforts of analysis, design and testing of propulsion systems, structures, aerodynamics and systems intended to result in 16-24% savings in DOC and up to 40% savings in fuel. The commuter development plans of various manufacturers are also indicated. S.C.S.

A81-24050 # **China aims for modern wings.** J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). *Astronautics and Aeronautics,* vol. 19, Feb. 1981, p. 56-64.

Observations of an AIAA group that visited aeronautical facilities in the People's Republic of China are presented. Consideration is given to the political and administrative structure of the aeronautics industry as well as to the major responsibilities of the central governmental organizations. Aircraft production is discussed, noting research and development, production facilities, manufacturing centers and safety procedures. Research in theoretical aerodynamics is outlined, and attention is given to wind-tunnel experiments, computational aerodynamics and university laboratories. S.C.S.

A81-24057 Mission Adaptive Wing research programme. R. W. DeCamp and R. Hardy (Boeing Military Airplane Co., Seattle, Wash.). *Aircraft Engineering,* vol. 53, Jan. 1981, p. 10, 11.

The concept of the Mission Adaptive Wing is to vary the wing cross-section shape in flight to conform to changes in altitude, Mach number, wing sweep and demanded wing lift. In order to develop the lowest drag coefficient at each desired lift coefficient, the wing shape is varied by leading and trailing edge devices employing flexible, smooth upper surfaces. Hydraulic motors drive the internal mechanisms. The wing lift-drag polar is an envelope of polars for specific wing shapes. Four areas of application are identified: (1) cruise camber control for reducing fuel consumption or obtaining the maximum range, (2) the direct lift mode in which lift is varied without changing the angle-of-attack, (3) control of loads experienced by the wing in order to reduce the root bending moment, and (4) gust alleviation. S.C.S.

A81-24059 Critical analysis and modern approaches to integrated system aircraft. F. Bossa and G. Guerra (Torino, Politecnico, Turin, Italy). *Aircraft Engineering,* vol. 53, Jan. 1981, p. 18-26. 5 refs.

Advanced technology for the control of present and future aircraft under lower weather minima and in more crowded terminal control areas is discussed. The NASA Terminal Configured Vehicle Program, in which a Boeing 737-100 aircraft was modified to include an aft flight deck in the passenger cabin with a fly-by-wire triply redundant computer system by which the aircraft can be flown, is presented and the operational problems and future requirements of a terminal control area are discussed. Future ATC components to be used for approach and landing operations are then considered, with emphasis on the microwave landing system, the automatic radar terminal system with precise four-dimensional navigation, the Beacon Collision Avoidance System and the Global Positioning Satellite system. Finally, the development of advanced display and control systems is examined, with attention given to CRT approaches to approach path identification and position prediction from the cockpit, automatic control problems, head-up displays and ground guidance. S.C.S.

A81-24070 **Active controls for civil aircraft.** H. P. Y. Hitch (British Aerospace, Aircraft Group, Weybridge, Surrey, England). *Aeronautical Journal,* vol. 83, Oct. 1979, p. 389-398. 7 refs.

Active control technology (ACT) of electromechanical and digital control elements are presented as means by which civil aviation aircraft will in time reap the benefits of relaxed or synthetic stability, fatigue, maneuver and gust load alleviation, wing flutter suppression and lower structural weight. A gradual incorporation of these features by existing aircraft is recommended in order to build confidence, pending the design of entire configurations that in addition will employ advanced composite primary structures and high aspect-ratio, supercritical airfoil profile wings. O.C.

A81-24072 **The static pressure in a vortex core.** J. Dunham (National Gas Turbine Establishment, Farnborough, Hants., England). *Aeronautical Journal,* vol. 83, Oct. 1979, p. 402-406. 19 refs.

An analysis and comparison with experimental data is given for the static core pressure of ground and wingtip vortices that might be ingested by turbine engine compressor intakes. Parameters considered include tangential velocity, turbulence, static pressure, core radius, stagnation pressure and axial velocity, along with test data from hot wire and laser velocimeters. O.C.

A81-24077 # **Numerical study on viscous shear flow past a circular cylinder.** H. Tamura, M. Kiya, and M. Arie (Hokkaido University, Sapporo, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 1952-1958. 17 refs.

Numerical solutions of the unsteady Navier-Stokes equations are presented for a two-dimensional flow past a circular cylinder immersed in a uniform shear flow. Although a pair of steady standing vortices is formed in the uniform flow when Re = 40, it is found that a periodic vortex shedding occurs at the same Reynolds number in shear flow with a shear parameter K = 0.025. When the shear parameter becomes as large as K = 0.2, the vortex shedding is suppressed even in the case of a shear flow revealing a clearly asymmetric flow pattern with respect to the geometrical centerline of the cylinder. The time-averaged lift force acts in the direction of the high-velocity side of the shear flow and its magnitude is approximately proportional to the shear parameter. B.J.

A81-24078 # **Numerical simulation of gross structure of turbulent plane mixing layer by discrete-vortex model.** M. Kiya, M. Arie (Hokkaido University, Sapporo, Japan), and K. Harigane. *JSME, Bulletin,* vol. 23, Dec. 1980, p. 1959-1966. 14 refs.

A discrete-vortex model was used to simulate a turbulent plane mixing layer. The vorticity in the mixing layer is partitioned into several vorticity blobs, which are replaced by inviscid discrete vortices with an inner structure. It is indicated that random walks of appropriate variance should be superposed on the motion of the vortices to obtain the time-averaged velocity and turbulent quantities consistent with experiments. The random walks are assumed to very roughly simulate the diffusion of vorticity by turbulent transport. B.J.

A81-24079 # **Fundamental studies on the control of turbulent boundary layers. I - Theoretical and experimental analyses of velocity profiles and parameters with and without adverse pressure gradient, with uniform suction through a porous flat plate.** T. Maeda, H. Yamaguchi, M. Ota, and N. Hirayama (Tokyo Metropolitan University, Tokyo, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 1967-1974. 15 refs.

This paper presents theoretical and experimental analyses of turbulent boundary layer velocity profiles and the boundary layer parameters. This work clarifies the influence of adverse pressure gradients and the effect of the boundary layer control by uniform suction on the boundary layer. A continuous velocity profile from a sublayer to an inner layer is obtained by developing the damping factor of a mixing length to the boundary layer with suction. The velocity profile in an outer layer is determined theoretically by extending a theory on the assumption of intermittency phenomena at the outer layer with adverse pressure gradient and uniform suction. The results of theoretical calculation are in good agreement with the experimental data. (Author)

A81-24080 # **Investigation of the starting process of a supersonic wind tunnel.** K. Matsuo, H. Mochizuki (Kyushu University, Fukuoka, Japan), K. Sasaguchi (Kumamoto University, Kumamoto, Japan), and N. Takechi. *JSME, Bulletin,* vol. 23, Dec. 1980, p. 1975-1981. 11 refs.

The starting process of a supersonic wind tunnel with a diffuser with contraction has been studied by schlieren optical observations and pressure measurements. It has been shown that the wind tunnel starts when the flow is sonic but not choked at the second throat; the flow in the starting process has been classified into three patterns according to the area ratio of the second throat to the test section. The differences between the theoretical values and the experimental results of the starting pressure ratio and the minimum starting area at the second throat have been explained, taking into consideration that a normal shock wave assumed in the previous one-dimensional theory becomes a pseudoshock wave due to the interaction with the wall boundary layer. (Author)

A81-24081 # **Self-excited oscillations of supersonic flow in a sudden enlargement of a duct.** T. Ikui, K. Matsuo, and H. Mochizuki (Kyushu University, Fukuoka, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 1982-1989. 8 refs.

The behavior of a shock wave in a supersonic outflow at a sudden enlargement of a duct has been clarified experimentally by a schlieren optical system and static pressure measurements. A self-excited oscillation of flow with a shock wave has been observed at the downstream duct at a particular range of supply pressures in which the outflowing jet is underexpanded at the sudden enlargement and furthermore the jet does not reattach in the downstream duct. In the oscillating flow, compression and expansion waves propagate back and forth between the sudden enlargement section and the exit of the duct, and the base-pressure in the dead-air region downstream of the sudden enlargement and the width of the ourflowing jet oscillate periodically. (Author)

A81-24086 # **A one-dimensional analysis and performance prediction of subsonic radial turbines.** M. Hamajima (Ishikawajima Mass-Produced Machinery, Co., Ltd., Tatsuno, Nagano, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 2064-2070. 14 refs.

A one-dimensional analysis of subsonic radial turbines in terms of nondimensional vorticity is developed by introducing a new incidence loss model. Based on this theory, a performance prediction of a radial turbine with a tip diameter of 228 mm is carried out for four rotational speeds. The predicted performance is found to agree sufficiently well with experimental results. B.J.

A81-24088 # **The balancing of flexible rotors - Theoretical relation of each balancing method and accuracies.** T. Iwatsubo (Kobe University, Kobe, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 2096-2103. 11 refs.

A balancing method for flexible rotors is systematically defined, and the relationship between a modal balance method and an influence coefficient method is described. The least squares method is also considered and discussed with respect to balancing quality, performance index, weighting function, and the relationship between weighting function and measuring errors of the influence coefficients. It is found that the influence coefficient method can provide the most general definition of the balancing of a flexible rotor, and that the modal balance method and other balancing methods can be derived as special cases. B.J.

A81-24089 # **Problem of rotor passing through critical speed with gyroscopic effect. III - Case of rotating shaft on flexible supports.** K. Nonami and M. Miyashita (Tokyo Metropolitan Univer-

sity, Tokyo, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 2104-2110. 10 refs.

A theoretical study is presented of the nonstationary vibration of a rotating shaft on flexible supports in passing through the critical speed. Emphasis is placed on the interaction or the coupling effect caused by near-critical speeds in the continuous passing through 1st and 2nd critical speeds. An asymptotic method is used to derive the equations of motion of the rotor system in transition through the critical speed. Analytical results are discussed and compared to experimental data. B.J.

A81-24090 # Coupled torsional-flexural vibration of a shaft in a geared system of rotors. I. H. Iida, A. Tamura (Tokyo Institute of Technology, Tokyo, Japan), K. Kikuch, and H. Agata (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Ibaraki, Japan). *JSME, Bulletin,* vol. 23, Dec. 1980, p. 2111-2117. 6 refs.

Theoretical and experimental studies have been performed of a coupled torsional-flexural vibration of a shaft in a spur geared system. It is found that in a system in which gears are mounted on a flexible shaft the torsional vibration is coupled to the flexural vibration, and the natural frequencies of the system differ from those obtained without consideration of the effect of coupling. The geometrical eccentricity of the gear causes vibration in the direction of power transmission, and the steady-state response at one of the critical speeds can be reduced by adding an unbalance. B.J.

A81-24172 # Calculation of the boundary of a supersonic inviscid jet flowing into a submerged space or a supersonic wake (K raschetu granitsy sverkhzvukovoi neviazkoi strui, istekaiushchei v zatoplennoe prostranstvo ili sputnyi sverkhzvukovoi potok). I. S. Belotserkovets and V. I. Timoshenko. *Inzhenerno-Fizicheskii Zhurnal,* vol. 40, Feb. 1981, p. 197-203. 11 refs. In Russian.

A81-24237 On the unsteady wake-induced lift on a slotted airfoil. II - The influence of displacement thickness fluctuations. M. S. Howe (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Journal of Sound and Vibration,* vol. 74, Feb. 8, 1981, p. 311-320. 9 refs.

In the preceding companion paper a theoretical model for determining the influence of a slot in a thin airfoil on the unsteady lift/radiated sound caused by vortices shed into the wake was presented. The unsteady motion produces additional vorticity at the upstream edge of the slot, and it was shown that, at sufficiently low reduced frequencies based on the width of the slot, this vorticity can prevent penetration by the flow, so that the airfoil behaves as if the slot were absent. At higher frequencies, however, both the lift and the sound power were predicted to be significantly reduced relative to their respective levels for the unslotted airfoil. The analysis is extended in this paper to include the effects of displacement thickness fluctuations of the boundary layers on the 'flap' downstream of the slot. These fluctuations arise as a result of the periodic ejection of vorticity from the slot. It is concluded that the earlier predictions of a reduction in the lift/sound pressure level are enhanced by the displacement thickness effects. (Author)

A81-24257 ORLA - An assessment of risks. M. W. McCarthy (Northrop Corp., Aircraft Group, Hawthorne, Calif.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 51-54. 7 refs.

The threshold analysis technique was used in a FORTRAN IV version of the AFLC 800-4 Optimum Repair Level Analysis (ORLA) model for the F-5G International Fighter Program. A model was constructed for ground support equipment which computes the equipment costs providing a target or marginal utility values for design input. This sensitivity analysis is also applicable to parametric studies which result in hardware that can be supported cost effectively in the field. A.T.

A81-24268 The new look in reliability - It works. J. D. McGrath and R. J. Freedman (General Electric Co., Aerospace Control Systems Dept., Binghamton, N.Y.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 304-309.

The Operational Mission Environment (OME) test program for the F/A-18 Hornet fighter/attack aircraft defines the manufacturing methods needed to assure reliability. The design phase analyzed reliability predictions, thermal conditions, stress concentrations, and failure modes; 'the worst case' analysis insured that the tolerance buildup in any signal path will not adversely affect system performance, and the integrated test phase included engineering development testing and flight worthiness trials. The manufacturing stage involved the SENTRY VIII IC tester and environmental handler, a printed circuit board for automatic integrated circuits and axial lead inserters, and maintained a formal defect trend analysis. A.T.

A81-24277 The necessity of 'testing-in' hardware reliability. H. Caruso (Westinghouse Electric Corp., Baltimore, Md.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 381-383.

Using the broad concept of reliability as an achieved result, this paper examines the practical limitations of reliability design and the role of 'tested-in reliability' in achieving design expectations. Reliability design is treated as providing only the potential for high field reliability which will not be attained without the coordinated use of reliability testing and other supporting disciplines. The possible penalties of interacting test effectiveness and delivery date variables are examined. A real example of potential cost savings due to tested-in reliability is presented. (Author)

A81-24280 *Development of conceptual Navy aircraft* Reliability Prediction Models. D. Ferguson, J. Kolson, J. Stracener (Vought Corp., Dallas, Tex.), and S. Meek (U.S. Navy, Naval Air Systems Command, Washington, D.C.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 395-401.

The development of Reliability Prediction Models, which provide an objective means for evaluating the baseline reliability characteristics of conceptual Navy fixed wing and rotary wing aircraft is described. Each model consists of a set of equations which relate the reliability of each major aircraft subsystem, expressed as the Mean Flight Hours Between Failures (MFHBF), to aircraft design/performance parameters. The equations of each model were statistically derived from historical data for 32 fixed wing and 11 rotary wing Navy/Marine Corps aircraft. The predicted MFHBF of each subsystem is consistent with subsystems currently in operational use by the Navy, so that adjustment factors must be applied to accommodate anticipated effects of future technological, managerial, and operational influences. The Reliability Prediction Models were applied by the Navy to evaluate the reliability characteristics of aircraft designs during the Sea Based Air Master Study (SBAMS), ranging from low speed multipurpose to high performance specialized mission conceptual aircraft. (Author)

A81-24283 Current and future concepts in FMEA. F. Sevcik (Ketron, Inc., Wayne, Pa.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 414-421.

The goal of the Failure Modes and Effects Analysis (FMEA) is to anticipate, identify and avoid failures in the operation of a new system while the system is still on the drawing board. The recent occurrence of failures in some new systems in operation has had disastrous effects on many lives. These events prompted the author to evaluate the documented problems and to seek improvements in FMEA procedures and their application. The result was surprising. While a great number of procedures exist, not one single FMEA

procedure could be found as an all encompassing document. Each FMEA procedure was different. It is believed that the recent disasters could have possibly been avoided if a good FMEA procedure had been applied during development. A simple, complete FMEA procedure is proposed. (Author)

A81-24285 Determination of aircraft structural inspection intervals. W. R. Shawver, L. E. Sloter, II, J. T. Stracener, and D. J. White (Vought Corp., Dallas, Tex.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 452-458. 8 refs. Navy Task LTV-79-12.

This study develops an analytical method for determining inspection times for nonredundant structural members subject to fatigue cracking. The analysis models the life of a crack by considering the probability of its initial existence, its initiation, and its growth during cyclic loading. The model tracks the growth of this predicted crack under various probabilistic loadings and environments using fracture mechanics techniques. Failure is said to occur when the crack length exceeds a critical crack length, which is a probability distribution caused by material property variations. The probability of failure is expressed as the joint probability distribution of the critical crack length and the predicted crack growth. During inspection, the nondestructive inspection capabilities are compared against the predicted crack length distribution. The cracks which have been detected are repaired or the items replaced and the processes of initiation and growth are continued until the next inspection. The principal result of the analysis is a family of failure probability versus aircraft flight hours curves for various inspection intervals. From these curves, inspection times for any desired risk level (reliability) can be determined. These curves also show the effectiveness of the inspections and the need to shorten the time between inspections as the aircraft ages if the same level of reliability is to be maintained. (Author)

A81-24286 Reliability growth measured by AFM 66-1 data. J. H. Boiles and J. J. Hadel (McDonnell Aircraft Co., St. Louis, Mo.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 27-29, 1981, Proceedings.
New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 465-471.

The usefulness of Air Force Maintenance Management Policy Regulation AFM 66-1 data as a source of information for reliability-growth programs is considered. A computer program developed for processing AFM 66-1 data with a capability for sorting or selecting any data element is discussed. The resulting detailed analyses enhance the capabilities of AFM 66-1 data to promote and measure reliability growth, as demonstrated by three examples. O.C.

A81-24389 # Computer simulation of unsteady flow past lifting rotors of coaxial configuration (Modelirovanie na EVM nestatsionarnogo obtekaniia nesushchikh vintov soosnoi skhemy). S. M. Belotserkovskii and B. E. Loktev. *Akademiia Nauk SSSR, Doklady*, vol. 256, no. 4, 1981, p. 810-814. 5 refs. In Russian.

A procedure for the simulation of unsteady flow past a coaxial lifting-rotor system is described in detail. The system of free unsteady vortices separated from the first rotor are represented as a closed vortex grid which consists of a combination of time-invariant vortex segments. The displacement velocities of this grid, coinciding with the velocities of corresponding fluid particles, are determined in the nodes of this grid. Numerical results are presented for a particular example of a coaxial rotor arrangement. B.J.

A81-24423 A contribution to the computation of transonic supersonic flows over blunt bodies. C. Weiland (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Göttingen, West Germany). *Computers and Fluids*, vol. 9, June 1981, p. 143-162. 23 refs.

Stationary inviscid transonic supersonic flowfields around spheres, ellipsoids and hemisphere-cylinders are calculated. The freestream Mach numbers considered are between 1.02 and 1.1. A special coordinate system is created and adjusted to the subsonic stagnation point region for transonic freestream Mach numbers; the integration of the governing equations is carried out by a time-dependent finite-difference procedure. All the calculations discussed were stable and converged uniquely to the asymptotic stationary state. The results include bow shocks, sonic lines, characteristics, lines of constant pressure, density and Mach numbers; a comparison is made between flow quantities which are calculable by analytical functions and the predicted quantities. The results are checked by considering the conservation of the total enthalpy. (Author)

A81-24424 A computer simulation of turbulent jet flow. A. V. J. Edwards and C. L. Morfey (Southampton, University, Southampton, England). *Computers and Fluids*, vol. 9, June 1981, p. 205-221. 24 refs. Research supported by the Science Research Council and University of Southampton.

The evolution of a round turbulent jet is simulated numerically under the constraint of axial symmetry. The vortex sheet shed from the orifice is represented by vortex ring elements, with a velocity field cut-off to control close encounters. Large-scale vortex clusters form in the model jet, similar to those inferred from laboratory flow visualization experiments. However, comparisons of statistical properties reveal significant differences between the axisymmetric model flow and real turbulent jets. (Author)

A81-24477 # Research on vortex bursting in compressible flow. J. Muylaert and F. Ide. Leuven, Katholieke Universiteit, Burgerlijk Electrotechnisch-Werktuigkundig Ingenieur Thesis, 1979. 149 p. 18 refs.

An investigation is presented of the influence of vortex breakdown on normal force and pitching moment in compressible flow for Mach numbers in the range 0.5-1 and wing aspect ratios of 1.26 and 2. Force measurements and the interpretation of schlieren photographs were used in the study. A new force balance was designed to measure normal force and pitching moment; and the use of a cassette data logger for data reduction required a new computer program. The type of vortex breakdown observed was very dependent on the leading-edge sweepback angle. The wing of aspect ratio 2 causes a gradual vortex bursting, while the other wing with higher sweepback produces a sudden loss of normal force at a certain angle. This critical angle decreases with increasing Mach number. B.J.

A81-24488 An experimental investigation of separating flow on a convex surface. B. H. L. Gowda and P. A. A. Narayana (Indian Institute of Technology, Madras, India). *Applied Scientific Research*, vol. 36, no. 4, 1980, p. 271-288. 18 refs.

The mean and turbulent characteristics of an incompressible turbulent boundary layer developing on a convex surface under the influence of an adverse pressure gradient are presented. The turbulence quantities measured include all the components of Reynolds stresses, autocorrelation functions and power spectra of the three components of turbulence. The results indicate the comparative influence of the convex curvature and adverse pressure gradient which are simultaneously acting on the flow. The investigation provides experimental information required for a better understanding of turbulent shear flows. (Author)

A81-24523 # Landings according to CAT II (Landungen nach Betriebsstufe II). S. L. Belogorodskii (Staatliches Forschungsinstitut der Zivilluftfahrt, USSR). *(Grazhdanskaia Aviatsiia*, no. 7, 1979.) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 16, no. 3, 1980, p. 162-167, 175. In German. (Translation).

A81-24524 # New technology for the NDB system and its reliability. II (Neue Technik für NDB-Anlagen und ihre Zuverlässigkeit. II). W. Trempler (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany) and G. Schöne (Deutsche Post, Leipzig, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 16, no. 3, 1980, p. 168-175. In German.

A81-24525 # **New technology for the NDB system and its reliability.** III. W. Trempler (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany) and G. Schöne (Deutsche Post, Leipzig, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 16, no. 4, 1980, p. 205-214. In German.

A81-24722 # **Dynamics of longitudinal motion of a variable-sweepback aeroplane with a deformable control system.** Z. Dzygadlo and C. Szendzielorz. *Journal of Technical Physics*, vol. 21, no. 2, 1980, p. 209-224. 10 refs.

A81-24723 # **On the use of complex form of the Strouhal number in the study of nonlinear aeroelasticity.** Z. Kopriva (Vojenska Akademie, Brno, Czechoslovakia). *Journal of Technical Physics*, vol. 21, no. 2, 1980, p. 245-252. 12 refs.

A81-24730 # **The problem of the unsteady hypersonic flow past a plane profile (K zadache o nestatsionarnom giperzvukovom obtekanii ploskogo profilia).** V. I. Il'enko and E. A. Potekhina. *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia*, Oct. 1980, p. 45-49. 6 refs. In Russian.

An analysis is presented of the plane problem of the motion of a sharp curvilinear profile with a large variable velocity; the shock wave is considered to be attached. The thin shock layer model along with the assumption that the dimensionless time a gas particle spends in the shock layer is small compared to unity is used to obtain an analytical solution in the case of an arbitrary contour for an arbitrary V(t) dependence. The uniformly accelerated motion of a wedge is considered as an example. Results obtained by means of an additional expansion agree well with results obtained by the thin shock layer method. P.T.H.

A81-24732 # **Characteristics of nonequilibrium flow with ionization in a region perturbed by a thin blunt body (Osobennosti neravnovesnogo techeniia s ionizatsiei v oblasti, vozmushchennoi tonkim zatuplennym telom).** L. A. Ladnova, A. F. Polianskii, L. I. Skurin, and A. V. Iurkov. *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia*, Oct. 1980, p. 53-57. 6 refs. In Russian.

An approximate calculation of the characteristics of a region perturbed by a thin blunt body moving at hypersonic velocity is used to study the distribution of electron density and temperature along such a body and in its wake. Attention is given to the motion of cones with a drag coefficient of 0.07-0.11 and semiaperture angles of 6 and 10 deg with a velocity of 7.4 km/s at heights of 40-60 km. It is shown that processes of transport along the lateral surface of the body and viscous deceleration of gas near the trailing critical point have a significant effect on the basic characteristics of plasma structures in the perturbed region. The latter effect produces a significant increase of electron density and temperature in the throat of the wake. P.T.H.

A81-24746 # **Cygnet - A canard configuration powered ultralight aircraft.** T. Morse and M. Watts (Texas A & M University, College Station, Tex.). *AIAA Student Journal*, vol. 18, Summer 1980, p. 20-23, 47. 10 refs.

The design of the Cygnet powered ultralight aircraft, which overcomes many of the safety hazards associated with conventional powered hang gliders by the use of a canard configuration, is presented. The canard was chosen for the Cygnet to meet performance requirements including stall resistance, maneuverability and efficiency, and a high-aspect-ratio lightly loaded canard was selected to reduce the problem of tucking at high speeds and adverse conditions. Computer analysis was used in the evaluation of wing airfoils, leading to the selection of the Lissaman 7769 as the main wing airfoil and the Wortman FX60-126 K35 as the canard. Despite the advantages of placing a high-lift canard above the wing, the Cygnet canard was positioned below the wing to take advantage of structural features. Cygnet was designed to have full aerodynamic control, making use of a movable elevator on the canard to control pitch and drag flaps to control roll and yaw. A McCulloch MC101B is used as the powerplant, with an oil bath clutch to reduce propeller speed and a foldable propeller. The hangcage, a three-dimensional pyramidal truss in which the pilot sits, connects the main wire-braced wing to the cantilevered canard. Tests with a radio-controlled model have demonstrated adequate pitch response, and the need for tip redesign to control roll. S.C.S.

A81-24748 # **The Coronel Transverse Wing Flight system.** P. D. Coronel. *AIAA Student Journal*, vol. 18, Summer 1980, p. 38-41, 47.

The Coronel Transverse Wing (CTW) flight system consists of two sets of thin, sharp-edged symmetrical airfoils designed for maximum aircraft speed. The airfoils are arranged in a staggered bi-wing configuration on the fuselage. The upper wing is permanently fixed and contains plain or slotted flaps hinged at the rear of the wing. The CTW is located below and to the rear of the upper wing. At the rear of the CTW is a second set of main or slotted flaps. Maximum lift is achieved through tilting the CTW on a centerline axis parallel to the trailing edge of the upper wing to a position where the leading edge of the CTW meets with and locks against the lowered primary wing flap. The advantages of the CTW include: (1) reduced fuel requirements, (2) maximum efficiency at any speed, (3) superior lifting capability, (4) short takeoff and landing, and (5) safe approach and takeoff angles. S.C.S.

A81-24757 **Numerical simulation of supersonic flow around solids of revolution with a leading detachment zone.** I. A. Belov and S. A. Isaev (Leningradskii Mekhanicheskii Institut, Leningrad, USSR). *(Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 6, May 1980, p. 608-611.) *Soviet Technical Physics Letters*, vol. 6, May 1980, p. 264, 265. 6 refs. Translation.

A numerical simulation of the detached supersonic flow of an ideal fluid around an object having a power-law shape and to the front of which a disk is attached is presented. The deliberate formation of a circulation flow in front of the object leads to a substantial reduction of the wave-fluid resistance of the object. Values are presented for the wave-fluid resistance as a function of Mach number, noting those determined for the nose cone of a Trident rocket. S.C.S.

A81-24814 **Plane transonic solution with shock by direct iteration.** P. Niyogi (Indian Institute of Technology, Kharagpur, India) and T. K. Das (Jadavpur University, Calcutta, India). *Acta Mechanica*, vol. 38, no. 3-4, 1981, p. 169-181. 17 refs.

Transonic reduced pressure distributions at thin symmetrical nonlifting profiles, with high subsonic free stream velocity, are predicted by determining approximate solutions of the Oswatitsch integral equation by direct iteration scheme which is extended here to include shocks. Computations carried out with a simplified model show rapid convergence to a flow with a shock in about 16 iteration steps, correct up to two decimal places. Results are presented for a NACA 0012 profile and a parabolic arc profile and are compared with other numerical results which indicate good agreement, particularly for the shock position. D.K.

A81-24815 **Transient three-dimensional flow along a porous plate.** P. Singh (Indian Institute of Technology, Kanpur, India), V. P. Sharma, and U. N. Misra (Indian Institute of Technology, Kharagpur, India). *Acta Mechanica*, vol. 38, no. 3-4, 1981, p. 183-190.

A81-24870 # **Helicopter-borne radiosonde system and its experimental uses.** M. Sekioka (Defense Academy, Yokosuka, Kanagawa, Japan). *Meteorological Society of Japan, Journal*, vol. 58, Dec. 1980, p. 537-543.

A81-24924 * **Heat transfer from a row of impinging jets to concave cylindrical surfaces.** P. Hrycak (New Jersey Institute of Technology, Newark, N.J.). *International Journal of Heat and Mass Transfer*, vol. 24, Mar. 1981, p. 407-419. 39 refs. Contract No. NAS3-11175.

Starting from the first principles, and with one experimentally obtained parameter, an expression for stagnation heat transfer is derived, applicable to round, impinging jets. The results obtained with a row of air jets impinging on an electrically-heated surface in a small-scale setup characteristic of a typical turbine blade have been found compatible with the average heat transfer from a geometrically similar, steam-heated surface scaled up ten times, and comparable with the results of other investigators. These findings were linked to the flow fields likely to exist in the gas turbine blades, internally cooled by a row of round jets or a single jet of equivalent width. The magnitude of heat-transfer coefficients obtained here with impinging jets approaches that normally associated with forced convection of water and evaporative cooling. (Author)

A81-24938 Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979 (Nederlandse Vereniging voor Luchtvaarttechniek, Jaarboek 1979). Edited by F. J. Sterk (Nederlandse Vereniging voor Luchtvaarttechniek, Amsterdam, Netherlands). Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1980. 58 p. In Dutch and English.

Papers are presented on flying qualities criteria for advanced control technology transports, research on fatigue at the Department of Aerospace Engineering of Delft University, and landing gear shock absorber design criteria and the assessment of tire-wheel configurations. Helicopter-ship qualification testing and a comparison of aluminum alloys sheets for tension critical aircraft structures are also considered. B.J.

A81-24939 # Research on fatigue at the Department of Aerospace Engineering of the Delft University. I. J. Schijve (Delft, Technische Hogeschool, Delft, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1980, p. 2-1 to 2-8. 19 refs.

A wide-ranging presentation is made of the Delft University aircraft structure fatigue research program, covering recent indications of the present severity of such problems (as in the Lockheed C5A), stress intensity factor analysis, crack growth resistance under static loading and fatigue crack growth under cyclic loading, stress growth under stress corrosion conditions, fatigue of laminated sheet materials and fatigue crack growth in slugs. Emphasis is given to the prospect of solving stress and fatigue problems by recourse to laminated composites in primary aircraft structures. O.C.

A81-24940 # Landing gear shock absorber design criteria and the assessment of tire/wheel configurations. J. van der Laarse (Fokker-VFW, Schiphol, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechnick, 1980, p. 3-1 to 3-12. 5 refs.

A study of landing gear parameters intended to simplify computerized preliminary design tasks for landing gear design work is presented. Aircraft response, descent energy absorption, aircraft structural load transfer, and characteristics of operation on various kinds of pavement are among the dynamic conditions examined for a number of commuter and airliner aircraft. Particular attention is given to the design requirements of the Fokker F29 landing gear. It is concluded that despite the improvement in preliminary design assessment methods, verification and adjustment of all parameters at a more advanced design stage will still have to be undertaken. O.C.

A81-24941 # Helicopter-ship qualification testing. R. Fang, T. Hoekstra, C. Leijnse, and L. T. Renirie (National Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1980, p. 4-1 to 4-9.

A test method developed by the Netherlands Aerospace Laboratory for the establishment of shipboard helicopter landing operation restrictions is described. The helicopter, in such an operational environment, must be maneuvered close to the ship's flight deck with extremely turbulent aerodynamic conditions prevailing, in addition to the movements of the flight deck. The method includes the recording and analysis of relevant parameters (such as wind speed and direction) for the helicopter and the ship, and a quantification of human factors by a pilot rating technique. Special attention is paid to a method for defining and presenting ship motion limits. O.C.

A81-24942 # Comparison of 2024 and 7475 aluminum alloy sheet for tension-critical aircraft structures. R. J. H. Wanhill (National Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1979. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1980, p. 5-1 to 5-7. 20 refs.

Flight simulation fatigue crack propagation tests on 2024-T3 and 7475-T761 aluminum alloy sheet were carried out using a gust spectrum representative of the load history of an under wing skin in a transport aircraft and a maneuver spectrum of fighter aircraft. The investigation included tests at several design stress levels and in environments of laboratory air and air plus water spray. The results are discussed with respect to the choice of structural concepts, such as laminated sheets and sandwich panels. (Author)

A81-24968 A new approach to thick-film resistors. D. F. Zarnow (U.S. Navy, Naval Avionics Center, Indianapolis, Ind.). *(International Society for Hybrid Microelectronics, International Microelectronics Symposium, Los Angeles, Calif., Nov. 13-15, 1979.) International Journal for Hybrid Microelectronics,* vol. 3, Spring 1980, p. 24-31.

The paper examines methods used by the Naval Avionics Center to modernize and refine materials and processes related to the fabrication of highly reliable thick-film resistors used in Navy avionics and related equipment. A manufacturing technology is presented, based on an elementary, analytical modeling method that successfully 'lumps' dominant factors which influence thick-film resistor production so that only three parameters are required to comprehensively characterize a prototype on production line. Values for these parameters, easily obtained, establish widely useful exponential predictor equations. Process and material control methods are also investigated. The results show that 85% of the 24 resistors for the microcircuit that were designed from the predictor equations were between -6 and +10% of their intended target value, 100% being between -6 and +15.5%. D.K.

A81-25173 Aircraft dynamic stability and response. A. W. Babister (Glasgow, University, Glasgow, Scotland). Oxford and Pergamon Press, 1980. 241 p. 84 refs. $15.

The fundamental concepts of aircraft dynamic stability and response are presented. Aircraft static stability and maneuverability are reviewed, and the theoretical basis of flight dynamics is examined with explanations of the technical terms used. The physical background for the estimation of aerodynamic derivatives is delineated. The flight dynamics theory is applied to the longitudinal and lateral motion of aircraft, and the effect of automatic control is discussed. The effects of aeroelasticity, dynamic coupling, and high incidence are surveyed. An example of the estimation of dynamic stability characteristics is provided. L.S.

A81-25174 B. M. Fraeijs de Veubeke memorial volume of selected papers. Edited by M. Geradin (Liège, Université, Liège, Belgium). Alphen aan den Rijn, Netherlands, Sijthoff and Noordhoff; Waterloo, Ontario, Canada, University of Waterloo, 1980. 767 p. $57.50.

Studies presented in this volume cover a variety of subjects, including elastostatics, elastodynamics, finite elasticity, heat conduction, vibration mode excitation, structural analysis of multicellular box beams, and nonlinear shell theory. Papers are presented on the

influence of internal damping on aircraft resonance, variational principles in fluid mechanics, dual analysis for heat conduction problems by finite elements, matrix structural analysis, and the dynamics of flexible bodies. V.L.

A81-25267 # **Eddy viscosity in accelerated and retarded cascade-wake flows.** J. W. Elsner and J. Wilczynski (Czestochowa, Politechnika, Czestochowa, Poland). *Rozprawy Inzynierskie,* vol. 27, no. 4, 1979, p. 547-557. 16 refs.

Theoretical and experimental results are presented on the evolution of eddy viscosity behind a row of symmetrical bodies in cascade flow with a longitudinal pressure gradient having a constant value in the downstream direction. It is shown that the longitudinal pressure gradient has a significant effect on the evolution of the overall flow pattern behind the row of bodies. The eddy viscosity coefficient decreases sharply with the growth of a specified coordinate, x(overbar)1. For coordinate values greater than 11, the coefficient appears to be an increasing function of the longitudinal pressure gradient. P.T.H.

A81-25311 # **Subsonic cascade flow analysis by a finite element method.** H. Shirahata and H. Daiguji (Tohoku University, Sendai, Japan). *JSME, Bulletin,* vol. 24, Jan. 1981, p. 29-36. 14 refs.

A finite element method was developed for analyzing steady two-dimensional inviscid subsonic flows through an arbitrary shaped cascade on an arbitrary revolutional surface with a varying channel height. The flows were assumed to be homentropic and homorothalpic. The Poisson's equation for stress function is calculated repeatedly by minimization of the functional using linear triangular elements; to increase the accuracy and save the computer time, the treatments of the periodic condition and the Kutta condition were improved and the calculation of velocity was performed by the least square method. As numerical examples, flows through a compressor rotor cascade on a conical surface and a turbine stator cascade on a plane were computed and the streamlines, the Mach number contours, pressure contours, and the pressure distributions on the blade surface were obtained. (Author)

A81-25312 # **The effect of sound on the vortex-shedding from a circular cylinder - Acoustical vibrations directed along axis of cylinder.** S. Okamoto (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), T. Hirose (Osaka University, Suita, Japan), and T. Adachi (Tsukuba, University, Sakura, Ibaraki, Japan). *JSME, Bulletin,* vol. 24, Jan. 1981, p. 45-53. 10 refs.

An experimental investigation has been carried out to study acoustic interferences in vortex-shedding from a circular cylinder in a crossflow subjected to the acoustical vibrations directed along the axis of the cylinder, and in particular, to measure the correlation of vortex-shedding along the cylinder axis. The results indicate that the effects of the acoustical vibrations directed along the axis of the cylinder are similar to the effects of the acoustical vibrations whose direction is normal to the axis of the cylinder on the vortex-shedding from the cylinder, and both vibrations increase the spanwise correlation of the cylinder wake. The acoustic frequencies which produce powerful effects on vortex-shedding correspond to the frequencies of laminar-turbulent transition wave in a separated shear layer, and there are critical sound pressure levels in these acoustical vibrations. (Author)

A81-25353 **Numerical computation of transonic potential flow through nozzles.** T. J. Baker (Aircraft Research Association, Ltd., Bedford, England). *Aeronautical Quarterly,* vol. 32, Feb. 1981, p. 31-42. 14 refs. Research supported by the Ministry of Defence (Procurement Executive).

A numerical method for computing potential flow through either a planar or an axisymmetric nozzle is presented. The approach used is to solve the full steady state potential equation by an iterative method. A shearing transformation is used to generate a coordinate mesh. A Mach number is specified at downstream infinity as part of the boundary data for a convergent-divergent nozzle; by varying this downstream Mach number, the effect of varying the nozzle pressure ratio is simulated. This iterative method is found to be stable provided that the difference formulas, which replace the derivatives in the partial differential equations, reflect the main physical features of the flow. The theory presented fits the experimental results except in the case of different positions of the Mach 1.8 contours indicated experimentally. D.K.

A81-25354 **Miniature pressure probe for measuring the surface-shear-stress vector in turbulent flow.** N. Pontikos and P. Bradshaw (Imperial College of Science and Technology, London, England). *Aeronautical Quarterly,* vol. 32, Feb. 1981, p. 43-47. 6 refs.

If two small fences are arranged approximately at right angles in plan view, the magnitude and direction of surface shear stress can be deduced from measurements of the pressure difference across each fence. Fence heights as small as 0.05 mm are easily achieved. The device is simpler to use than null-seeking arrangements, and is accurate even in the presence of strong pressure gradients, which are shown to have large effects on other types of surface obstacle in three-dimensional flow. (Author)

A81-25355 **A numerical study of vortex shedding from one and two circular cylinders.** P. K. Stansby (Salford, University, Salford, Lancs., England). *Aeronautical Quarterly,* vol. 32, Feb. 1981, p. 48-71. 17 refs.

A discrete-vortex representation of the wake of a circular cylinder, in which vortices are convected in a potential-flow calculation and maintain their identities unless they approach one another or a surface closely, predicts many of the unsteady flow features and is computationally more efficient than other schemes. The mean rate of shedding of vorticity is adjusted to be compatible with experiments at a high subcritical Reynolds number of 30,000 and the model gives reasonable predictions of separation, drag, lift, Strouhal number and vorticity loss in the formation region. The method is extended to accommodate a second cylinder and many of the surprising features which have been observed experimentally with two cylinders in a side-by-side arrangement are reproduced. (Author)

A81-25374 **Position-determination accuracies of navigation methods (Positionsgenauigkeiten von Navigationsverfahren).** I. Harre (Krupp Atlas-Elektronik, Bremen, West Germany). *Ortung und Navigation,* no. 3, 1980, p. 340-359. 5 refs. In German.

A81-25375 **Considerations concerning an 'information busbar' for distributing on-board measurement and control information (Gedanken über eine 'Informations-Sammelschiene' für die Verteilung von Mess- und Steuerinformationen an Bord).** B. Brosch (Telefunken AG, Ulm, West Germany). *Ortung und Navigation,* no. 3, 1980, p. 384-391. In German.

A81-25376 **Concepts and state of the art of the precision DME of the microwave landing system (Konzepte und Stand des Auswahlprozesses für das Präzisions DME des Mikrowellenlandesystems).** W. Skupin (Braunschweig, Technische Universität, Braunschweig, West Germany). *Ortung und Navigation,* no. 3, 1980, p. 394-413. In German.

The paper deals with some basic concepts which have been proposed for the DME/M - a high-precision range measuring system that is an integral component of the microwave landing system. Work on the final definition of the concepts is reviewed, and the current status of DME development is examined. V.P.

A81-25378 **The use of bonded crack-stoppers in pressure cabins.** M. Norris. *Aeronautical Journal,* vol. 85, Feb. 1981, p. 57-62. 10 refs.

Based on design and testing experience with the BAe 146 commuter aircraft, refinements on the design, construction and fatigue-crack inspection methods of a pressurized hull structure reinforced by bonded, crack-stopping elements are projected. Structural analysis, stress intensity factor and crack-stopper fatigue life

calculations, and design considerations such as structural configuration ('Z' or 'top-hat') and choice of materials (aluminum) are covered. O.C.

A81-25379 Experimental investigations of the base pressures found on a bluff body in ground effect. R. L. L. Frost. *Aeronautical Journal*, vol. 85, Feb. 1981, p. 63-70. 5 refs.

A series of experiments were conducted to investigate the effects of yaw and pitch on the base pressures of various bluff body geometries under ground effect. It was found that as the bodies were yawed, significant variations in base pressure distribution dependent on the geometry tested developed, in addition to a horizontal cross-flow across the base, and that the effect of pitch attitude on base pressure was strongly related to the model geometry being tested. These tests are of interest in drag reduction and vortex control of road vehicles. O.C.

A81-25384 Recent developments in integral equation method in transonic flow. P. Niyogi (Indian Institute of Technology, Kharagpur, India). *Indian Academy of Sciences, Proceedings (Engineering Sciences)*, vol. 3, July 1980, p. 143-167. 44 refs.

The present work gives a brief review of the integral equation method in transonic aerodynamics, with particular emphasis on the works of Norstrud (1970), Nixon (1974), and Niyogi (1975, 1976). The use of the integral equation method can result in a significant reduction in computer time, roughly by a factor of 60, compared to the finite difference relaxation procedure. In shock-free symmetrical super-critical flows, the simple solution of Niyogi which delivers results with less than 5% overall error, may be conveniently used for analysis as well as for design purposes. The direct iteration scheme, applicable to shock-free flow, as well as to flows with shocks, emerges as particularly attractive due to its favorable convergence behavior and computational simplicity. It is expected to be even more effective for three-dimensional problems. Further, the simple model suggested by Oswatitsch (1950) for thin symmetrical profile flow is sufficiently accurate for most practical purposes. For results of high accuracy, a hybrid direct iteration/finite difference procedure is suggested, which would use the converged direct iteration solution of the simple Oswatitsch model as the starting solution for the finite difference procedure. (Author)

A81-25446 Linearized analysis of the three-dimensional compressible flow through a rotating annular blade row. J. A. Lordi and G. F. Homicz (Calspan Advanced Technology Center, Buffalo, N.Y.). *Journal of Fluid Mechanics*, vol. 103, Feb. 1981, p. 413-442. 17 refs. Contract No. F33615-73-C-2046.

Linearized solutions for the flow field of an isolated rotating blade row in an infinitely long annular duct are critically reviewed. Previously published source-flow solutions omitted a term which affected the thickness part of the rotor flow field constructed from them. Both three-dimensional and compressibility effects are included, though attention is confined to subsonic flows. The behavior of blade-surface pressure and velocity distribution is described for both the thickness and loading cases, with sample numerical evaluations of the surface quantities presented. The revised source solution has been used to form a pressure dipole solution, which in turn has been used to construct the rotor-loading contribution to the flow field. The present pressure-dipole representation of the lifting surface has been shown to be equivalent to the vortex representation of Okurounmu and McCune (1970, 1974). O.C.

A81-25475 * # The Aerospace Vehicle Interactive Design system. A. W. Wilhite (NASA, Langley Research Center, Space Systems Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0233*. 12 p. 17 refs.

The Aerospace Vehicle Interactive Design (AVID) is a computer-aided design system that was developed for the conceptual and preliminary design of aerospace vehicles. The AVID system evolved from the application of several design approaches in an advanced concepts environment in which both mission requirements and vehicle configurations are continually changing. The basic AVID software facilitates the integration of independent analysis programs into a design system where the programs can be executed individually for analysis or executed in groups for design iterations and parametric studies. Programs that have been integrated into an AVID system for launch vehicle design include geometry, aerodynamics, propulsion, flight performance, mass properties, and economics. (Author)

A81-25512 * # Unsteady Newton-Busemann flow theory. I - Airfoils. W. H. Hui and M. Tobak (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 19, Mar. 1981, p. 311-318. 9 refs.

Newtonian flow theory for unsteady flow at very high Mach numbers is completed by the addition of a centrifugal force correction to the impact pressures. The correction term is the unsteady counterpart of Busemann's centrifugal force correction to impact pressures in steady flow. For airfoils of arbitary shape, exact formulas for the unsteady pressure and stiffness and damping-in-pitch derivatives are obtained in closed form, which require only numerical quadratures of terms involving the airfoil shape. They are applicable to airfoils of arbitrary thickness having sharp or blunt leading edges. For wedges and thin airfoils these formulas are greatly simplified, and it is proved that the pitching motions of thin airfoils of convex shape and of wedges of arbitrary thickness are always dynamically stable according to Newton-Busemann theory. Leading-edge bluntness is shown to have a favorable effect on the dynamic stability; on the other hand, airfoils of concave shape tend toward dynamic instability over a range of axis positions if the surface curvature exceeds a certain limit. As a byproduct, it is also shown that a pressure formula recently given by Barron and Mandl for unsteady Newtonian flow over a pitching power-law shaped airfoil is erroneous and that their conclusion regarding the effect of pivot position on the dynamic stability is misleading. (Author)

A81-25513 * # Partially confined multiple jet mixing. A. Krothapalli, D. Baganoff, and K. Karamcheti (Stanford University, Stanford, Calif.). *AIAA Journal*, vol. 19, Mar. 1981, p. 324-328. 6 refs. NASA-supported research.

Results of hot-wire measurements in an incompressible partially confined jet issuing from an array of rectangular nozzles, equally spaced with their small dimensions aligned are presented. The quantities measured include mean velocity and the Reynolds stress in the two central planes of the jet at stations covering up to 115 widths (small dimension of a nozzle) downstream of the nozzle exit. For downstream distances greater than 60 widths, the flowfield is observed to be nearly homogenous and the turbulence appears to be quite similar to that of a grid generated turbulence. (Author)

A81-25585 # Analytically determined fin-tip heat transfer coefficients. E. M. Sparrow and C. F. Hsu (Minnesota, University, Minneapolis, Minn.). *ASME, Transactions, Journal of Heat Transfer*, vol. 103, Feb. 1981, p. 18-25. NSF Grant No. 75-18141.

An analysis was performed to determine the fin-tip heat transfer coefficients for an array of straight longitudinal fins attached to a plane wall. The array is shrouded by an adiabatic surface positioned adjacent to the tips, with a clearance gap between the shroud and the tips. The analysis was carried out for hydrodynamically and thermally developed conditions and for laminar flow. Results were obtained from numerical solutions of the momentum and energy conservation equations for the fluid and the energy equation for the fin, with two-dimensional conduction being permitted in the fin. From the solution, the average fin-tip heat transfer coefficient was evaluated and compared with the average coefficient for a segment of the principal face of the fin that is adjacent to the tip, the segment length being half the tip width. These coefficients were found not to differ too greatly, with the largest deviations being on the order of twenty-five percent. When convective heat transfer at the fin tip was suppressed, the heat transfer coefficients on the tip-adjacent portion of the principal face increased markedly. Because of this compensat-

ing effect, the overall performance of the fin is about the same when the tip is either convectively active or adiabatic. In general, large variations of the fin heat transfer coefficient were encountered between the base and the tip, with the smallest values at the base and the largest values at the tip. (Author)

A81-25612 High power silver zinc and thermal batteries for missiles and aviation applications. S. Font (Société des Accumulateurs Fixes et de Traction, Romainville, Seine-Saint-Denis, France). In: Progress in batteries and solar cells. Volume 3.
Cleveland, Ohio, JEC Press, Inc., 1980, p. 248-250.

The characteristics of the silver zinc and thermal batteries are given. The P.A.C.-type silver oxide zinc reserve battery has direct application in missiles and aircraft where high reliability, high power, and long shelf life are required. The calcium-calcium chromate couple can be used up to 40 A/dm sq, whereas the lithium-aluminum-iron disulphide couple permits 200 A/dm sq. The advantages of the thermal battery include a long shelf life, low cost, and the ability to be used without a specific heating device. L.S.

A81-25618 A new airborne nickel cadmium battery concept. R. Bonnaterre and E. Leocard (Société des Accumulateurs Fixes et de Traction, Romainville, Seine-Saint-Denis, France). In: Progress in batteries and solar cells. Volume 3.
Cleveland, Ohio, JEC Press, Inc., 1980, p. 270-273. Research supported by the Direction Technique des Constructions Aéronautiques and Ministry of Defence of England.

A new battery design with increased power-to-weight and energy-to-weight ratios as a result of improvements in the volumetric efficiency of its elements is disclosed. Research work culminating in the design, encompassed electrode thickness and separation optimization, ionic permeability for hydroxide ions through a separator and impermeability to oxygen transfer between electrodes, better mechanical and thermal behavior of the separator material, and extended electrolyte volume to reduce the frequency of maintenance operations. Such batteries supply a number of aircraft on-board devices that are indispensable to the aircraft in case of main generator failure. O.C.

A81-25648 Influence of zero-lift downwash on the relation between minimum-drag center-of-gravity position and inherent stability boundary (Einfluss des Nullabwinds auf die Zuordnung von widerstandsoptimaler Schwerpunktlage und natürlicher Stabilitätsgrenze). H. Max (Dornier GmbH, Friedrichshafen, West Germany) and G. Sachs (München, Hochschule der Bundeswehr, Neubiberg, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 5, Jan.-Feb. 1981, p. 52-54. In German.

A81-25679 Finite element calculation of thin-wall reinforced shells of the fuselage type with account for physical nonlinearity and loss of stability of certain elements. Z. I. Burman and V. A. Shuvalov. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 20-24.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 16-19. 8 refs. Translation.

Techniques for refining the stress state of fuselage-type shells working beyond the limits of linear deformability are examined. Refinement is achieved by sequential imposition of initial deformations providing the required load limitation and also by account for the additional loads on the reinforcing elements caused by the diagonal tension field in the skin. (Author)

A81-25680 Wing analysis by the plate analogy using an integral-difference method. M. B. Vakhitov, M. S. Safariev, and V. I. Khaliulin. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 25-29.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 20-23. 7 refs. Translation.

A numerical method for analyzing wings with complex attachment conditions and subject to the action of external load and a temperature field is developed. Wings of complex planform and irregular structural scheme are analyzed by breaking them down into bays. The numerical results are compared with experiment. (Author)

A81-25681 Application of hybrid schemes in analysis of thin-wall structures by the displacement method. M. B. Vakhitov and P. D. Levashov. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 30-34.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 24-27. Translation.

Hybrid computational schemes using a combination of various hypotheses and assumptions in various zones are proposed for reducing the overall number of unknowns in flight vehicle airframe stress analysis. Ways of forming the resolving equation for such a scheme with use of the displacement method are noted. (Author)

A81-25682 Numerical study of stream surface structure near highly loaded wings. A. A. Gruzdev. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 35-39.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 28-31. 5 refs. Translation.

A study is made within an ideal fluid framework of the deformation of a rectangular contour, with attention to the shape of the trailing wake traveling in infinite space and near the ground plane. The calculation results are compared with calculations using linear theory, and the shape of the free vortices is found by successive approximations. In contrast with the usual methods, this technique does not require discretization of the vortex shape, and a regular solution of the Cauchy problem for the equation is obtained for any values of the core diameter. O.C.

A81-25683 Iterative method for determining maximum load capacity of aircraft structures. Iu. A. Denisov, Iu. G. Popov, and G. Sh. Simonova. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 40-44.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 32-35. Translation.

An iterative method for determining the maximum load capacity of aircraft structures that is easily implemented on a computer is proposed. Analysis of the calculation results shows that the iteration process converges rapidly and that 5 to 12 approximations are sufficient for determining the load capacity of the structure by the chord method with accuracy to 1% of the design load. Further increase of the load capacity calculation accuracy by one significant place requires 3 to 4 additional calculations. O.C.

A81-25685 Optimization of airplane time to reach a given flight altitude and speed. V. V. Ivanov and T. K. Sirazetdinov. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 50-56.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 40-44. 6 refs. Translation.

An algorithm for constructing the optimal trajectory for the climbing of an aircraft to a given altitude and its reaching a given speed in minimal time is presented. It is noted that the proposed method makes it possible to solve problems with boundary conditions and limitations on phase coordinates and control, finding along with the best solution many allowable solutions. From comparison of these results with the energy method it follows that the proposed method yields better results than existing alternatives when using more complex mathematical models to describe aircraft motion. O.C.

A81-25688 Analytic design of regulators with limitations. T. K. Sirazetdinov and S. V. Smirnov. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 67-71.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 53-56. 5 refs. Translation.

A solution is proposed for the problem of complex dynamic system control synthesis in the transfer of an object from some point in space to a specified region, with inequality-type limitations on the magnitude of the control and on the derivatives of the phase coordinates. The problem of the analytic design of such regulators is an extension of the problem of optimal regular analytic design in a basic control sense. O.C.

A81-25689 Calculation of flow with variable specific heat around a profile. O. P. Sidorov. *(Aviatsionnaia Tekhnika,* vol. 23, no.

2, 1980, p. 77-82.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 62-65. Translation.

Linear temperature dependence of the specific heat is assumed and it is shown that the isentropic equation and the Bernoulli equation take on additional terms. In this connection all the well-known expressions and formulas used for calculating compression and expansion flows change their form. If the solution of the problem of flow around a profile is compared with the solution with constant specific heat, the temperature, density, and pressure on the profile decrease. (Author)

A81-25690 Analysis of the influence of atmospheric turbulence on alternating bending stress level in helicopter main rotor blades. A. I. Turkina. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 83-86.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 66-68. Translation.

The influence of a vertical gust on elastic main rotor blades is examined, with an allowance made for helicopter disturbed motion by joint solution of the equations of blade bending and helicopter motion. A comparative analysis is made for various flight regimes and the influence of flight speed and flapping compensator coefficient on the alternating stress level is shown. It is found that the stresses increase. (Author)

A81-25691 Parametric analysis of multipurpose airplanes based on utilization effectiveness criteria. I. N. Agliullin. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 87-89.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 69-71. Translation.

To overcome the contradictions inherent in the design process of multipurpose aircraft, such as maximization of versatility and minimization of system complexity, a method of reduction and decomposition of mathematical system-function models is proposed. The simplest possible analogs of the system are arrived at by means of statistical relationships and use of the characteristics of prototypes of various elements. As work on the design proceeds, the approximate models are replaced by more exact and complicated ones. O.C.

A81-25694 On the inter-relationship of the basic parameters and characteristics of various flight vehicles. Iu. V. Makarov. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 96-99.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 79-82. 5 refs. Translation.

The relations holding between configurational features of static and dynamic air-cushion vehicles (ACVs) and their operational characteristics are discussed, with extensive comparisons to vehicles, such as helicopters, having comparable characteristics. Power-loading as a function of lifting surface loadings is considered for static ACVs and helicopters, and for dynamic ACVs and aircraft. O.C.

A81-25696 Damping in the problem of natural vibrations of an elastic system with internal resonance. V. E. Kriutchenko. *(Aviatsionnaia Tekhnika,* vol. 23, no. 2, 1980, p. 107-111.) *Soviet Aeronautics,* vol. 23, no. 2, 1980, p. 92-95. 6 refs. Translation.

The problem of predicting the potentially deleterious structural effects of natural vibration frequency variations over the course of operation of flight vehicles is considered. In the process of functioning of the system with reduction of the fuel weight the natural vibration frequency of the liquid in the tanks and the elastic vibration frequency of the supporting structure increase monotonically but at different rates. As a result situations may arise when definite integer ratios develop between the partial frequencies, which is the phenomenon of internal resonance. If calculated values are compared with the values of the coefficient of elastic resistance realized during flight vehicle operation, insight is gained into what changes elastically attached masses cause in the natural vibration spectrum of a system with internal resonance. O.C.

A81-25701 Laws of unstable crack growth under cyclic loading. V. T. Troshchenko, P. V. Iasnii, and V. V. Pokrovskii (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* June 1980, p. 3-7.) *Strength of Materials,* vol. 12, no. 6, Feb. 1981, p. 669-674. 9 refs. Translation.

An experimental study of the laws of stable and unstable crack growth was conducted, with a specimen in plane bending for the cyclic case, and with specimens having a fatigue crack in off-center tension for the static. Specimen dimensions for both cases were 25 mm thickness and 70 mm width. Curves were plotted for such factors as the dependence of critical crack growth rate on cyclic fracture toughness, temperature dependence on fracture toughness, dependence of the critical stress intensity factor on the number of load cycles, and the effect of mode of cyclic loading on fracture toughness parameters. These findings are of importance to the design of metallic aircraft structures. O.C.

A81-25903 # Inverse problems of the dynamics of controlled flight - Lateral motion (Obratnye zadachi dinamiki upravliaemogo poleta - Bokovoe dvizhenie). B. N. Petrov and P. D. Krut'ko (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). *Akademiia Nauk SSSR, Doklady,* vol. 256, no. 5, 1981, p. 1068-1072. In Russian.

A method is developed for the automatic lateral control of a flight vehicle. An algorithm for the control of the position of the center of mass relative to a prescribed flight line is obtained which assures the stability of the control system with respect to constant disturbing forces. B.J.

A81-26007 Problems and promises in gas turbine combustor design development. D. A. Hudson (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: Gas turbine combustor design problems. Washington, D.C., Hemisphere Publishing Corp., 1980, p. 3-9; Discussion, p. 9, 10.

Current design emphasis for gas turbine engine combustion systems is in part durability. The development of combustion systems which meet durability goals has required concentration on solving the problems of accurate duty cycle definition and high temperature maldistributions. Recent improvements in the understanding of aircraft utilization has allowed accurate duty cycle descriptions which, in turn, has improved our capability to design more durable combustion systems. Maldistribution of high temperature regions in the combustor continues to be the greatest causal factor of distress to the combustion system. These maldistributions of high temperature are caused primarily by ill-defined and poorly controlled flow fields in the dome of the combustion system. The most challenging and beneficial research facing the combustor designer today is an improved understanding of the flow field in the combustor dome region. Future combustion systems will be facing many problems from new fuels effects, advanced aerodynamics, reduced wall cooling, and combustion instabilities. To meet the challenges of current and future problems, promising new techniques such as combustion modelling, variable geometry and new non-metallic materials are being developed. (Author)

A81-26008 Noise from gas turbine combustors. W. C. Strahle (Georgia Institute of Technology, Atlanta, Ga.). In: Gas turbine combustor design problems. Washington, D.C., Hemisphere Publishing Corp., 1980, p. 27-34; Discussion, p. 34-36. 8 refs.

The state-of-the-art in understanding of the noise generation mechanisms of gas turbine combustors is presented. An elementary discussion is given of the physics of the three currently recognized noise sources; these are direct combustion noise, entropy noise and vorticity-nozzle interaction noise. A new empirical correlation and its rational basis are given which collapse previous disparate results from Pratt & Whitney, General Electric and Boeing combustors. Techniques are discussed for noise reduction and the importance of combustor noise is discussed for various gas turbine systems. A presentation is given of current and past experiments conducted at Georgia Tech which have as their aim a clear separation of different noise sources. (Author)

A81-26014 **Basic ignition research related to altitude relight problems.** D. R. Ballal and A. H. Lefebvre (Purdue University, West Lafayette, Ind.). In: Gas turbine combustor design problems. Washington, D.C., Hemisphere Publishing Corp., 1980, p. 189-200; Discussion, p. 200, 201. 8 refs.

A problem of major importance to aircraft gas turbines is that of re-establishing combustion after a flame-out at high altitudes. A question that often arises is why the ignition energy requirements of gas turbine combustors are so much higher than the corresponding values obtained from more basic studies of minimum ignition energy in gaseous and heterogeneous fuel/air mixtures, as reported in the literature. In order to shed more light on this question, a series of experiments have been conducted on the influence on minimum energy of various relevant parameters such as air pressure, temperature, velocity, turbulence, fuel/air ratio and, in the case of liquid fuels, mean drop size. The results show that, in addition to the adverse effects on ignition of low air pressure and temperature, the main reason for the large ignition energies associated with turbojet combustors is the high level of turbulence in the primary combustion zone. Another important consideration is the mean drop size of the fuel spray. It is found that quite modest improvements to atomization quality can reduce appreciably the amount of spark energy needed to effect ignition. (Author)

A81-26015 **Gas turbine engine emission abatement - Status and needed advancements.** D. W. Bahr (General Electric Co., Cincinnati, Ohio). In: Gas turbine combustor design problems. Washington, D.C., Hemisphere Publishing Corp., 1980, p. 205-222; Discussion, p. 222, 223. 12 refs.

The various smoke and gaseous pollutant emission standards applicable to aircraft and stationary gas turbine engines are reviewed. The results and trends of emission abatement technology programs which have been or are being conducted to meet these standards are briefly summarized. These programs include efforts to evolve technology for the design of both aircraft and industrial gas turbine engines with reduced pollutant emission levels. Based on the results and trends of these programs, some key emission abatement technology needs of gas turbine engines are outlined with emphasis on longer-term needs. (Author)

A81-26028 **An analytical study of nonlinear stabilization during ballistic descent.** O. A. Privarnikov. *(Kosmicheskie Issledovaniia,* vol. 18, July-Aug. 1980, p. 500-506.) *Cosmic Research,* vol. 18, no. 4, Jan. 1981, p. 356-361. Translation.

Transients arising in the autonomous nonlinear control over the pitch channel, and the control law derivative, are analyzed with allowance for the nonlinearity of the aerodynamic characteristics. Approximate analytical solutions of the differential equation describing a transient process in the vibrational and aperiodic cases are obtained, and are used to study, in implicit form, the influence of the parameters of an automatic stabilization system on the properties of the transient response. V.P.

A81-26045 **A mathematical computer simulation of stationary and nonstationary flow of an ideal incompressible fluid around solid profiles and arrays.** V. N. Kotovskii, M. I. Nisht, and R. M. Fedorov (Voenno-Vozdushnaia Inzhenernaia Akademiia, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady,* vol. 252, no. 6, 1980, p. 1341-1345.) *Soviet Physics - Doklady,* vol. 25, June 1980, p. 437-439. 9 refs. Translation.

The method of single vortices is used to calculate flow past thick profiles and gratings of a preselected form. The following conditions are assumed in solving the problem: the fluid is incompressible and nonviscous; the flow is without separation; the parameters of the undisturbed flow are specified; and the profile surface is impermeable. A system of linear algebraic equations is proposed to determine the values of single vortex circulation. The described technique was used for systematic numerical calculation of steady and unsteady ideal fluid flow past different bodies (e.g., circular and elliptic cylinders, profiles of various form, and profile lattices). S.S.

A81-26118 **Some problems of modeling high-speed aerodynamics.** G. I. Bagaev, G. P. Klemenkov, and A. M. Kharitonov (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). (Aeromekhanika. Sbornik statei posviashchaetsia 60-letiiu so dnia rozhdeniia akademika Vladimira Vasil'evicha Struminskogo, p. 194-199.) *Fluid Mechanics - Soviet Research,* vol. 9, May-June 1980, p. 13-17. 16 refs. Translation.

Modeling problems considered in the development of a high-speed aerodynamics facility for experimental work at the Institute of Theoretical and Applied Mechanics of the USSR Academy of Sciences Siberian Division are discussed. Variation of Re and M numbers in similitude studies, simulation of in-flight high-Re flow typical of modern aircraft, separated flows, development of facilities handling a broad Re range for transonic flow studies, hot-shot wind tunnels for hypersonic flow studies and control of turbulence are dealt with. Results of mass flow rate fluctuations measurements in response to wind-tunnel variation of M and Re are presented. R.D.V.

A81-26119 **Some aerodynamic properties of cones in viscous supersonic flow.** A. P. Krasil'shchikov and V. V. Nosov. (Aeromekhanika. Sbornik statei posviashchaetsia 60-letiiu so dnia rozhdeniia akademika Vladimira Vasil'evicha Struminskogo, p. 199-207.) *Fluid Mechanics - Soviet Research,* vol. 9, May-June 1980, p. 18-24. 10 refs. Translation.

In the experiments described, rounded, blunted and sharp-nosed cone models were propelled against oncoming supersonic flows in a wind tunnel developed for measuring the resistance of models at large Reynolds numbers. The Mach numbers, obtained by adding the flow and model velocities, ranged from 5 to 15. Shadow photographs of the flow pattern are presented, and some qualitative characteristics of cones of various cone angles, associated with the drag characteristics of the models are examined. V.P.

A81-26120 **Some optimization problems of internal aerodynamics.** G. M. Riabinkov. (Aeromekhanika. Sbornik statei posviashchaetsia 60-letiiu so dnia rozhdeniia akademika Vladimira Vasil'evicha Struminskogo, p. 207-217.) *Fluid Mechanics - Soviet Research,* vol. 9, May-June 1980, p. 25-33. Translation.

The paper describes some experiments in determining the optimal shapes and parameters of components of wind tunnels, including a supersonic adjustable diffusor, a Laval nozzle, and an ejector. A plane variable-geometry supersonic diffusor was followed by a subsonic variable-geometry diffusor, which was followed by a cylindrical section and a subsonic fixed-geometry diffusor. Choice of optimal diffusor outline ensuring maximum value of the total recovery was done in three stages: (1) evaluation of the optimal aspect ratio of the supersonic diffusor, (2) evaluation of the effectiveness of the cylindrical section placed in throat, and (3) implementation of an iterative procedure. Other experiments determined the optimal aspect ratio of a plane Laval nozzle for different Mach numbers and the optimal Mach number of the ejected gas for a fixed ratio of critical section area to mixing chamber cross section area of an ejector, and the optimal length of the mixing chamber of the ejector. P.T.H.

A81-26122 **Investigation of transient processes in the perforated working section of a wind tunnel.** Z. A. Anan'eva, V. R. Bertyn', G. V. Zemtsova, V. F. Kvasha, A. V. Podmazov, and B. V. Ponomarev. (Aeromekhanika. Sbornik statei posviashchaetsia 60-letiiu so dnia rozhdeniia akademika Vladimira Vasil'evicha Struminskogo, p. 230-238.) *Fluid Mechanics - Soviet Research,* vol. 9, May-June 1980, p. 44-50. 12 refs. Translation.

In the study described, opto-electronic recording techniques and high-speed shadow photography were used to study the unsteady sound fields generated by flows at Mach numbers ranging from 0.6 to 1.25 in a wind tunnel with two perforated walls. The cross-section of the useful length was 0.15 by 0.15 m; the hole diameter was 4 mm; the hole area was 20% of the wall area. Recordings obtained with a high-speed streak camera showed that at subsonic speeds the generated acoustic waves move in a direction opposite to the flow.

Photographs showing some specific features of the boundary layer on the perforated walls are given and discussed. V.P.

A81-26123 The application of liquid crystals in experimental aerodynamics. G. M. Zharkova (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). (Aeromekhanika. Sbornik statei posviashchaetsia 60-letiiu so dnia rozhdeniia akademika Vladimira Vasil'evicha Struminskogo, p. 238-244.) *Fluid Mechanics - Soviet Research*, vol. 9, May-June 1980, p. 51-56. 15 refs. Translation.

The high heat sensitivity of the coloration of liquid crystals makes them suitable for high-resolution temperature measurements, flow and boundary layer visualization, etc. The objectives of the experimental study described were to develop liquid-crystal mixtures for specific temperatures; to study the properties of such mixtures; and to develop liquid-crystal temperature indicators. The influence of mechanical shear on the coloration of liquid crystals is studied, along with means of using liquid crystals in skin friction measurements and in nondestructive testing. V.P.

A81-26134 Generation of vortex noise in flow past a profile in a channel. M. A. Il'chenko, A. N. Rudenko, and V. L. Epshtein. *(Akusticheskii Zhurnal*, vol. 26, Sept.-Oct. 1980, p. 708-717.) *Soviet Physics - Acoustics*, vol. 26, Sept.-Oct. 1980, p. 400-405. 9 refs. Translation.

The paper deals with an experimental investigation of sound generation by vortex shedding from plates of various profiles in a channel of rectangular cross section (150 x 50 mm). The influence of the plate profile, Mach number (0.05 to 0.3), and pressure ((1.05 to 2.5) x 10 to the fifth) on the frequency and amplitude of the generated oscillations was investigated. The results obtained were interpreted qualitatively. V.P.

A81-26137 Influence of boundary-layer suction on the spectrum of radiation from a thin plate vibrating under the action of pressure fluctuations. R. A. Mkhitarov. *(Akusticheskii Zhurnal*, vol. 26, Sept.-Oct. 1980, p. 772-775.) *Soviet Physics - Acoustics*, vol. 26, Sept.-Oct. 1980, p. 435, 436. 5 refs. Translation.

The mean square sound pressure is calculated for a thin rectangular plate performing oscillations under the action of pressure pulsations in the boundary layer. Calculations are carried out for a freestream Mach number of 0.4, a Reynolds number of 5 x 10 to the fourth, and a suction intensity of 4.2 x 10 to the -3rd power. The mean square sound pressure is found to decrease, as compared to the flow conditions in the absence of suction, at low and moderate frequencies, and to increase at high frequencies. V.P.

A81-26189 Discussion of the pressure-source aerosonic theory and of Doak's criticism. W. C. Meecham (California, University, Los Angeles, Calif.). *Acoustical Society of America, Journal*, vol. 69, Mar. 1981, p. 643-646. 13 refs.

The pressure-source theory is reviewed and simply derived on the assumption that the source flow has a small fluctuation-Mach number. It is shown that one prominent criticism of such theories is based on a fundamental fluid mechanics error. C.R.

A81-26242 The joints of aeronautical carbon resin composite structural elements (Assemblages des éléments structuraux en matériaux composites carbone résine dans l'aéronautique). J. Cuny (Société Nationale Industrielle Aérospatiale, Laboratoire Central, Suresnes, Hauts-de-Seine, France). In: Composite materials, bonding and adhesion: The art of assembling materials; International Forum, Lyons, France, September 11-14, 1979, Transactions. Paris, Association Nationale de la Recherche Technique, 1980, p. 173-194. In French.

The current state of development in the joining of carbon-reinforced aircraft structural elements is reviewed. Attention is given to techniques of carbon-carbon and carbon-metal bonding, and to in situ bonding. The joining of composite structures by means of mechanical fasteners is then examined in regard to their effects on the mechanical behavior of continuous and discontinuous structures subjected to a normal stress field. It is pointed out that up to now, the approach to the analysis and solution of joining problems in carbon-reinforced materials has been that of the adaptation of techniques developed for the fastening of metallic materials, and that significant improvements may be expected by the development of techniques proper to composites. A.L.W.

A81-26244 The quality of nonmetallic materials (Qualité des matériaux non métalliques). G. Hilaire (Société Nationale Industrielle Aérospatiale, Laboratoire Central, Suresnes, Hauts-de-Seine, France). In: Composite materials, bonding and adhesion: The art of assembling materials; International Forum, Lyons, France, September 11-14, 1979, Transactions. Paris, Association Nationale de la Recherche Technique, 1980, p. 207-243. In French.

The activities involved in the quality assurance at each stage of component manufacture for vital aircraft components are discussed. Procedures intended to ensure the proper functional characteristics of materials are considered, and examples demonstrating the importance of considerations of fabrication processes and the chemical composition of materials are presented. Critical points in the control of the quality of fabrication processes are considered, including ambient conditions, polymerization conditions, and pot life, and attention is given to the means used for the inspection of the finished components, including transmission and reflection ultrasonics, radiography and holography. A L.W.

A81-26419 Failure by fatigue. G. G. Garrett (Witwatersrand, University, Johannesburg, Republic of South Africa). In: Engineering applications of fracture analysis; Proceedings of the First National Conference on Fracture, Johannesburg, Republic of South Africa, November 7-9, 1979. Oxford, Pergamon Press, 1980, p. 79-93. 24 refs.

A review of advances made in recent years in the analysis of metal structures fatigue, with attention to the fatigue problems encountered by aircraft is presented. Topics range from the mechanics of fatigue crack growth to design methods aimed at improving fatigue performance, with particular regard to the analytical approaches available for describing and predicting fatigue behavior in response to both operational and environmental factors. O.C.

A81-26501 * Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. Symposium supported by U.S. Navy, U.S. Air Force, NSF, and NASA. Edited by G. R. Hough (Vought Advanced Technology Center, Dallas, Tex.). New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics. Volume 72), 1980. 481 p. Members, $25.; nonmembers, $45.

The symposium focused on laminar boundary layers, boundary layer stability analysis of a natural laminar flow glove on the F-111 TACT aircraft, drag reduction of an oscillating flat plate with an interface film, electromagnetic precipitation and ducting of particles in turbulent boundary layers, large eddy breakup scheme for turbulent viscous drag reduction, blowing and suction, polymer additives, and compliant surfaces. Topics included influence of environment in laminar boundary layer control, generation rate of turbulent patches in the laminar boundary layer of a submersible, drag reduction of small amplitude rigid surface waves, and hydrodynamic drag and surface deformations generated by liquid flows over flexible surfaces. A.T.

A81-26503 * # Boundary layer stability analysis of a natural laminar flow glove on the F-111 TACT airplane. L. J. Runyan (Boeing Commercial Airplane Co., Seattle, Wash.) and L. L. Steers (NASA, Flight Research Center, Edwards, Calif.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 17-32. 16 refs.

A natural laminar flow airfoil has been developed as a part of the aircraft energy efficiency program. A NASA flight program incorporating this airfoil into partial wing gloves on the F-111 TACT airplane was scheduled to start in May, 1980. In support of this research effort, an extensive boundary layer stability analysis of the partial glove has been conducted. The results of that analysis show the expected effects of wing leading-edge sweep angle, Reynolds number, and compressibility on boundary layer stability and transition. These results indicate that it should be possible to attain on the order of 60% laminar flow on the upper surface and 50% laminar flow on the lower surface for sweep angles of at least 20 deg, chord Reynolds numbers of 25 x 10 to the 6th and Mach numbers from 0.81 to 0.85. (Author)

A81-26504 # **Drag reduction of an oscillating flat plate with an interface film.** R. S. Sharma. In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 33-44. 15 refs.

A mathematical analysis for laminar drag reduction of an oscillating plate by the use of an intermediate film is presented. Expressions for velocity profiles for the film and the fluid above it are derived. The power input to oscillate the plate is significantly reduced by the use of a thin film of an elastico-viscous fluid. The influence of fluid elasticity on drag reduction is indicated. (Author)

A81-26506 * # **Electromagnetic precipitation and ducting of particles in turbulent boundary layers.** K. R. Davey (Texas A & M University, College Station, Tex.) and J. R. Melcher (MIT, Cambridge, Mass.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers.
New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 90-107. 7 refs. Grant No. NsG-1453.

A method for analyzing magnetic migration of particles in turbulent flows is applied to the prediction of particle trajectories and densities in turbulent aerodynamic boundary layers. Results for conditions typical of aircraft with 30-40 micron particles indicate a large upstream collection and a 5% loss of particles during one pass through the boundary layer. The capacity of the magnetic field to achieve a balance with turbulent diffusion in confining the particles to the boundary layer is discussed. V.L.

A81-26507 * # **Large-eddy breakup scheme for turbulent viscous drag reduction.** J. N. Hefner, L. M. Weinstein, and D. M. Bushnell (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 110-127. 38 refs.

A concept for reducing turbulent skin friction drag by altering/controlling the large coherent eddy structures within the turbulent boundary layer is proposed. Results of an ongoing experimental and numerical investigation to develop large-eddy breakup devices (LEBU devices) are presented and indicate that the average skin friction drag downstream of the LEBU devices is reduced by up to 24% compared to 'undisturbed' flat plate levels; device drag requires further reduction before net drag reductions can be realized. Future work is discussed and will focus on reducing device drag by taking advantage of the unsteady 'freestream' ahead of the LEBU devices. (Author)

A81-26508 * # **Modification in drag of turbulent boundary layers resulting from manipulation of large-scale structures.** T. C. Corke, Y. Guezennec, and H. M. Nagib (Illinois Institute of Technology, Chicago, Ill.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 128-143. 12 refs. Grant No. NsG-1591.

The effects of placing a parallel-plate turbulence manipulator in a boundary layer are investigated by means of flow visualization and hot-wire measurements. The manipulator was found to be effective in inhibiting the intermittent large scale structure of the boundary layer, and the effect persists for at least 70 boundary-layer thicknesses downstream of the manipulator. With the removal of the large scale, there was an observed reduction in the streamwise turbulence intensity levels near the wall. The downstream distribution of the skin friction coefficient, determined from the stream wise change in fluid momentum, was also altered by the introduction of the manipulator. The data from both the visualization and hot wire studies are provided. L.S.

A81-26510 * # **Drag characteristics of V-groove and transverse curvature riblets.** M. J. Walsh (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 168-184. 9 refs.

The paper examines the drag characteristics of longitudinally ribbed surfaces where the rib dimensions are the order of the initial turbulent wall burst region near the wall. Direct drag measurements are presented for symmetric and unsymmetric V-groove, and (larger wavelength) transverse curvature riblets. The direct drag data indicate net drag reductions as large as 7% for certain V-groove riblets with heights in terms of law of the wall coordinates h+ less than 30. For one of the riblet models, the drag reduction is confirmed by reductions in the momentum thickness, turbulent velocity fluctuations, and Reynolds stress profiles. Although the direct drag data for the transverse curvature riblets showed drag increases, certain models did show that the drag increase diminished with increasing velocity. This trend is opposite to the normal one found for rough surfaces and should be investigated further. (Author)

A81-26511 # **Transonic maneuver/cruise airfoil design employing active diffusion control.** C. H. Haight and R. L. Mask (Vought Advanced Technology Center, Dallas, Tex.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 187-211. 14 refs. Contract No. N62269-76-C-0318.

The use of advanced active diffusion control employing combined blowing/contouring has resulted in cruise and maneuvering transonic airfoil design points that are similar enough to permit deployment from a common section while still achieving outstanding performance at both flight conditions. An airfoil thickness ratio of 7% was selected, relating to high-performance aircraft/missile applications. For the maneuvering deployment at freestream M = 0.80, increments in lift coefficient of +0.18 and +0.40 were measured respective to supercritical and conventional airfoil baselines. Drag divergence for the cruise geometry was delayed by 0.08-0.09 on Mach number relative to predictions for a comparable Whitcomb-type section. Equivalent drag polars define potential performance gains over a wide range of operating conditions. Data show the blowing jet momentum coefficient required, even for maneuvering, to be well within the limits of bypass bleed and approaching levels for compressor bleed, based on estimates using existing engine technology. The high Mach number design point performance of a variable geometry transonic section employing active diffusion control indicates the potential for unique performance and efficiency advantages in advanced airfoil design. (Author)

A81-26512 # **Low drag airfoil design utilizing passive laminar flow and coupled diffusion control.** R. L. Mask (Vought Advanced Technology Center, Dallas, Tex.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 212-232. 24 refs. Contracts No. N62269-77-C-0442; No. N62269-79-C-0277.

A two-dimensional high-chord Reynolds number passive laminar airfoil was designed for lift coefficient = 0.73 at freestream M = 0.6 and Re = 4 x 10 to the 7th (evaluated for chord length) providing an extremely high L/D = 240. This laminar airfoil design concept integrates passive laminar flow stabilization, by pressure gradient shaping, with active diffusion control techniques on the airfoil trailing edge. A discussion of the design concept and the predicted performance is given. Full scale Reynolds number experiments defining maximum transition Reynolds number and environment influence on transition are presented. (Author)

A81-26513 * # **Hybrid suction surface for turbulent boundary layer flow.** S. P. Wilkinson (NASA, Langley Research Center, Hampton; Old Dominion University, Norfolk, Va.), R. L. Ash (Old Dominion University, Norfolk, Va.), and L. M. Weinstein (NASA, Langley Research Center, Hampton, Va.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 233-248. 16 refs.

A hybrid suction surface which combines favorable aspects of both uniformly porous and discrete opening suction surfaces has been evaluated experimentally for use with incompressible turbulent boundary layers. The surface consisted of an array of closely spaced slots aligned in the direction of the freestream flow. Direct drag and mean boundary layer velocity profile measurements showed that the slotted surface had nominally the same suction characteristics as a uniformly porous surface. (Author)

A81-26514 * # **Design considerations of advanced supercritical low drag suction airfoils.** W. Pfenninger, H. L. Reed, and J. R. Dagenhart (NASA, Langley Research Center, Hampton, Va.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 249-271. 11 refs. NASA-supported research.

Supercritical low drag suction laminar flow airfoils were laid out for shock-free flow at design freestream Mach = 0.76, design lift coefficient = 0.58, and t/c = 0.13. The design goals were the minimization of suction laminarization problems and the assurance of shock-free flow at freestream Mach not greater than design freestream Mach (for design lift coefficient) as well as at lift coefficient not greater than design lift coefficient (for design freestream Mach); this involved limiting the height-to-length ratio of the supersonic zone at design to 0.35. High design freestream Mach numbers result with extensive supersonic flow (over 80% of the chord) on the upper surface, with a steep Stratford-type rear pressure rise with suction, as well as by carrying lift essentially in front- and rear-loaded regions of the airfoil with high static pressures on the carved out front and rear lower surface. B.J.

A81-26515 * # **Compliant surfaces - Introduction.** D. M. Bushnell (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). In: Viscous flow drag reduction; Symposium, Dallas, Tex., November 7, 8, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 387-390. 15 refs.

It is noted that the essence of the compliant surface question is whether or not wall motion can provide a decrease in skin friction for either transitional or turbulent flows. This wall motion is capable of being externally excited or flow driven, with varying amounts of fluid motion-wall motion phasing (depending primarily upon wall structural configuration and damping). It is concluded that current research has eroded still further the experimental data base which indicates drag reduction on compliant surfaces under turbulent boundary layers in air. The need for further clarification and research is stressed for the small wavelength liquid case. C.R.

A81-26609 **Trajectory generation techniques for multivariable control of aircraft turbine engines.** M. M. Akhter, S. M. Rock, and R. L. De Hoff (Systems Control, Inc., Palo Alto, Calif.). In: Asilomar Conference on Circuits, Systems, and Computers, 13th, Pacific Grove, Calif., November 5-7, 1979, Conference Record. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1980, p. 65-68. 10 refs. Contract No. F33615-77-C-2096.

Practical trajectory generation techniques for advanced aircraft turbine engines are presented. The procedures utilize models of the engine and concepts from linear optimal control theory, yet do not require large memory storage nor the solution of a two-point boundary value problem. The implementation of these techniques is demonstrated using the F100 turbofan engine and the variable cycle engine (GE JTDE-23) as examples. (Author)

A81-26610 **Control design for reduction of aerodynamic tail forces using quadratic synthesis.** W. E. Holley and S. Y. Wei (Oregon State University, Corvallis, Ore.). In: Asilomar Conference on Circuits, Systems, and Computers, 13th, Pacific Grove, Calif., November 5-7, 1979, Conference Record. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1980, p. 73-77. 11 refs.

Quadratic synthesis methods are utilized in this paper to study the feasibility of using an autopilot with aileron and rudder control to reduce the aerodynamic force on the vertical tail for flight in turbulence. The aircraft modeled is a typical, small business jet transport under cruise conditions. The results clearly show the trade-off between ride performance and tail force reduction. (Author)

A81-26617 **The S3 transition.** J. G. Altman and S. N. LeGrand (Boeing Aerospace Co., Houston, Tex.). In: Asilomar Conference on Circuits, Systems, and Computers, 13th, Pacific Grove, Calif., November 5-7, 1979, Conference Record. Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1980, p. 108-111.

The S3 type of transition associated with L-Nets is discussed with reference to its structure and implementation. It is noted that for each S3 transition: (1) there exists at least one sink and one source; (2) the truth table is longer than the width of its input size; and (3) the transition uses the smallest amount of information. Examples discussed include an inverter, an exclusive OR gate, a solid state relay, and a flip flop. V.L.

A81-26747 **The Windecker Eagle - A new era in general aviation aircraft manufacturing.** G. A. Alther (Composite Aircraft Corp., Midland, Tex.). In: Reinforced plastics; Proceedings of the Conference, El Segundo, Calif., December 2, 1980. El Segundo, Calif., Technology Conferences, 1980, p. 104-114. 7 refs.

An historical and technical account is given of the construction methods and flight experience accumulated to date of the Windecker Eagle, an FAA-certified, all-fiberglass/epoxy general aviation aircraft. Extrapolating from lessons learned in constructing and operating five prototype aircraft, it is argued that extensive application of nonwoven, unidirectional cloth-reinforced epoxy primary structures will result in lower aircraft weight and higher payload fraction, gains in aerodynamic efficiency due to the greater regularity of skin contours, and savings in construction tooling and labor costs and energy requirements. O.C.

A81-26770 **Environmental chemistry and management of hydrazine.** M. G. MacNaughton, T. B. Stauffer, and D. A. Stone (USAF, Engineering and Services Center, Tyndall AFB, Fla.). *(Aerospace Medical Association, Annual Scientific Meeting, 50th, Washington, D.C., May 14-17, 1979.) Aviation, Space, and Environmental Medicine,* vol. 52, Mar. 1981, p. 149-153. 6 refs.

The recent use of 70% hydrazine-water fuel in the F-16 emergency power unit (EPU) presents problems for organizations responsible for protection of personnel and the environment because of the worldwide deployment of this aircraft and the requirement for fuel handling in a flightline environment. Hydrazine has a low vapor pressure (14 mm Hg at 25 C) but still evaporation rates (16-100 mg/sq cm hr) from liquid pools are sufficient to generate hazardous

atmospheric concentrations greater than the permissible exposure level (3 ppm) up to 2 km downwind under worst-case meteorological conditions (F Stability). In contrast to the general feeling that hydrazine degrades in the presence of atmospheric oxygen, studies show hydrazine is relatively stable in both air (half life approximately 6 h) and oxygenated aqueous solutions (half life approximately 5 d). The toxicity and stable character of hydrazine in the environment requires quick and thorough management of any accidental spills to preclude hazards to personnel and serious environmental degradation. The Air Force has established comprehensive containment and treatment procedures which will be used in the event of inadvertent releases of hydrazine from the EPU or during handling or transport of the bulk fuel. (Author)

A81-26836 # **Diagnosis-prognosis of intense turbulence, causing aircraft buffeting, on the basis of temperature-wind sounding (Diagnoz-prognoz intensivnoi turbulentnosti, vyzyvaiushchei boltanku samoletov, po dannym temperaturno-vetrovogo zondirovaniia).** G. S. Buldovskii. In: Forecasting of meteorological conditions for aviation. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 215), 1979, p. 3-12. 13 refs. In Russian.

A diagnostic-predictive method is developed for the study of intense clear air turbulence in the upper troposphere on the basis of radio sounding data. The method is based on theoretical studies of flow stability in the free atmosphere. The statistical analysis of observational data was performed using linear discriminant analysis. The method can be used to analyze conditions of aircraft buffeting. P.T.H.

A81-26839 # **Evaluation of the effect of horizontal and vertical stratification on the stability of air flows (Otsenka vliianiia gorizontal'noi i vertikal'noi stratifikatsii na ustoichivost' vozdushnykh techenii).** N. P. Shakina. In: Forecasting of meteorological conditions for aviation. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 215), 1979, p. 38-51. 22 refs. In Russian.

Simple linear estimates of the possibility of the growth of unstable mesoscale wave perturbations (with wavelengths of the order of several tens to several hundreds of kilometers) are carried out for atmospheric frontal regions characterized by large horizontal and vertical inhomogeneities of wind and temperature fields. Considerable vertical wind shears and horizontal temperature gradients can cause the growth of these wave disturbances even in the presence of stable thermal stratification. Horizontal shears tend to destabilize primarily the longer waves. It is suggested that horizontal flow structure should be taken into account in the evaluation of convection. P.T.H.

A81-26862 Superconducting generator design for airborne applications. B. B. Gamble and T. A. Keim (General Electric Co., Schenectady, N.Y.). In: Advances in cryogenic engineering. Volume 25 - Proceedings of the Cryogenic Engineering Conference, Madison, Wis., August 21-24, 1979. New York, Plenum Press, 1980, p. 127-136. 6 refs. Contract No. F33615-76-C-2167.

The objective of the present study is to consolidate advanced concepts and advanced materials developed for superconducting generators to attain specific design goals and to advance the state of the art of superconducting generators for airborne applications. The generator is to be designed to provide 20 MW of dc power at a voltage of 20-40 kV from the rectifier. The inertia is required to be 13.6 kg-m or less, and the specific weight goal is 0.045 kg/kW. These goals are to be met in a design capable of 1-s field ramping and 1-s spin-up to design conditions. The generator is to be capable of both continuous operation with run times of up to 5 min and pulsed operation. P.T.H.

A81-26931 F-16 improvement program - Making the digits count. M. Lambert. *Interavia*, vol. 36, Mar. 1981, p. 258, 259.

The Multinational Staged Improvement Program (MSIP) for the expansion of the digital avionics and introduction of new radar, sensor and weapons systems in the F-16 fighter aircraft is presented. Stage I of the program begins at the end of 1981, with the incorporation of structural and wiring changes to accommodate an improved version of the APG-66 radar, a beyond-visual-range missile system, forward-looking electro-optical and terrain-following pods and head-up displays for the LANTIRN IR targeting system, a radar altimeter and increased air conditioning capacity, which will be installed during phase II, beginning in mid-1984. The third stage of the MSIP includes options such as Seek Talk radio, the Advanced Self-Protection Jammer and GPS, to be phased in by 1986, as well as AMRAAM and MRASM missiles. A set of five new avionics boxes is also proposed to accommodate the additions after the advanced APG-66, including the D3 fire control computer and an expanded stores management processor, which will replace existing units, a pair of electronic multifunction displays, and a multifunction keyboard. S.C.S.

A81-26933 * # **Curved-flow, rolling-flow, and oscillatory pure-yawing wind-tunnel test methods for determination of dynamic stability derivatives.** J. R. Chambers, S. B. Grafton (NASA, Langley Research Center, Hampton, Va.), and F. H. Lutze (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *NATO, AGARD, Lecture Series on Dynamic Stability Parameters, Moffett Field, Calif., Mar. 2-5, 1981 and Rhode-Saint-Genèse, Belgium, Mar. 16-19, 1981, Paper.* 14 p. 7 refs.

Dynamic stability derivatives are evaluated on the basis of rolling-flow, curved-flow and snaking tests. Attention is given to the hardware associated with curved-flow, rolling-flow and oscillatory pure-yawing wind-tunnel tests. It is found that the snaking technique, when combined with linear- and forced-oscillation methods, yields an important method for evaluating beta derivatives for current configurations at high angles of attack. Since the rolling flow model is fixed during testing, forced oscillations may be imparted to the model, permitting the measurement of damping and cross-derivatives. These results, when coupled with basic rolling-flow or rotary-balance data, yield a highly accurate mathematical model for studies of incipient spin and spin entry. S.C.S.

A81-26945 Use of optimization in helicopter vibration control by structural modification. G. T. S. Done (City University, London, England) and M. A. V. Rangacharyulu (Birla Institute of Technology and Science, Pilani, India). *(European Rotorcraft and Powered Lift Aircraft Forum, European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.) Journal of Sound and Vibration,* vol. 74, Feb. 22, 1981, p. 507-518. 9 refs.

The application of optimization methods to helicopter crew area vibration reduction by means of structural modification is studied. With stiffness parameters as design variables, forced vibration response circles are used to identify the parameters most effective in controlling crew area response, thereby reducing them. The problem is cast as a nonlinear programming problem, and a sequential unconstrained minimization technique incorporating an algorithm is used to determine the precise values of the parameters. Although too simple for actual engineering design use, the model demonstrates what optimization routines make possible. O.C.

A81-26954 Vibrations of multispan stiffened plates via modified Bolotin method. I. Elishakoff, A. Sternberg (Technion - Israel Institute of Technology, Haifa, Israel), and T. J. van Baten (Delft, Technische Hogeschool, Delft, Netherlands). In: Recent advances in structural dynamics; Proceedings of the International Conference, Southampton, England, July 7-11, 1980. Volume 1. Southampton, University of Southampton, 1980, p. 37-50. 27 refs.

A modified Bolotin technique is extended to a row of skin-stringer plates continuous over the supporting stringers. The number of plates per row is finite, all plates and stringers are identical, and the structure is clamped all-around; the bending rigidity of the stringers is assumed to be identical. The solution is based on two auxiliary problems of the Voigt-Levy type and an eigenfrequency wave-number relationship. Transcendental expressions are derived in terms of wave numbers; the method is superior to other approximate solutions in that the number of spans is explicit avoiding numerical complexity. A.T.

A81-26986 # **Investigation of the influence of active particles on the basic combustion characteristics in turbulent flow (Issledovanie vliianiia aktivnykh chastits na osnovnye kharakteristiki goreniia v turbulentnom potoke).** V. N. Gruzdev, M. D. Tavger, and A. V. Talantov. *Aviatsionnaia Tekhnika,* no. 3, 1980, p. 37-41. In Russian.

Experiments studied the influence of active particles on flame propagation speed and on completeness of combustion for a nonhomogeneous kerosene-oxygen mixture in turbulent flow. The active particles corresponded to incomplete combustion products found in engine chambers and capable of promoting chemical reactions. The injection of such agents is suggested as a means of intensifying fuel combustion. T.M.

A81-26991 # **Losses of total pressure during mixing of flows in a step diffuser (Poteri polnogo davleniia pri smeshenii potokov v stupenchatom diffuzore).** V. P. Labendik, A. Ia. Dantsyg, and N. N. Ponomarev. *Aviatsionnaia Tekhnika,* no. 3, 1980, p. 60-63. 5 refs. In Russian.

Total-pressure losses for a step diffuser were calculated for two positions of sudden expansion: at the inlet to the mixing chamber and at the outlet of the chamber. An analysis is presented of the influence of gas compressibility on the level of losses for different velocities and area ratios at the inlet. B.J.

A81-26994 # **Determination of the thickness of blades of open wheels of radial-axial turbines (Opredelenie tolshchin lopatok otkrytykh koles radial'no-osevykh turbin).** R. G. Sagadeev and V. A. Strunkin. *Aviatsionnaia Tekhnika,* no. 3, 1980, p. 78-82. In Russian.

The paper develops a strength-optimal method for the thickness design of the blades of open-type radial-axial turbines. The technique is based on the use of a finite element model of the turbine wheel. Calculations of the thermal-stress state of blades designed by the present method are presented. B.J.

STAR ENTRIES

N81-17981*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC CRUISE RESEARCH 1979, PART 1
Mar. 1980 542 p refs Conf. held at Hampton, Va., 13-16 Nov. 1979 2 Vol.
(NASA-CP-2108-Pt-1; L-13385) Avail: NTIS HC A23/MF A01 CSCL 01A

Aerodynamics, stability and control, propulsion, and environmental factors of the supersonic cruise aircraft are discussed. Other topics include airframe structures and materials, systems integration, and economics.

N81-17982*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OVERVIEW OF THE LANGLEY SUBSONIC RESEARCH EFFORT ON SCR CONFIGURATION
Paul L. Coe, Jr., James D. Thomas, Jarrett K. Huffman, Robert P. Weston, Ward E. Schoonover, Jr., and Carl L. Gentry, Jr. *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 13-33 refs
Avail: NTIS HC A23/MF A01 CSCL 01A

Recent advances achieved in the subsonic aerodynamics of low aspect ratio, highly swept wing designs are summarized. The most significant of these advances was the development of leading edge deflection concepts which effectively reduce leading edge flow separation. The improved flow attachment results in substantial improvements in low speed performance, significant delay of longitudinal pitch up, increased trailing edge flap effectiveness, and increased lateral control capability. Various additional theoretical and/or experimental studies are considered which, in conjunction with the leading edge deflection studies, form the basis for future subsonic research effort. E.D.K.

N81-17983*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESULTS OF A LOW-SPEED WIND TUNNEL TEST OF THE MDC 2.2M SUPERSONIC CRUISE AIRCRAFT CONFIGURATION
L. P. Yip, L. P. Parlett, R. L. Roensch, J. E. Felix, and H. R. Welge *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 35-57 refs Prepared in cooperation with Douglas Aircraft Co., Long Beach, Calif.

Avail: NTIS HC A23/MF A01 CSCL 01A

Results of a low speed test conducted in the Full Scale Tunnel at NASA Langley using an advanced supersonic cruise vehicle configuration are presented. These tests used a 10 percent scale model of a configuration that had demonstrated high aerodynamic performance at Mach 2.2 during a previous test program. The low speed model has leading and trailing edge flaps designed to improve low speed lift to drag ratios at high lift and includes devices for longitudinal and lateral/directional control. The results obtained during the low speed test program have shown that full span leading edge flaps are required for maximum performance. The amount of deflection of the leading edge flap must increase with C sub L to obtain the maximum benefit. Over 80 percent of full leading edge suction was obtained up to lift off C sub L's of 0.65. A mild pitch up occurred at about 6 deg angle of attack with and without the leading edge flap deflected. The pitch up is controllable with the horizontal tail. Spoilers were found to be preferable to spoiler/deflectors at low speeds. The vertical tail maintained effectiveness up to the highest angle of attack tested but the tail on directional stability deteriorated at high angles of attack. Lateral control was adequate for landing at 72 m/sec in a 15.4 m/sec crosswind. E.D.K.

N81-17984*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE PREDICTION OF PRESSURE DISTRIBUTIONS ON AN ARROW-WING CONFIGURATION INCLUDING THE EFFECT OF CAMBER, TWIST, AND A WING FIN
Percy J. Bobbitt, Marjorie E. Manro, and Robert M. Kulfan *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 59-115 refs Prepared in cooperation with the Boeing Commercial Airplane Co., Seattle
(Contracts NAS1-12875; NAS1-4141; NAS1-14962; NAS1-15678)
Avail: NTIS HC A23/MF A01 CSCL 01A

Wind tunnel tests of an arrow wing body configuration consisting of flat, twisted, and cambered twisted wings were conducted at Mach numbers from 0.40 to 2.50 to provide an experimental data base for comparison with theoretical methods. A variety of leading and trailing edge control surface deflections were included in these tests, and in addition, the cambered twisted wing was tested with an outboard vertical fin to determine its effect on wing and control surface loads. Theory experiment comparisons show that current state of the art linear and nonlinear attached flow methods were adequate at small angles of attack typical of cruise conditions. The incremental effects of outboard fin, wing twist, and wing camber are most accurately predicted by the advanced panel method PANAIR. Results of the advanced panel separated flow method, obtained with an early version of the program, show promise that accurate detailed pressure predictions may soon be possible for an aeroelasticity deformed wing at high angles of attack. E.D.K.

N81-17985*# Old Dominion Univ., Norfolk, Va.
EXPLORATORY SUBSONIC INVESTIGATION OF VORTEX-FLAP CONCEPT ON ARROW WING CONFIGURATION

Dhanvada M. Rao *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1981 p 117-129 refs

(Contract NsG-1315)
Avail: NTIS HC A23/MF A01 CSCL 01A

The drag reduction potential of a vortex flap concept, utilizing the thrust contribution of separation vortices maintained over leading edge flap surfaces, was explored in subsonic wind tunnel tests on a highly swept arrow wing configuration. Several flap geometries were tested in comparison with a previous study on the same model with leading edges drooped for attached flow. The most promising vortex flap arrangements produced drag reductions comparable with leading edge droop over a range of lift coefficients from 0.3 to 0.6 (untrimmed), and also indicated beneficial effects in the longitudinal and lateral static stability characteristics. E.D.K.

N81-17986*# Boeing Commercial Airplane Co., Seattle, Wash.
WIND TUNNEL TEST RESULTS OF A NEW LEADING EDGE FLAP DESIGN FOR HIGHLY SWEPT WINGS, A VORTEX FLAP
L. James Runyan, Wilbur D. Middleton, and John A. Paulson *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 131-147 refs

Avail: NTIS HC A23/MF A01 CSCL 01A

A leading edge flap design for highly swept wings, called a vortex flap, was tested on an arrow wing model in a low speed wind tunnel. A vortex flap differs from a conventional plain flap in that it has a leading edge tab which is counterdeflected from the main portion of the flap. This results in intentional separation at the flap leading edge, causing a vortex to form and lie on the flap. By trapping this vortex, the vortex flap can result in significantly improved wing flow characteristics relative to conventional flaps at moderate to high angles of attack, as demonstrated by the flow visualization results of this tests. E.D.K.

N81-17987*# Rockwell International Corp., Thousand Oaks, Calif. North American Aircraft Div.
A STUDY OF WING BODY BLENDING FOR AN ADVANCED SUPERSONIC TRANSPORT
T. P. Goebel, E. Bonner, and D. A. Robinson *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 149-169 refs
(Contract NAS1-15720)
Avail: NTIS HC A23/MF A01 CSCL 01C

Increases in supersonic cruise lift drag ratio were sought at Mach numbers 2.2 and 2.7 using wing body planform and thickness blending. Constrained twist and camber optimization was performed in the presence of nacelles. Wing and fuselage thickness distributions were optimized for either minimum volume wave drag or minimum total pressure wave drag. The zero leading edge suction lift drag ratios were determined for three wing planforms. The magnitude of the effect of leading edge suction on attainable lift drag ratio was defined on one planform and estimation of available leading edge suction was made. Author

N81-17988*# Boeing Commercial Airplane Co., Seattle, Wash.
PREDICTION OF NACELLE AERODYNAMIC INTERFERENCE EFFECTS AT LOW SUPERSONIC MACH NUMBERS

Robert M. Kulfan *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 171-203 refs

Avail: NTIS HC A23/MF A01 CSCL 01A

The accuracy of analytical predictions of nacelle aerodynamic interference effects at low supersonic speeds are studied by means of test versus theory comparisons. Comparisons shown include: (1) isolated wing body lift, drag, and pitching moments; (2) isolated nacelle drag and pressure distributions; (3) nacelle interference shock wave patterns and pressure distributions on the wing lower surface; (4) nacelle interference effects on wing body lift, drag, and pitching moments; and (5) total installed nacelle interference effects on lift, drag, and pitching moment. The comparisons also illustrate effects of nacelle location, nacelle spillage, angle of attack, and Mach numbers on the aerodynamic interference. The initial results seem to indicate that the methods can satisfactorily predict lift, drag, pitching moment, and pressure distributions of installed engine nacelles at low supersonic Mach numbers with mass flow ratios from 0.7 to 1.0 for configurations typical of efficient supersonic cruise airplanes. E.D.K.

N81-17989*# Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYTIC DEVELOPMENT OF IMPROVED SUPERSONIC CRUISE AIRCRAFT BASED ON WIND TUNNEL DATA
R. L. Roensch and G. S. Page *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 205-227 refs
(Contract NAS1-14621)
Avail: NTIS HC A23/MF A01 CSCL 01C

Data obtained from the MDC/NASA cooperative wing tunnel program were used to develop empirical corrections to theory. These methods were then used to develop a 2.2M supersonic cruise aircraft configuration with a cruise trimmed maximum L/D of 10.2. The empirical corrections to the theory are reviewed, and the configuration alternatives examined in the development of the configuration are presented. The benefits of designing for optimum trimmed performance, including the effects of the nacelles, are discussed. Author

N81-17990*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC WINGS WITH SIGNIFICANT LEADING-EDGE THRUST AT CRUISE
A. Warner Robins, Harry W. Carlson, and Robert J. Mack *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 229-246 refs
Avail: NTIS HC A23/MF A01 CSCL 01A

Experimental/theoretical correlations are presented which show that significant levels of leading edge thrust are possible at supersonic speeds for certain planforms which match the theoretical thrust distribution potential with the supporting airfoil geometry. The analytical process employed spanwise distribution of both it and/or that component of full theoretical thrust which acts as vortex lift. Significantly improved aerodynamic performance in the moderate supersonic speed regime is indicated. Author

N81-17991*# Calspan Advanced Technology Center, Buffalo, N.Y.
FLYING QUALITIES DESIGN CRITERIA APPLICABLE TO SUPERSONIC CRUISE AIRCRAFT
Charles R. Chalk *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 251-267 refs

(Contract F33615-78-C-3602)
Avail: NTIS HC A23/MF A01 CSCL 01C

A comprehensive set of flying qualities design criteria was prepared for use in the supersonic cruise research program. The framework for stating the design criteria is established and design criteria are included which address specific failures, approach to dangerous flight conditions, flight at high angle of attack, longitudinal and lateral directional stability and control, the primary flight control system, and secondary flight controls. Examples are given of lateral directional design criteria limiting lateral accelerations at the cockpit, time to roll through 30 deg of bank, and time delay in the pilot's command path. Flight test data from the Concorde certification program are used to substantiate a number of the proposed design criteria. E.D.K.

N81-17992*# Douglas Aircraft Co., Inc., Long Beach, Calif.
ADVANCED SUPERSONIC TRANSPORT FIXED-BASE SIMULATOR EVALUATIONS AT LANDING APPROACH

John B. Feather *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 269-283 refs

Avail: NTIS HC A23/MF A01 CSCL 14B

Equations of motion simulating the landing approach case for the supersonic cruise vehicle were programmed and exercised using a fixed base simulation facility. Unaugmented and augmented system comparisons using this facility are provided. Refinements necessary for system performance improvement are made. The unaugmented longitudinal responses to elevator commands are slow and sluggish, requiring augmentation to increase the speed of the response. In the lateral directional case, the Dutch roll is highly underdamped and requires an augmentation system to increase this damping and provide satisfactory flying qualities. The status of this fixed base study is that the longitudinal equations, updated with recent wind tunnel data, were evaluated on the simulator and the system found to be satisfactory. The lateral axis equations are linearized and are not yet updated to large excursion capability; consequently, only limited, preliminary findings on this system are available. The basic results so far indicate augmentation systems are required to provide a satisfactory longitudinal system, and that additional study and evaluation of the lateral directional case are necessary before a more complete assessment can be made. E.D.K.

N81-17993*# Lockheed-California Co., Burbank.
SIMULATOR INVESTIGATION OF ARROW-WING LOW-SPEED HANDLING QUALITIES
Ben T. Averett *In* NASA. Langley Res. Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 285-298 ref

Avail: NTIS HC A23/MF A01 CSCL 14B

Low speed handling qualities of arrow wings were investigated with a piloted simulator. Existing aerodynamic data were used from NASA SCAT 15F tunnel tests augmented with Lockheed low speed wind tunnel test data. Two arrow wing planforms were chosen for the simulation effort a Mach 2.0 design and a Mach 2.7 design. These designs are in the SCAT 15F Mach 2.7 design family, having the same beta AR and beta cot lambda. Piloted simulation results indicate that both the Mach 2.0 and Mach 2.7 planforms have satisfactory longitudinal flying qualities. However, in the control of bank angle the Mach 2.0 planform demonstrates satisfactory handling qualities while the Mach 2.7 planform is unacceptable. This situation applies for crosswind landings at FAA limits and for lineup in heavy turbulence. The low speed superiority of the Mach 2

planform with its lower sweep and higher aspect ratio is also shown by its ability to approach at least 8 m/s slower than the Mach 2.7 planform without degradation in handling qualities.
Author

N81-17994*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT OF SCR AIRCRAFT TAKEOFF AND LANDING PROCEDURES FOR COMMUNITY NOISE ABATEMENT AND THEIR IMPACT ON FLIGHT SAFETY

William D. Grantham and Paul M. Smith (Kentron International, Inc.) *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 299-333 refs
Avail: NTIS HC A23/MF A01 CSCL 01C

Piloted simulator studies to determine takeoff and landing procedures for a supersonic cruise transport concept that result in predicted community noise levels which meet current Federal Aviation Administration (FAA) standards are discussed. The results indicate that with the use of advanced procedures, the subject simulated aircraft meets the FAA traded noise levels during takeoff and landing utilizing average flight crew skills. The advanced takeoff procedures developed involved violating three of the current Federal Aviation Regulations (FAR) noise test conditions. These were: (1) thrust cutbacks at altitudes below 214 meters (700 ft); (2) thrust cutback level below those presently allowed; and (3) configuration change, other than raising the landing gear. It was not necessary to violate any FAR noise test conditions during landing approach. It was determined that the advanced procedures developed do not compromise flight safety. Automation of some of the aircraft functions reduced pilot workload, and the development of a simple head-up display to assist in the takeoff flight mode proved to be adequate. M.G.

N81-17995*# General Electric Co., Lynn, Mass.
VCE TEST BED ENGINE FOR SUPERSONIC CRUISE RESEARCH

J. W. Vdoviak and J. A. Ebacher *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 347-356
Avail: NTIS HC A23/MF A01 CSCL 21E

Various design concepts for a variable cycle engine applicable to a supersonic, mixed mission propulsion system which would combine the merits of a turbofan at subsonic operating conditions with those of a turbojet for supersonic operating conditions are briefly examined. In particular the integration of the variable area bypass injector with the core driven (aft fan block) fan stage is discussed and the technical benefits of the configuration are summarized. M.G.

N81-17997*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Products Div.
PROGRESS WITH VARIABLE CYCLE ENGINES

John S. Westmoreland *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 371-390 refs
(Contracts NAS3-20048; NAS3-20061; NAS3-20602)
Avail: NTIS HC A23/MF A01 CSCL 21E

The evaluation of components of an advanced propulsion system for a future supersonic cruise vehicle is discussed. These components, a high performance duct burner for thrust augmentation and a low jet noise coannular exhaust nozzle, are part of the variable stream control engine. An experimental test program involving both isolated component and complete engine tests was conducted for the high performance, low emissions duct burner with excellent results. Nozzle model tests were completed which substantiate the inherent jet noise benefit associated with the unique velocity profile possible of a coannular exhaust nozzle system on a variable stream control engine. Additional nozzle model performance tests have established high thrust efficiency levels at takeoff and supersonic cruise for this nozzle system. Large scale testing of these two critical components is conducted using an F100 engine as the testbed for simulating the variable stream control engine. M.G.

N81-17998*# Lockheed-California Co., Burbank.
EFFECTS ON INLET TECHNOLOGY ON CRUISE SPEED SELECTION

L. H. Bangert, D. M. Santman, G. Horie, and L. D. Miller *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 391-411 refs

Avail: NTIS HC A23/MF A01 CSCL 01C

The impact of cruise speed on technology level for certain aircraft components is examined. External-compression inlets were compared with mixed compression, self starting inlets at cruise Mach numbers of 2.0 and 2.3. Inlet engine combinations that provided the greatest aircraft range were identified. Results show that increased transonic to cruise corrected air flow ratio gives decreased range for missions dominated by supersonic cruise. It is also found important that inlets be designed to minimize spillage drag at subsonic cruise, because of the need for efficient performance for overland operations. The external compression inlet emerged as the probable first choice at Mach 2.0, while the self starting inlet was the probable first choice at Mach 2.3. Airframe propulsion system interference effects were significant, and further study is needed to assess the existing design methods and to develop improvements. M.G.

N81-17999*# General Electric Co., Cincinnati, Ohio.
VCE EARLY ACOUSTIC TEST RESULTS OF GENERAL ELECTRIC'S HIGH-RADIUS RATIO COANNULAR PLUG NOZZLE

Paul R. Knott, J. F. Brausch, P. K. Bhutiani, R. K. Majjigi, and V. L. Doyle *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 417-452 refs

(Contracts NAS3-20582; NAS3-21608)
Avail: NTIS HC A23/MF A01 CSCL 20A

Results of variable cycle engine (VCE) early acoustic engine and model scale tests are presented. A summary of an extensive series of far field acoustic, advanced acoustic, and exhaust plume velocity measurements with a laser velocimeter of inverted velocity and temperature profile, high radius ratio coannular plug nozzles on a YJ101 VCE static engine test vehicle are reviewed. Select model scale simulated flight acoustic measurements for an unsuppressed and a mechanical suppressed coannular plug nozzle are also discussed. The engine acoustic nozzle tests verify previous model scale noise reduction measurements. The engine measurements show 4 to 6 PNdB aft quadrant jet noise reduction and up to 7 PNdB forward quadrant shock noise reduction relative to a fully mixed conical nozzle at the same specific thrust and mixed pressure ratio. The influences of outer nozzle radius ratio, inner stream velocity ratio, and area ratio are discussed. Also, laser velocimeter measurements of mean velocity and turbulent velocity of the YJ101 engine are illustrated. Select model scale static and simulated flight acoustic measurements are shown which corroborate that coannular suppression is maintained in flight. M.G.

N81-18000*# Douglas Aircraft Co., Inc., Long Beach, Calif.
FLIGHT AND TUNNEL TEST RESULTS OF THE MDC MECHANICAL JET NOISE SUPPRESSOR NOZZLE

R. D. FitzSimmons, R. A. McKinnon, and E. S. Johnson *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 453-478 refs

Avail: NTIS HC A23/MF A01 CSCL 20A

The flight and wind tunnel tests to determine the acoustic and performance effects of a mechanical jet noise suppressor nozzle mounted on a Viper engine of an HS-125 airplane are discussed. Flyover noise measurements were made with microphones mounted on top of a 137.5 m bridge tower. Seven nozzle configurations including two references nozzles, two suppressors, and three ejector inlets were tested. The suppressor nozzle of interest for an advanced supersonic transport, the suppressor/treated ejector, achieved a measured noise reduction of 14 EPNdB relative to a conventional conical reference nozzle at the highest pressure ratio tested (approximately 2.5). The unique engine nacelle, flight hardware, and nacelles from the HS-125 flight test program, combined with a simulated HS-125 fuselage were windtunnel tested. Both propulsion and acoustic data were recorded. Preliminary thrust data results from the wind tunnel tests are summarized and compared to other mechanical suppressor test results. The test results indicate that

a noise reduction of at least 16 EPNdB would be possible for the suppressor/ejector nozzle scaled to typical AST engine size with a 5% thrust loss at a typical takeoff climb speed. M.G.

N81-18001*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF NOZZLE DESIGN ON THE NOISE FROM SUPERSONIC JETS
John M. Seiner, Thomas D. Norum, and Lucio Maestrello *In its* Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 479-491 refs
Avail: NTIS HC A23/MF A01 CSCL 20A

The aeroacoustic supersonic performance of various internal nozzle geometries is evaluated for shock noise content over a wide range of nozzle pressure ratios. The noise emission of a Mach 1.5 and 2.0 convergent-divergent (C-D) nozzle is measured and compared to convergent nozzles. Comparisons are also made for a Mach 1.5 conical C-D nozzle and a porous plug nozzle. The Mach 1.5 conical C-D nozzle shows a small reduction in shock noise relative to the shock free case of the Mach 1.5 C-D nozzle. The Mach 1.5 C-D nozzle is found to have a wide operating nozzle pressure ratio range around its design point where shock noise remains unimportant compared to the jet mixing noise component. However it is found that the Mach 2 C-D nozzle shows no significant acoustic benefit relative to the convergent nozzle. Results from the porous plug nozzle indicate that shock noise may be completely eliminated, and the jet mixing noise reduced. Author

N81-18002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF NOISE TECHNOLOGY FOR ADVANCED SUPERSONIC CRUISE AIRCRAFT
James R. Stone and Orlando A. Gutierrez *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 493-518 refs

Avail: NTIS HC A23/MF A01 CSCL 20A

Developments in acoustic technology applicable to advanced supersonic cruise aircraft, particularly those which relate to jet noise and its suppression are reviewed. The noise reducing potential of high radius ratio, inverted velocity profile coannular jets is demonstrated by model scale results from a wide range of nozzle geometries, including some simulated flight cases. These results were verified statistically at large scale on a variable cycle engine (VCE) testbed. A preliminary assessment of potential VCE noise sources such as fan and core noise is made, based on the testbed data. Recent advances in the understanding of flight effects are reviewed. The status of component noise prediction methods is assessed on the basis of recent test data, and the remaining problem areas are outlined. M.G.

N81-18004*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED TECHNOLOGY FOR CONTROLLING POLLUTANT EMISSIONS FROM SUPERSONIC CRUISE AIRCRAFT
Robert A. Duerr and Larry A. Diehl *In* NASA. Langley Research Center Supersonic Cruise Res. 1979, Pt. 1 Mar. 1980 p 535-549
Avail: NTIS HC A23/MF A01 CSCL 13B

Gas turbine engine combustor technology for the reduction of pollutant emissions is summarized. Variations of conventional combustion systems and advanced combustor concepts are discussed. Projected results from far term technology efforts aimed at applying the premixed prevaporized and catalytic combustion techniques to aircraft combustion systems indicate a potential for significant reductions in pollutant emission levels. M.G.

N81-18005*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC CRUISE RESEARCH 1979, PART 2
Mar. 1980 407 p refs Conf. held at Hampton, Va., 13-16 Nov. 1979
(NASA-CP-2108-Pt-2; L-13385) Avail: NTIS HC A18/MF A01 CSCL 01A

Advances in airframe structure and materials technology for supersonic cruise aircraft are reported with emphasis on titanium and composite structures. The operation of the Concorde is examined as a baseline for projections into the future. A market survey of U.S. passenger attitudes and preferences, the impact of advanced air transport technology and the integration of systems for the advanced SST and for a smaller research/business jet vehicle are also discussed.

N81-18006*# Lockheed-California Co., Burbank.
STRUCTURAL CONCEPT TRENDS FOR COMMERCIAL SUPERSONIC CRUISE AIRCRAFT DESIGN
I. F. Sakat, G. W. Davis, and B. Saelman *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 563-587 refs 2 Vol.

Avail: NTIS HC A18/MF A01 CSCL 01C

Structural concept trends for future commercial supersonic transport aircraft are considered. Highlights, including the more important design conditions and requirements, of two studies are discussed. Knowledge of these design parameters, as determined through studies involving the application of flexible mathematical models, enabled inclusion of aeroelastic considerations in the structural-material concepts evaluation. The design trends and weight data of the previous contractual study of Mach 2.7 cruise aircraft were used as the basis for incorporating advanced materials and manufacturing approaches to the airframe for reduced weight and cost. Structural studies of design concepts employing advanced aluminum alloys, advanced composites, and advanced titanium alloy and manufacturing techniques are compared for a Mach 2.0 arrow-wing configuration concept. Appraisals of the impact of these new materials and manufacturing concepts to the airframe design are shown and compared. The research and development to validate the potential sources of weight and cost reduction identified as necessary to attain a viable advanced commercial supersonic transport are discussed. A.R.H.

N81-18007*# Douglas Aircraft Co., Inc., Long Beach, Calif.
OPPORTUNITIES FOR STRUCTURAL IMPROVEMENTS FOR AN ADVANCED SUPERSONIC TRANSPORT VEHICLE
J. E. Fischler *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1981 p 589-616 refs

Avail: NTIS HC A18/MF A01 CSCL 01C

The superplastically formed diffusion-bonded (SPF/DB) program has developed successfully and far enough to recommend that a major structural program to validate the weight and cost of SPF/DB sandwich titanium structure should be initiated. The NASA Langley study of wing and fuselage SPF/DB sandwich panels shows that this process is potentially structurally efficient. The Douglas SPF/DB expanded sandwich process that utilizes a welded core sheet that expands to face sheets proves to be very efficient. The theoretical weight optimization design charts for the wing and fuselage concepts were validated by small-scale tests. Mnay design applications were fabricated. Projecting the results of an SPF/DB sandwich airframe structure to a MDC AST design shows significant weight and cost savings. A 6 percent lower direct operating cost was calculated. A growth AST utilizing composites, metal matrices, and SPF/DB sandwich shows future promise for a post-1990 technology readiness. Titanium SPF/DB sandwich, compared to presently available aluminum structure, is superior for application to a Mach 2.2 supersonic transport. A.R.H.

N81-18008*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC CRUISE RESEARCH AIRCRAFT STRUCTURAL STUDIES: METHODS AND RESULTS
J. Sobieszczanski-Sobieski, David Gross (Kentron International, Hampton, Va.), William Kurtze, Jerry Newsom, Gregory Wrenn (Kentron International, Hampton, Va.), and William Greene (Kentron International, Hampton, Va.) *In its* Supersonic Cruise

Res., 1979, Pt. 2 Mar. 1981 p 617-656 refs

Avail: NTIS HC A18/MF A01 CSCL 01C

NASA Langley Research Center SCAR in-house structural studies are reviewed. In methods development, advances include a new system of integrated computer programs called ISSYS, progress in determining aerodynamic loads and aerodynamically induced structural loads (including those due to gusts), flutter optimization for composite and metal airframe configurations using refined and simplified mathematical models, and synthesis of active controls. Results given address several aspects of various SCR configurations. These results include flutter penalties on composite wing, flutter suppression using active controls, roll control effectiveness, wing tip ground clearance, tail size effect on flutter, engine weight and mass distribution influence on flutter, and strength and flutter optimization of new configurations. The ISSYS system of integrated programs performed well in all the applications illustrated by the results, the diversity of which attests to ISSYS' versatility. A.R.H.

N81-18009*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AN ASSESSMENT OF BUFFER STRIPS FOR IMPROVING DAMAGE TOLERANCE

C. C. Poe, Jr. and John M. Kennedy *In its* Supersonic Cruise Res., 1979, Pt. 2 Mar. 1981 p 657-673 refs

Avail: NTIS HC A18/MF A01 CSCL 01C

Graphite/epoxy panels with buffer strips were tested in tension to measure their residual strength with crack-like damage. Panels were made with [45/0/-45/90](2S) and [45/0/450](2S) layups. The buffer strips were parallel to the loading directions. They were made by replacing narrow strips of the 0 deg graphite plies with strips of either 0 deg S-Glass/epoxy or Kevlar-49/epoxy on either a one for one or a two for one basis. In a third case, 0 deg graphite/epoxy was used as the buffer material and thin, perforated Mylar strips were placed between the 0 deg piles and the cross-plies to weaken the interfaces and thus to isolate the 0 deg plies. Some panels were made with buffer strips of different widths and spacings. The buffer strips arrested the cracks and increased the residual strengths significantly over those plain laminates without buffer strips. A shear-lag type stress analysis correctly predicted the effects of layups, buffer material, buffer strip width and spacing, and the number of plies of buffer material. Author

N81-18010*# Boeing Aerospace Co., Seattle, Wash.

EVALUATION OF HIGH-TEMPERATURE STRUCTURAL ADHESIVES FOR EXTENDED SERVICE

Carl L. Hendricks and Sylvester G. Hill *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2, Mar. 1980 p 675-686

(Contract NAS1-15605)

Avail: NTIS HC A18/MF A01 CSCL 11A

Candidate high-temperature stable resin formulations were evaluated for adhesive properties when bonded to titanium treated with various surface preparations. The adhesive formulations included LARC-13, NR150 A2, NR150 B2, NR056X, FM-34, HR-602, and polyphenylquinoxaline. Eight titanium surface preparations were compared for resulting bond strength with the candidate adhesives. After initial evaluation, three adhesive systems (comprised of adhesive, primer, and titanium surface preparation) were selected for further screening. The screening (still in progress) includes cure-cycle optimization and bond properties from 219 K (-65 F) to 505 K (450 F), after isothermal aging at 505 K (450 F) up to 15,000 hours, and after humidity aging at 322 K (9120 F)/ 95 percent R. H. for up to 2000 hours. Larger-area bond capability of the three adhesive system can be demonstrated by fabrication of 30.5 cm (12 in) square titanium honeycomb sandwich and metal-to-metal bonded panels. Author

N81-18013*# British Aerospace Aircraft Group, Bristol (England).

CONCORDE WITH THE AIRLINES

Clive S. Leyman *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 741-757

Avail: NTIS HC A18/MF A01 CSCL 01C

The only supersonic aircraft in airline service, Concorde, offers the first actual test of supersonic cruise feasibility and the only real experience relative to passenger, airline, and community acceptance. The dominant characteristic of Concorde operations is low aircraft utilization, due partly to the restricted route network. Operating costs, the maintenance/reliability record and associated dispatch delays are discussed. Problems with overwater operations, and the secondary boom phenomena are examined. Monthly average load factors for various routes, major causes of technical delays, aircraft technical performance, and aircraft tracks are graphically depicted. A.R.H.

N81-18014*# Boeing Commercial Airplane Co., Seattle, Wash.

LONG-RANGE AIRPLANE STUDY: THE CONSUMER LOOKS AT SST TRAVEL

Karyl H. Landes and J. A. Matter (Boeing Computer Services, Inc., Seattle, Wash.) *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 759-804

Avail: NTIS HC A18/MF A01 CSCL 01C

The attitudes of long-range air travelers toward several basic air travel decisions, were surveyed. Of interest were tradeoffs involving time versus comfort and time versus cost as they pertain to supersonic versus conventional wide-body aircraft on overseas routes. The market focused upon was the segment of air travelers most likely to make that type of tradeoff decision: those having flown overseas routes for business or personal reasons in the recent past. The information generated is intended to provide quantifiable insight into consumer demand for supersonic as compared to wide-body aircraft alternatives for long-range overseas air travel. A.R.H.

N81-18015*# Office of Technology Assessment, Washington, D. C.

ASSESSMENT OF THE IMPACT OF ADVANCED AIR-TRANSPORT TECHNOLOGY

R. L. Maxwell and L. V. Dickinson, Jr. *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1981 p 805-819

Avail: NTIS HC A18/MF A01 CSCL 01C

The long term prospects for commercial supersonic transportation appear attractive enough to keep supersonic research active and reasonably healthy. On the other hand, the uncertainties surrounding an advanced supersonic transport, (AST) specifically fuel price, fuel availability and noise, are too significant to warrant an accelerated research and development program until they are better resolved. It is estimated that an AST could capture about $50 billion (1979 dollars) of the potential $150 billion in sales up to the year 2010. A.R.H.

N81-18016*# Boeing Commercial Airplane Co., Seattle, Wash.

OVERVIEW OF BOEING SUPERSONIC TRANSPORT EFFORTS, 1971 - 1979

A. Sigalla *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 821-832

Avail: NTIS HC A18/MF A01 CSCL 01C

Following cancellation of the United States Supersonic Transport program, the status of the technology was assessed carefully and emphasis was put on finding solutions for what were considered the major technical difficulties. In particular, work on the breakthroughs needed to advance the technology was emphasized. Currently, solutions to all major technical problems are identified. Depending on the subject, either the problem is no longer a concern or the steps needed to bring about a solution are mapped out clearly. Throughout the NASA SCR program, important strides were made in the identification of design advances which would greatly improve supersonic airplane fuel efficiency, noise, and other performance and cost affecting parameters. Furthermore, these efforts created an atmosphere in which it was possible for new ideas to flourish and positive inventions to take place such as the variable cycle engine and the blended fuselage. These technical gains show that, given availability of such technology, advanced supersonic transports could be developed that would be economically successful and environmentally acceptable. A.R.H.

N81-18017*# Boeing Commercial Airplane Co., Seattle, Wash.
A FAMILY OF SUPERSONIC AIRPLANES: TECHNICAL AND ECONOMIC FEASIBILITY
Frank D. Neumann and Jerry W. Whitten *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 833-854 refs

Avail: NTIS HC A18/MF A01 CSCL 01C

To improve the prospects for success in the market place, the family approach is essential to the design of future supersonic airplanes. The evolution from a basic supersonic airplane to a family could follow historic patterns, with one exception: substantial changes in passenger carrying capacity will be difficult by the conventional fuselage 'doughnut' approach so successfully used on the cylindrical fuselage of subsonic airplanes. The primary reasons for this difference include the requirement for highly integrated 'area ruled' configurations, to give the desired high supersonic aerodynamic efficiency, and other physical limitations such as takeoff and landing rotation. A concept for a supersonic airplane family that could effectively solve the variable range and passenger capacity problem provides for modification of the fuselage cross section that makes it possible to build a family of three airplanes with four, five, and six abreast passenger seating. This is done by replacing or modifying portions of the fuselage. All airplanes share the same wing, engines, and major subsystems. Only small sections of the fuselage would be different, and aerodynamic efficiency need not be compromised. A.R.H.

N81-18018*# Boeing Commercial Airplane Co., Seattle, Wash.
IMPACT OF CHANGING FUEL CHARACTERISTICS ON SUPERSONIC CRUISE AIRPLANE
O. J. Hadaller, J. E. Schmidt, A. M. Momenthy, and P. E. Johnson *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 855-872 refs

Avail: NTIS HC A18/MF A01 CSCL 21D

The question of an advanced supersonic cruise research airplane is related to future oil supplies and prices. Technical data on the impact of changing fuel characteristics on the SCR airplane were developed. Projections of crude oil characteristics typical of the 1985 to 2000 time period were made with the help of consultants to the oil industry. Refineries for the future were modeled to establish jet fuel of engine and aircraft systems for future airplanes, with emphasis on supersonic cruise airplanes. Study results do not show a need for broadening the fuel specification. Hypothetical study fuels with broader specifications were defined, however, as was the impact of their properties on the SCR airplane and systems. A.R.H.

N81-18019*# McDonnell-Douglas Corp., Long Beach, Calif.
TECHNOLOGY DEVELOPMENT STATUS AT McDONNELL DOUGLAS
William T. Rowe *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1981 p 873-888

Avail: NTIS HC A18/MF A01 CSCL 01C

The significant technology items of the Concorde and the conceptual MCD baseline advanced supersonic transport are compared. The four major improvements are in the areas of range performance, structures (materials), aerodynamics, and in community noise. Presentation charts show aerodynamic efficiency; the reoptimized wing; low scale lift/drag ratio; control systems; structural modeling and analysis; weight and cost comparisons for superplasticity diffusion bonded titanium sandwich structures and for aluminum brazed titanium honeycomb structures; operating cost reduction; suppressor nozzles; noise reduction and range; the bicone inlet; a market summary; environmental issues; high priority items; the titanium wing and fuselage test components; and technology validation. A.R.H.

N81-18020*# McDonnell-Douglas Corp., Long Beach, Calif.
SUPERSONIC MARKET AND ECONOMIC ANALYSES
Lucian S. Rochte *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 889-907

Avail: NTIS HC A18/MF A01 CSCL 01C

Advanced supersonic transport markets of the free world were projected for the period 1985 to 2004. Passenger traffic volume and airplane range and seat capacity requirements were estimated for Mach 2.2 service by international regional area market areas and by city pairs within and between these areas. Market factors and traffic factors examined include variable loads, growth rates, supersonic transport market shares, and schedule frequencies considering the different makeup of passenger traffic and individual city pairs. Direct, indirect, and total operating costs and yield levels were economically analyzed for first class and full fare economy class traffic. A.R.H.

N81-18021*# Lockheed-California Co., Burbank.
THE IMPACT OF MATERIALS TECHNOLOGY AND OPERATIONAL CONSTRAINTS ON THE ECONOMICS OF CRUISE SPEED SELECTION
J. S. Clauss, Jr., F. A. Bruckman, D. L. Horning, R. H. Johnston, and J. V. Werner *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1981 p 909-934 refs

Avail: NTIS HC A18/MF A01 CSCL 01C

Six material concepts at Mach 2.0 and three material concepts at Mach 2.55 were proposed. The resulting evaluations, based on projected development, production, and operating costs, indicate that aircraft designs with advanced composites as the primary material ingredient have the lowest fare premiums at both Mach 2.0 and 2.55. Designs having advanced metallics as the primary material ingredient are not economical. Advanced titanium, employing advanced manufacturing methods such as SFF/DB, requires a fare premium of about 30 percent at both Mach 2.0 and 2.55. Advanced aluminum, usable only at the lower Mach number, requires a fare premium of 20 percent. Cruise speeds in the Mach 2.0-2.3 regime are preferred because of the better economics and because of the availability of two material concepts to reduce program risk - advanced composites and advanced aluminums. This cruise speed regime also avoids the increase in risk associated with the more complex inlets and airframe systems and higher temperature composite matrices required at the higher Mach numbers typified by Mach 2.55. A.R.H.

N81-18022*# Rockwell International Corp., Los Angeles, Calif. North American Aircraft Div.
SUPERSONIC CRUISE VEHICLE RESEARCH/BUSINESS JET
Robert J. Kelly *In* NASA. Langley Research Center Supersonic Cruise Res., 1979, Pt. 2 Mar. 1980 p 935-949

Avail: NTIS HC A18/MF A01 CSCL 01C

A comparison study of a GE-21 variable propulsion system with a Multimode Integrated Propulsion System (MMIPS) was conducted while installed in small M = 2.7 supersonic cruise vehicles with military and business jet possibilities. The 1984 state of the art vehicles were sized to the same transatlantic range, takeoff distance, and sideline noise. The results indicate the MMIPS would result in a heavier vehicle with better subsonic cruise performance. The MMIPS arrangement with one fan engine and two satellite turbojet engines would not be appropriate for a small supersonic business jet because of design integration penalties and lack of redundancy. Author

N81-18023*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CIVIL MARKETS FOR BUOYANT HEAVY-LIFT VEHICLES
Peter J. Mettam (Booz, Allen and Hamilton, Bethesda, Md.), Dagfin Hansen (Booz, Allen and Hamilton, Bethesda, Md.), and Mark D. Ardema Mar. 1981 36 p refs
(NASA-TM-81270) Avail: NTIS HC A03/MF A01 CSCL 01B

Worldwide civil markets for heavy lift airships were investigated. Substantial potential market demand was identified for payloads of from 13 to 800 tons. The largest markets appear to be in applications to relieve port congestion, construction of power generating plants, and, most notably, logging. Because of significant uncertainties both in vehicle and market characteristics, further analysis will be necessary to verify the identified market potential of heavy lift airship concepts. A.R.H.

N81-18024 Mississippi State Univ., State College.
AN APPROXIMATE FACTORIZATION SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR TRANSONIC FLOW USING BODY-FITTED COORDINATES WITH APPLICATION TO NACA 64A010 AIRFOILS ***Ph.D. Thesis***
George Kyle Cooper 1980 124 p
Avail: Univ. Microfilms Order No. 8104478

Although aircraft were routinely flown at transonic speeds for the last two decades, the designers of these machines have had to formulate their designs almost exclusively on the basis of experience, in contrast to subsonic or supersonic aircraft design in which a welter or analytical, experimental, and numerical techniques exist. Since this type of fluid flow is characterized by complex viscid-inviscid interactions, the development of fast numerical models of the full Navier-Stokes equations promises to alleviate this situation. One such model is the approximate factorization algorithm introduced by Beam and Warming and implemented by Steger, et al. This research is principally concerned with an independent implementation of this numerical algorithm and initial studies of its ability to efficiently and accurately describe transonic flow about an NACA 64A010 airfoil section. The approximate factorization algorithm is developed from the nondimensional, conservative, vectorized Navier-Stokes equations expressed in curvilinear coordinates. Dissert. Abstr.

N81-18027*# Flow Research, Inc., Kent, Wash.
AERODYNAMIC EFFECTS OF NEARLY UNIFORM SLIPSTREAMS ON THIN WINGS IN THE TRANSONIC REGIME **Final Report**
Magdi H. Rizk May 1980 58 p refs
(Contract NAS2-9913)
(NASA-CR-152351) Avail: NTIS HC A04/MF A01 CSCL 01A

A simplified model is used to describe the interaction between a propeller slipstream and a wing in the transonic regime. The undisturbed slipstream boundary is assumed to coincide with an infinite circular cylinder. The undisturbed slipstream velocity is rotational and is a function of the radius only. In general, the velocity perturbation caused by introducing a wing into the slipstream is also rotational. By making small disturbance assumptions, however, the perturbation velocity becomes nearly potential, and an approximation for the flow is obtained by solving a potential equation. A.R.H.

N81-18028*# Kaman Aerospace Corp., Bloomfield, Conn.
MULTICYCLIC CONTROLLABLE TWIST ROTOR DATA ANALYSIS **Final Report**
Fu-Shang Wei and A. L. Weisbrich 15 Jan. 1979 170 p refs
(Contract NAS2-8726)
(NASA-CR-152251; R-1562) Avail: NTIS HC A08/MF A01 CSCL 01A

Rsults provide functional relationship between rotor performance, blade vibratory loads and dual control settings and indicate that multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads. Higher harmonic terms of servo flap deflection were found to be most pronounced in flatwise bending moment, transmission vertical vibration and pitch link vibratory load equations. The existing test hardware represents a satisfactory configuration for demonstrating MCTR technology and defining a data base for additional wind tunnel testing. T.M.

N81-18029*# Arizona Univ., Tucson. College of Engineering.
TRANSONIC FLOW STUDIES **Final Report, 1 Nov. 1975 - 31 Oct. 1980**
Richard A. Seebass and K.-Y. Fung 28 Feb. 1981 230 p refs
(Grant NsG-2112)
(NASA-CR-163965; TFD-81-01) Avail: NTIS HC A10/MF A01 CSCL 01A

Major emphasis was on the design of shock free airfoils with applications to general aviation. Unsteady flow, transonic flow, and shock wave formation were examined. T.M.

N81-18030*# National Aeronautics and Space Administration, Washington, D. C.
DEVELOPMENT AND WIND TUNNEL INVESTIGATION OF THREE SUPERCRITICAL AIRFOIL PROFILES FOR TRANSPORT AIRCRAFT
E. Stanewsky and H. Zimmer Nov. 1980 50 p refs Transl. into ENGLISH of 'Entwicklung und windkanalerprobung von drei ueberkritischen traffluegelprofilen fuer verkehrsflugzeuge" Rept. DGLR Paper 74-100 West Germany, 1974 54 p Presented at the 7th Jahrestagung, Kiel, 17-19 Sep. 1974; sponsored by DGLR Original language document was announced as A75-24147 Transl. by Scientific Translation Service, Santa Barbara, Calif.
Original doc. prep. by Dornier G.m.b.H., Friedrichshafen, West Germany
(Contract NASw-3198)
(NASA-TM-75840) Avail: NTIS HC A03/MF A01 CSCL 01A

Three supercritical airfoil profiles were designed for transport aircraft and were tested in a wind tunnel. The investigation of the profiles CAST 7 and CAST 10-2 for different Reynolds numbers and free and forced transition show that the flow development over these profiles in the important incident flow regions depends very greatly on the Reynolds number and the position of the transition strip. This strong dependence results from the large pressure gradients in the vicinity of the profile trailing edge and the related danger of trailing edge separation, as well as the low pressure or Mach number gradient of the compression shock on the suction side of the profile. The strong dependence of the development of the trailing edge separation with increasing Mach number or increasing angle of attack on the initial boundary layer thickness, that is the boundary layer ahead of the compression shock, is the decisive factor here. The tests of the airfoil profiles were carried out for free transition and a Reynolds number Re = 2,400,000. E.D.K.

N81-18032*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
A SCHEDULING MODEL FOR THE AERIAL RELAY SYSTEM
Raymond A. Ausrotas and Elliott W. Liu Sep. 1980 113 p refs
(Contract NAS1-15268)
(NASA-CR-159387; FTL-R79-10) Avail: NTIS HC A06/MF A01 CSCL 01C

The ability of the Aerial Relay System to handle the U.S. transcontinental large hub passenger flow was analyzed with a flexible, interactive computer model. The model incorporated city pair time of day demand and a demand allocation function which assigned passengers to their preferred flights. T.M.

N81-18033*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THEORETICAL STUDY OF NETWORK DESIGN METHODOLOGIES FOR THE AERIAL RELAY SYSTEM
Jorge M. Rivera and Robert W. Simpson Jun. 1980 182 p refs
(Contract NAS1-15268)
(NASA-CR-159365; FTL-R80-10) Avail: NTIS HC A09/MF A01 CSCL 01C

The aerial relay system network design problem is discussed. A generalized branch and bound based algorithm is developed which can consider a variety of optimization criteria, such as minimum passenger travel time and minimum liner and feeder operating costs. The algorithm, although efficient, is basically useful for small size networks, due to its nature of exponentially increasing computation time with the number of variables.
Author

N81-18034# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
EVALUATION OF AFIT/F-16 RESTRAINT CONCEPTS IN THE + OR - 2Gy ENVIRONMENT
Robert E. VanPatten, John W. Frazier, Daniel W. Repperger, and Dana B. Rodgers Oct. 1980 24 p
(AF Proj. 7231)
(AD-A094323; AFAMRL-TR-80-130) Avail: NTIS HC A02/MF A01 CSCL 05/5

The acceleration stresses imposed by the lateral (+ or - Gy) maneuvering capabilities of six-degrees-of-freedom (6 DOF) aircraft, such as the AFTI/F-16, may potentially impact pilot performance. This centrifuge research was done to evaluate the effectiveness of special canopy-rail-mounted shoulder restraints at + or - Gy in the presence of a sum-of-sines tracking task implemented via a side stick (force) controller. Results indicate that additional restraints are desirable. GRA

N81-18036# Champlain Technology Industries, Palo Alto, Calif.
EVALUATION OF THE PERFORMANCE OF THE REMOTE AREA PRECISION POSITIONING SYSTEM (RAPPS) Final Report, Feb. - Oct. 1980
E. H. Bolz and T. E. Scalise Oct. 1980 74 p refs
(Contract DOT-FA75WA-3662)
(AD-A094169; FAA-RD-80-120) Avail: NTIS HC A04/MF A01 CSCL 17/7

A flight test program was flown within the coverage area of the West Coast Loran-C chain during June and July 1979. These tests were conducted for Loran-C evaluation purposes. The Remote Area Precision Positioning System (RAPPS) was utilized as the data collector and independent positioning system for those tests. This report presents an evaluation of the performance of the RAPPS system under actual test conditions. The RAPPS positioning system is based on DME multilateration and takes advantage of existing TACAN or DME installations. It was found under certain conditions to suffer degradation due to multipath propagation and signal dropouts due to terrain masking. After isolating clearly erroneous measurements, residual ranging errors of 285 ft (1 sigma) were estimated based on available data. The RAPPS data collector was designed to acquire data from two Loran-C receivers, the DME subsystem, an altimeter and a clock. The data collector functioned satisfactorily with a few deficiencies. The foremost deficiency was a lack of precise time-tagging of each individual data element, which caused processing of the Loran-C data to be quite difficult. GRA

N81-18037# Federal Aviation Agency, Atlantic City, N.J. Technical Center.
DISCRETE ADDRESS BEACON SYSTEM (DABS) RECEIVER AND AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) AND DABS PROCESSOR SUBSYSTEM TESTS Final Report, Feb. - Dec. 1979
Leonard H. Baker Dec. 1980 59 p refs
(AD-A094124; FAA-CT-80-11; FAA-RD-80-75) Avail: NTIS HC A04/MF A01 CSCL 17/9

This report describes the subsystem interrogator and processor tests conducted by the Federal Aviation Administration (FAA) Technical Center on the engineering laboratory model of the Discrete Address Beacon System (DABS). These tests were conducted to determine the performance of the multichannel receiver and the Air Traffic Control Radar Beacon System (ATCRBS) and DABS processors. These performance test results supplement the functional subsystem testing performed by Texas Instruments, Incorporated during the factory tests. The results of the receiver tests were used to determine the operating parameters and performance of the monopulse receiver and the operating characteristics of the video quantizer. The ATCRBS reply processor tests identified the static performance and characteristics of the variable parameters in this unit. The DABS reply processor tests defined the performance of the critical elements in the DABS processor. These elements were the video digitizer, the message bit and monopulse processing, and the error detection and correction. Identification and optimization of the characteristics of the variable parameters of this unit were determined. It was concluded that the subsystems tested met the requirements specified in the DABS engineering requirement (ER) FAA-ER-240-26. GRA

N81-18038# Mitre Corp., McLean, Va. Metrek Div.
CONFLICT MONITORING ANALYSIS OF PARALLEL ROUTE SPACING IN THE HIGH ALTITUDE AIRSPACE, VOLUME 2 Interim Report
Arthur P. Smith, III Jul. 1980 121 p refs
(Contract DOT-FA80WA-4370)
(AD-A094152; MTR-79W00235-Vol-2; FAA-EM-80-16-Vol-2) Avail: NTIS HC A06/MF A01

The work reported in this document was undertaken as part of the examination of the soundness of the current standards for the spacing between parallel aircraft routes and the enhancement of analytical methods to evaluate future standards. This interim report describes work completed to date on the Conflict Monitoring Parallel Route Spacing Analysis. This analysis assesses the potential for collision and the controller workload associated with aircraft flying on same direction parallel routes. To assess the potential for collision the analysis considers a conflict alert function similar to that employed in the National Airspace System. The conflict alert function detects pairs of aircraft which are projected to violate the radar separation standard within a given time period. In the analysis, the event of a conflict alert is followed by a probabilistic delay and a resolution maneuver characterized by a randomly chosen horizontal turn rate. The controller intervention rate is estimated by using a simulation. Actual aircraft tracks were sampled from the FAA data base which supports this activity. GRA

N81-18039# Mitre Corp., McLean, Va.
AUTOMATIC TRAFFIC ADVISORY AND RESOLUTION SERVICE (ATARS) MULTI-SITE, ALGORITHMS, REVISION 1
R. H. Lentz, W. D. Love, N. S. Malthouse, D. L. Roberts, T. L. Signore, R. A. Tornese, and A. D. Zeitlin Oct. 1980 503 p refs
(Contract DOT-FA80WA-4370)
(AD-A094195; MTR-80W00100-Rev-1; FAA-RD-80-3-Rev-1) Avail: NTIS HC A22/MF A01 CSCL 01/5

This document presents detailed computer algorithms for programming the Automatic Traffic Advisory and Resolution Service (ATARS), formerly known as IPC, within a multi-site Discrete Address Beacon System (DABS) network. This document is to be used by Federal Aviation Administration to specify and define the ATARS portion of the integrated DABS/ATARS system. The FAA has directed that the Conflict Indicator Register (CIR) be replaced by the Resolution Advisory Register (RAR) as the avionics mechanism for coordinating resolution advisories between ATARS sites and between ATARS and BCAS. Since it will be some time before the RAR can be fully incorporated into the ATARS algorithms, a number of modifications have been made to the ATARS logic which will permit testing of the rest of the ATARS design, while eliminating the special CIR message requirements, now obsolete, upon the DABS sensor. These modifications constitute Revision 1 to the original MITRE technical report on the ATARS multi-site algorithms. GRA

N81-18040# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ACTIVE BEACON COLLISION AVOIDANCE SYSTEM (BCAS) FUNCTIONAL OVERVIEW
J. D. Welch and V. A. Orlando 17 Dec. 1980 44 p refs
(Contract DOT-FA72WAI-817)
(AD-A094177; ATC-102; FAA-RD-80-127) Avail: NTIS HC A03/MF A01 CSCL 17/9

The Active Beacon Collision Avoidance System (BCAS) is a beacon-based airborne collision avoidance system that provides for cooperative threat resolution between BCAS and conflicting aircraft and coordination with the ground ATC control function through the DABS data link. All beacon-equipped aircraft in the vicinity of the BCAS are detected. ATCRBS-equipped aircraft are interrogated using a special Mode C interrogation, DABS aircraft are initially detected passively. Those aircraft that represent a possible threat are discretely interrogated to maintain a range/altitude track. This document provides a functional overview of BCAS including operational features, a description of the avionics package, and examples of surveillance data obtained with experimental BCAS equipment. The results show that reliable surveillance performance is achieved in low and medium density airspace. GRA

N81-18041# Mitre Corp., McLean, Va. Metrek Div.
CONFLICT MONITORING ANALYSIS OF PARALLEL ROUTE SPACING IN THE HIGH ALTITUDE CONUS AIRSPACE, VOLUME 1 Interim Report
Arthur P. Smith, III Jul. 1980 65 p refs

(Contract DOT-FA80WA-4370)
(AD-A094071; MTR-79W00235-Vol-1; FAA-EM-80-16-Vol-1)
Avail: NTIS HC A04/MF A01 CSCL 01/2

This work was undertaken as part of the examination of the soundness of the current standards for the spacing between parallel aircraft routes and the enhancement of analytical methods to evaluate future standards. This report describes work completed to date on the Conflict Monitoring Parallel Route Spacing Analysis. This analysis assesses the potential for collision and the controller workload associated with aircraft flying on same direction parallel routes. To assess the potential for collision the analysis considers a conflict alert function similar to that employed in the National Airspace System. The conflict alert function detects pairs of aircraft which are projected to violate the radar separation standard within a given time period. In the analysis the event of a conflict alert is followed by a probabilistic delay and a resolution maneuver characterized by a randomly chosen horizontal turn rate. The controller intervention rate is estimated by using a simulation. Actual aircraft tracks were sampled from the FAA data base which supports this activity. These tracks are initiated on the routes based on randomly chosen sector entry times which reflect the level of route loading. For both the potential for collision and the intervention rate, trial results based on a subset of the FAA data are given. GRA

N81-18042# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
DEFINITION OF THE PROBLEMS ASSOCIATED WITH AIR TRAFFIC CONTROL OF CLOSELY SPACED HELICOPTER TRAFFIC PERFORMING DECELERATED INSTRUMENT APPROACHES Final Technical Report, 17 Sep. 1979 - 30 Jun. 1980
R. W. Simpson Ft. Monmouth, N. J. AVRADCOM Dec. 1980 66 p refs
(Contract DAAK80-79-C-0282; DA Proj. 1L2-26220-AH-85)
(AD-A094073; USAAVRADCOM-TR-79-0282-F) Avail: NTIS HC A04/MF A01 CSCL 17/7

This study reviews the requirements for a modern, high performance all weather Air Traffic Management and Control (ATM/C) System designed for U.S. Army airfields. A strawman ATM/C system is created to illustrate problems, and to identify research and development needs in surveillance, communications, and computer display and automation. GRA

N81-18043 California Univ., Los Angeles.
APPLICATION OF THE FINITE ELEMENT METHOD TO ROTARY WING AEROELASTICITY Ph.D. Thesis
Friedrich Karl Straub 1980 237 p
Avail: Univ. Microfilms Order No. 8104040

A finite element method for the spatial discretization of the dynamic equations of equilibrium governing rotary wing aeroelastic problems is presented. The equations of motion are nonself adjoint, nonlinear, and in partial differential form. For this class of problems, variational principles are not available. Thus, formulation of the finite element equations is based on weighted Galerkin residuals. This Galerkin finite element method reduces algebraic manipulative labor significantly, when compared to the application of the global Galerkin method to similar problems. However, more computer time is spent on the numerical calculations. The numerical simulations of the flap lag problem show the Galerkin finite element method to be a practical tool. The results indicate that the trimmed flap lag problem is basically stable. Nonlinear effects and higher harmonic contributions are important for both stability and response, in particular, at high advance ratios and more so for flap than for lag. Inclusion of two modes for each elastic degree of freedom is necessary to reliably determine the blade response. Dissert. Abstr.

N81-18044*# Neilsen Engineering and Research, Inc., Mountain View, Calif.
CONTINUED DEVELOPMENT AND CORRELATION OF ANALYTICALLY BASED WEIGHT ESTIMATION CODES FOR WINGS AND FUSELAGES Contractor Technical Report, Jun. 1975 - May 1976
Joseph Mullen, Jr. Mar. 1978 139 p refs
(Contract NAS2-8558)
(NASA-CR-152331; NEAR-TR-161) Avail: NTIS HC A07/MF A01 CSCL 01C

The implementation of the changes to the program for Wing Aeroelastic Design and the development of a program to estimate aircraft fuselage weights are described. The equations to implement the modified planform description, the stiffened panel skin representation, the trim loads calculation, and the flutter constraint approximation are presented. A comparison of the wing model with the actual F-5A weight material distributions and loads is given. The equations and program techniques used for the estimation of aircraft fuselage weights are described. These equations were incorporated as a computer code. The weight predictions of this program are compared with data from the C-141. T.M.

N81-18045*# Neilsen Engineering and Research, Inc., Mountain View, Calif.
DATA BASE FOR THE PREDICTION OF AIRFRAME/PROPULSION SYSTEM INTERFERENCE EFFECTS Final Report, 14 Feb. 1977 - 1 Jan. 1979
Oden J. McMillan, Edward W. Perkins, Gary D. Kuhn, and Stanley C. Perkins, Jr. Nov. 1979 435 p refs
(Contract NAS2-9513)
(NASA-CR-152316; NEAR-TR-187) Avail: NTIS HC A19/MF A01 CSCL 01C

Supersonic tactical aircraft with highly integrated jet propulsion systems were investigated. Primary attention was given to those interference effects which impact the external aerodynamics of the aircraft. R.C.T.

N81-18046*# Mississippi State Univ., Mississippi State. Dept. of Aerospace Engineering.
AN APPLICATION OF WAKE SURVEY RAKES TO THE EXPERIMENTAL DETERMINATION OF THRUST FOR A PROPELLER DRIVEN AIRCRAFT Final Report
K. R. Hall, S. J. Miley, and H. J. Tsai Feb. 1981 77 p refs (Grant NsG-1454)
(NASA-CR-163967; MSSU-EIRS-ASE-81-3) Avail: NTIS HC A04/MF A01 CSCL 01C

The use of wake survey rakes for the in flight determination of the resultant thrust for a constant pitch propeller driven, low wing, single engine general aviation aircraft was investigated. The lack of slipstream static pressure distribution seriously affected the results but recommendations for removing the deficiency are discussed. The wake survey rake is shown to be a valuable tool in aircraft flight testing. E.D.K.

N81-18047*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
DESCRIPTION OF THE HiMAT TAILORED COMPOSITE STRUCTURE AND LABORATORY MEASURED VEHICLE SHAPE UNDER LOAD
Richard C. Monaghan Feb. 1981 60 p refs
(NASA-TM-81354; H-1144) Avail: NTIS HC A04/MF A01 CSCL 01C

The aeroelastically tailored outer wing and canard of the highly maneuverable aircraft technology (HiMAT) vehicle are closely examined and a general description of the overall structure of the vehicle is provided. Test data in the form of laboratory measured twist under load and predicted twist from the HiMAT NASTRAN structural design program are compared. The results of this comparison indicate that the measured twist is generally less than the NASTRAN predicted twist. These discrepancies in twist predictions are attributed, at least in part, to the inability of current analytical composite materials programs to provide sufficiently accurate properties of matrix dominated laminates for input into structural programs such as NASTRAN. A.R.H.

N81-18048# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
STRUCTURE AND LIFETIME ATTESTATION OF TORNADO [STRUKTUR UND LEBENSDAUERNACHWEIS FUER TORNADO]

Arendts Seibert 17 Dec. 1979 35 p In GERMAN Presented at DGLR Symp. on the MRCA program TORNADO, 13 Dec. 1979
(MBB-PUB-P-0001) Avail: NTIS HC A03/MF A01

Structural design and durability of the Tornado, a multirole combat aircraft, are discussed. The Tornado is a flexible wing, small combat airplane which is capable of low flight and short takeoff and landing. The construction expenses are relatively low for a small plane. The Tornado is very small airplane with considerable equipment packing density. It is concluded that though the number of flying hours is shorter, the amount of loads per flying hours, stress, and the hardness of fatigue spectra is considerably greater than those of transportation air carriers.
Transl. by E.A.K.

N81-18049# Fiber Science, Inc., Salt Lake City, Utah.
HELICOPTER EXTERNAL CARGO SLING APEX FITTING: DEVELOPMENT AND TESTING Final Report, Apr. 1977 - May 1980
Randy L. Crane and Harvey D. Goff Nov. 1980 23 p refs
(Contract DAAJ02-77-C-0026; DA Proj. 1L2-62209-AH-76)
(AD-A093515; FSI-1140; USAAVRADCOM-TR-80-D-22) Avail: NTIS HC A02/MF A01 CSCL 13/5

A one-piece helicopter external cargo sling apex fitting was developed from Kevlar 29 to meet Army requirements for a lightweight, nonmetallic fitting that will facilitate cargo hook movement of sling-assisted loads. This report outlines the processes of material selection, design concepts, manufacturing methods, and testing undertaken to develop a versatile unit that meets or exceeds all previous criteria. GRA

N81-18050# Information Spectrum, Inc., Warminster, Pa.
COMPILATION OF ENERGY EFFICIENT CONCEPTS IN ADVANCED AIRCRAFT DESIGN AND OPERATIONS. VOLUME 2: ABSTRACT DATA BASE Final Report, 10 Mar. - 5 Nov. 1980
Milton Clyman, Sheldon J. Einhorn, and Richard S. Schultz 5 Nov. 1980 435 p refs
(Contract N62269-80-C-0200)
(AD-A094226; NADC-79239-60-Vol-2) Avail: NTIS HC A19/MF A01 CSCL 01/3

The technologies necessary to support next generation (I 1990+) air vehicle design and operation concepts that will reduce the requirements for natural petroleum derived energy are considered in the Advanced Concepts Data Base which consists of 599 abstracts listed as 948 entries. The data base abstracts are arranged into 11 areas of R&D effort as follows: synthetic fuels, liquid hydrogen fuels, other fuels; gas turbines, nuclear propulsion, advanced propulsion; aerodynamics; structures and materials; flight performance management; advanced and unconventional systems; and energy efficient operation. A.R.H.

N81-18051# Information Spectrum, Inc., Warminster, Pa.
COMPILATION OF ENERGY EFFICIENT CONCEPTS IN ADVANCED AIRCRAFT DESIGN AND OPERATIONS. VOLUME 1: TECHNICAL REPORT Final Report, 10 Mar. - 5 Nov. 1980
Milton Clyman, Sheldon J. Einhorn, and Richard S. Shultz 5 Nov. 1980 101 p refs
(Contract N62269-80-C-0200)
(AD-A094225; NADC-79239-60-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 01/3

This final report (contained in two volumes) presents the results of research into published literature. The search addressed the technologies necessary to support next generation (1990+) vehicle design and operation concepts that will reduce the requirement for natural petroleum-derived energy. The Advanced Concepts Evaluation (ACE) Data Base consists of 599 unique abstracts listed as 948 entries. The ACE Data Base is arranged into eleven areas of R D effort, each subdivided into Navy and non-Navy funded programs. Volume 1 includes introduction, Data Bases searched, research methodology for creation of the ACE Data Base, summary of search results, conclusions and recommendations. This volume contains an appendix of search strategies utilized. GRA

N81-18052# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
PRELIMINARY AIRWORTHINESS EVALUATION OH-58C HELICOPTER CONFIGURED WITH A MAST MOUNTED SIGHT Final Report
John A. Bishop, Marvin L. Hanks, Tom P. Benson, and Arthur M. Arrigo May 1980 76 p refs
(AD-A094172; USAAEFA-78-09) Avail: NTIS HC A05/MF A01 CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted a preliminary airworthiness evaluation of the OH-58C helicopter with a mast mounted sight and Bell Helicopter, Textron Model 570B three-axis stability and control augmentation system. The evaluation was completed in two phases at the Bell Helicopter Engineering Flight Research Center, Arlington, Texas (elevation 630 ft). Phase 1 consisted of an evaluation of a dummy mast mounted sight installed on an instrumented helicopter. This phase was conducted between 15 and 30 October 1980 and 12 flights were flown for a total of 9.7 productive hours. Phase 2 consisted of a qualitative assessment of the handling qualities of the OH-58C configured with the operational Rockwell International sight. This phase was completed on 30 November 1980 in two flights for 1.5 productive test flight hours. The overall evaluation indicated that the OH-58C handling qualities with installed mast mounted sight and three-axis SCAS were satisfactory within the flight envelope tested. No problems were noted that will prevent future operational testing of the system. The addition of a three-axis SCAS significantly improved the OH-58C handling qualities, particularly in low speed flight, and is an enhancing characteristic. GRA

N81-18053# Boeing Vertol Co., Philadelphia, Pa.
HELICOPTER ICING REVIEW Final Report, 30 Sep. 1978 - 31 Jul. 1980
A. A. Peterson and L. U. Dadone Sep. 1980 249 p refs
(Contract DOT-FA78WA-4258)
(AD-A094175; D210-11583-1; FAA-CT-80-210) Avail: NTIS HC A11/MF A01 CSCL 01/3

The development of techniques and criteria permitting the release of a helicopter into known (i.e., forecast) icing situations is actively being investigated by both military and civilian agencies through ongoing test programs and study efforts. As part of this overall effort, helicopter icing characteristics, available ice protection technology, and test techniques are discussed in this technical treatment. Recommendations are provided in the areas of icing certification procedures and icing research. One of the key issues addressed in this report is the test environment, i.e., the use of inflight evaluation in natural icing only, or, the use of a simulated icing environment to supplement and/or expand the certification envelope. Involved in this issue is the shape (and extent) of the rotor ice (natural vs simulated) as it affects the aerodynamics and dynamics of the rotor system, together with the shedding characteristics as it affects the behavior and safety of the complete vehicle. GRA

N81-18054# Naval Ship Research and Development Center, Bethesda, Md.
SOME DYNAMIC PROPERTIES OF RIGID TWO-BLADED FULLY GIMBALLED TIP-JET HELICOPTER ROTOR WITH CIRCULATION CONTROL
Harvey R. Chaplin Aug. 1980 35 p refs
(ZF66412001)
(AD-A094031; DTNSRDC/TM-16-80-16) Avail: NTIS HC A03/MF A01 CSCL 20/4

Simplified analyses are carried out for the motions of a simple rigid two-bladed fully gimballed rectangular rotor rotating at constant speed about a stationary center point and about a center point translating at a low constant advance ratio. (The term 'fully gimballed' means that hub moments about all axes are zero.) It is concluded that: the rotor can be rendered dynamically stable by appropriate mass balancing. In a particular example considered, the mass balancing was estimated to increase the rotor weight by about 20%. The steady state motion about a translating center due to first harmonic moments induced by translation is a wobbling motion with the principal axis of rotation describing a cone about its mean position at twice to rotor

rotational frequency. A circulation control system can control total rotor lift and can cause precession of the mean position of the principal rotational axis to any desired orientation. It cannot, however, influence the amplitude of the steady state wobble.
GRA

N81-18055# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
WIND SHEAR SYSTEMS IMPLEMENTATION PLAN, BENEFIT/COST STUDY Final Report, 19 Aug. 1979 - Jun. 1980
Byron F. Bond Aug. 1980 80 p refs
(Contract DOT-FA79WA-4279)
(AD-A094168; FAA-RD-80-103) Avail: NTIS HC A05/MF A01 CSCL 01/4

Since July 1973 there have been eight U.S. air carrier accidents attributed to encounters with strong low-level wind shears during terminal flight operations. The FAA research and development effort has taken a threefold approach to the wind shear problem: (1) developing and implementing improved forecasting techniques and procedures for predicting and reporting low-level wind shear in the terminal area; (2) placing wind shear detection equipment on the ground and transmitting information to the pilot; and (3) installing equipment aboard the aircraft that would provide the pilot with wind shear information in 'real time . The results of the latter effort, i.e., airborne wind shear systems and techniques are evaluated as to their relative benefits and costs both to the user and to the FAA. Ground speed is a major input variable to many of the candidate airborne wind shear systems. Eight techniques for providing ground speed are evaluated and cost comparisons are documented. Also evaluated are three self contained wind shear systems that do not rely on ground speed as a reference and a head-up display for displaying wind shear data. GRA

N81-18057# Michigan Univ., Ann Arbor. W. E. Lay Automotive Lab.
LIGHT AIRCRAFT ENGINES, THE POTENTIAL AND PROBLEMS FOR USE OF AUTOMOTIVE FUELS. PHASE 1: LITERATURE SEARCH Final Report, Oct. 1979 - Sep. 1980
D. J. Patterson, K. Morrison, M. Remondino, and T. Slopsema Dec. 1980 122 p refs
(Contract DOT-FA79NA-6083)
(AD-A094154; FAA-CT-81-150) Avail: NTIS HC A06/MF A01 CSCL 21/4

A comprehensive data research and analysis for evaluating the use of automotive fuels as a substitute for aviation grade fuel by piston-type general aviation aircraft engines is presented. Historically known problems and potential problems with fuels were reviewed for possible impact relative to application to an aircraft operational environment. This report reviews areas such as: fuel specification requirements, combustion knock, preignition, vapor lock, spark plug fouling, additives for fuel and oil, and storage stability. GRA

N81-18059# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE REACTING AND NON-REACTING FLOW CHARACTERISTICS OF SOLID RAM-JETS
Winston Elliott Scott Sep. 1980 80 p refs
(AD-A094567) Avail: NTIS HC A05/MF A01 CSCL 21/5

An investigation was conducted to determine the relationship between the non-reacting and the reacting flow characteristics of solid fuel ramjets. Polymethylmethacrylate fuel grains were burned in a ramjet motor on a thrust stand. Combustion efficiency, regression rate profile and pressures were determined for the reacting flows and compared to profiles obtained in non-reacting flows for velocity, pressure, and near-wall and centerline turbulence intensity. Near-wall turbulence profiles were in agreement with the fuel regression profiles obtained in reacting flows. Combustion efficiency was found to be a strong function of mixture ratio. Near-wall mixing significantly increased fuel regression rate. GRA

N81-18060*# Lear Siegler, Inc., Santa Monica, Calif. Astronics Div.
DEVELOPMENT AND EVALUATION OF AUTOMATIC LANDING CONTROL LAWS FOR POWER LIFT STOL AIRCRAFT Final Report
B. Feinreich and G. Gevaert Jan. 1981 258 p
(Contract NAS2-10324)
(NASA-CR-152399) Avail: NTIS HC A12/MF A01 CSCL 01C

A series of investigations were conducted to generate and verify through ground bases simulation and flight research a data base to aid in the design and certification of advanced propulsive lift short takeoff and landing aircraft. Problems impacting the design of powered lift short haul aircraft that are to be landed automatically on STOL runways in adverse weather were examined. An understanding of the problems was gained by a limited coverage of important elements that are normally included in the certification process of a CAT 3 automatic landing system. T.M.

N81-18061*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH LIFT CHARACTERISTICS IN THE CASE OF THE V-WING CONCEPT
H. Zimmer Nov. 1980 41 p refs Transl. into ENGLISH "Das hochauf triebsverhalten beim rautenfluegelkonzept" Rept. DGLR Paper 78-114 West Germany, 30 Aug. 1978 43 p Presented at Deutscher Luft-und Raumfahrt-Kongress, Darmstadt, West Germany, 19-23 Sep. 1978 Original language document announced as A79-14072 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Dornier-Werke G.m.b.H., Friedrichshafen, West Germany
(Contract NASw-3198)
(NASA-TM-75872) Avail: NTIS HC A03/MF A01 CSCL 01C

Theoretical experimental investigation of a diamond wing concept were carried out. Experimental results are available for two models with two low speed channels and two high speed channels, with various parameters varied. The expected reduction of the induced and the wave resistance and an increase in the maximum lift were confirmed by previous results. In addition, structural calculations for a hypothetical full scale version were carried out. According to the stresses and deformations determined, the wing concept should also be able to control the loads. E.D.K.

N81-18062# Analytic Sciences Corp., Reading, Mass.
RESEARCH IN MULTIRATE ESTIMATION AND CONTROL Annual Report, 1 May 1979 - 1 May 1980
Douglas P. Glasson 20 Dec. 1980 124 p refs
(Contract N00014-79-C-0431)
(AD-A094070; TASC-TR-1356-1) Avail: NTIS HC A06/MF A01 CSCL 12/1

A new approach to multirate control system synthesis based on optimal estimation and control theory was developed. The new techniques obviate dimensionality problems typical of classically based design techniques and offer a systematic procedure for designing to desired closed-loop specifications. Mathematical derivations of the optimal multirate state estimator, regulator, and proportional-plus-integral controllers are presented. The transient response and robustness properties of multirate systems designed by the present techniques are investigated through examples. GRA

N81-18063 Stanford Univ., Calif.
DESIGN FOR ACTIVE AND PASSIVE FLUTTER SUPPRESSION AND GUST ALLEVIATION Ph.D. Thesis
Mordechay Karpel 1980 117 p
Avail: Univ. Microfilms Order No. 8103527

The control techniques are ased on a rational approximation of the unsteady aerodynamic loads in the entire Laplace domain, which yields matrix equations of motion with constant coefficients. Some existing rational approximation schemes were reviewed, the matrix Pade approximant was modified, and a new technique which yields a minimal number of augmented states for a desired accuracy is presented. The state space aeroelastic model was used to design an active control system for simultaneous flutter suppression and gust alleviation. The design target is for a continuous controller which transfers some measurements taken

on the vehicle to a control command applied to a control surface. The control parameters are constant and they are optimized to mimimize any desired combination of gust response parameters in a way that assures stability over the range of varying aerodynamic parameters in the entire flight envelope. Structural modifications were formulated in a way which enables the treatment of passive flutter suppression means with the same procedures by which active systems are designed. Dissert. Abstr.

N81-18066# Air Force Human Resources Lab., Brooks AFB, Tex. Operating Training Div.
ADVANCED FLIGHT SIMULATOR: UTILIZATION IN A-10 CONVERSION AND AIR-TO-SURFACE ATTACK TRAINING Final Report
Thomas H. Gray, Edward K. Chun, Harold D. Warner (Dayton Univ. Res. Inst.), and James L. Eubanks (Dayton Univ. Res. Inst.) Jan. 1981 191 p refs
(AF Proj. 1123)
(AD-A094608; AFHRL-TR-80-20) Avail: NTIS HC A09/MF A01 CSCL 05/9

The purposes of this research were to develop transition and surface attack simulator training programs for novice A-10 pilots and to determine simulator features and capabilities required for effective training in the air-to-surface (A/S) mission. These goals were refined to four specific objectives: development of a transition and surface attack syllabus; generation of objective performance measurement algorithms; determination of design requirements for instructor stations; and assessment of the utility of advanced instructional features. These objectives were accomplished using A-10 Instructor Pilots and four classes of 'B' course students who had recently completed Undergraduate Pilot Training and Fighter Lead-In-School. Each class received two blocks of instruction on the Advanced Simulator for Pilot Training (ASPT). The first block consisted of 4 to 8 hours of conversion training with primary emphasis on traffic pattern work. The second block of training was composed of 4 to 7 hours of A/S weapons delivery (i.e., dive bombing and strafe). The key findings were: (1) for the initial phases of weapons delivery training, the transfer of training from the ASPT to the A-10 is nearly 100 percent, therefore, in the early phases of A/S training, one simulator mission can effectively replace one aircraft mission, thus allowing actual flying time to be transferred to other phases of training; (2) objective assessments of piloting and weapons delivery skills are highly useful in A-10 training; (3) improvements are needed in the display and controls at the A-10 instructor station. GRA

N81-18067# Naval Postgraduate School, Monterey, Calif.
VALIDATION OF A TWO-DIMENSIONAL PRIMITIVE VARIABLE COMPUTER CODE FOR FLOW FIELDS IN JET ENGINE TEST CELLS Final Report
Paul J. Mallon, Patrick J. Hickey, and David W. Netzer Oct. 1980 73 p refs Sponsored by Navy
(AD-A094615; NPS67-80-014) Avail: NTIS HC A04/MF A01 CSCL 09/2

Pressure and velocity data were collected in a full scale jet engine test cell in order to validate the predictive accuracy of a two dimensional and axisymmetric primitive variable computer code. It was found that the model reasonably predicted the velocity profiles in the augmentor tube. Inaccuracy increased at higher engine thrust settings at positions far downstream in the augmentor tube. Predicted pressure profiles were reasonable but the magnitudes were in considerable error at high flow rates. GRA

N81-18096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RISK TO THE PUBLIC FROM CARBON FIBERS RELEASED IN CIVIL AIRCRAFT ACCIDENTS
1980 71 p refs
(NASA-SP-448) Avail: NTIS HC A04/MF A01 CSCL 11D

Because carbon fibers are strong, stiff, and lightweight, they are attractive for use in composite structures. Because they also have high electrical conductivity, free carbon fibers settling on electrical conductors can cause malfunctions. If released from the composite by burning, the fibers may become a hazard to exposed electrical and electronic equipment. As part of a Federal study of the potential hazard associated with the use of carbon fibers, NASA assessed the public risk associated with crash fire accidents of civil aircraft. The NASA study projected a dramatic increase in the use of carbon composites in civil aircraft and developed technical data to support the risk assessment. Personal injury was found to be extremely unlikely. In 1993, the year chosen as a focus for the study, the expected annual cost of damage caused by released carbon fibers is only $1000. Even the worst-case carbon fiber incident simulated (costing $178,000 once in 34,000 years) was relatively low-cost compared with the usual air transport accident cost. On the basis of these observations, the NASA study concluded that exploitation of composites should continue, that additional protection of avionics is unnecessary, and that development of alternate materials specifically to overcome this problem is not justified. Author

N81-18097*# HITCO, Gardena, Calif. Defense Products Div.
DEVELOPMENT OF ASSEMBLY TECHNIQUES FOR FIRE RESISTANT AIRCRAFT INTERIOR PANELS Final Report
Samuel C. S. Lee May 1978 67 p refs
(Contract NAS2-9153)
(NASA-CR-152119; HTR-5-78) Avail: NTIS HC A04/MF A01 CSCL 11D

Ten NASA Type A fire resistant aircraft interior panels were fabricated and tested to develop assembly techniques. These techiques were used in the construction of a full scale lavatory test structure for flame propagation testing. The Type A panel is of sandwich construction consisting of Nomex honeycomb filled with quinone dioxime foam, and bismaleimide/glass face sheets bonded to the core with polyimide film adhesive. The materials selected and the assembly techniques developed for the lavatory test structure were designed for obtaining maximum fire containment with minimum smoke and toxic emission. Author

N81-18139*# San Jose State Coll., Calif.
DYNAMIC, HOT SURFACE IGNITION OF AIRCRAFT FUELS AND HYDRAULIC FLUIDS Final Report, Jan. 1977 - Dec. 1979
Donald J. Myronuk Oct. 1980 47 p refs
(Grants NsG-2165; NsG-2219; AFOSR MIPR FY 1455-77; AF Proj. 3048)
(NASA-CR-163979; AD-A094382; AFAPL-TR-79-2095) Avail: NTIS HC A03/MF A01 CSCL 21/4

The dynamic surface ignition characteristics of aircraft fuels and hydraulic fluids were investigated on heated stainless steel and titanium surfaces. Local air flow (0.8 to 50 meters per second) (2.4 to 152.4 ft/sec) effects were measured. aircraft fuels evaluated on titanium surfaces ignited (25 to 75 C) (77 to 167 F) lower (500 to 600 C) (932 to 1112 F) than values required to ignite the fuels on a heated stainless steel surface. Higher local surface air speeds necessitated higher surface temperatures for ignition of an applied fluid. The same trends were noted for hydraulic fluids sprayed on the heated surfaces. GRA

N81-18199*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CERAMIC AND COATING APPLICATIONS IN THE HOSTILE ENVIRONMENT OF A HIGH TEMPERATURE HYPERSONIC WIND TUNNEL
Richard L. Puster, John R. Karns, Peter Vasquez, and Warren C. Kelliher Jan. 1981 34 p refs
(NASA-TM-81931) Avail: NTIS HC A03/MF A01 CSCL 11I

A Mach 7, blowdown wind tunnel was used to investigate aerothermal structural phenomena on large to full scale high speed vehicle components. The high energy test medium, which provided a true temperature simulation of hypersonic flow at 24 to 40 km altitude, was generated by the combustion of methane with air at high pressures. Since the wind tunnel, as well as the models, must be protected from thremally induced damage, ceramics and coatings were used extensivley. Coatings were used both to protect various wind tunnel components and to improve the quality of the test stream. Planned modifications for the wind tunnel included more extensive use of ceramics in

order to minimize the number of active cooling systems and thus minimize the inherent operational unreliability and cost that accompanies such systems. Use of nonintrusive data acquisition techniques, such as infrared radiometry, allowed more widespread use of ceramics for models to be tested in high energy wind tunnels. R.C.T.

N81-18201# Goodrich (B. F.) Co., Akron, Ohio.
ALUMINIZED CODING STUDY FOR RETROFITTING IN-SERVICE SLIDE MATERIALS Final Report
R. J. Cole and G. S. Sims Nov. 1980 69 p ref
(Contract DOT-FA79NA-6065; FAA Proj. 161-350-320)
(AD-A094170; FAA-CT-81-151; BFG-80-31-023) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report describes the work to develop a thermal-resistant reflective coating for the retrofit of in-service slides and slide/rafts. The report includes the experimental evaluation of commercially available reflective coatings and paints, ingredient-modification experiments, methods of application, physical properties tests, and retrofit cost estimate. The end product of this study resulted in a new aluminum polyurethane coating, BF Goodrich coating KE7620, suitable for retrofit purposes. GRA

N81-18244# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN NO. 1980-2, MARCH - APRIL 1980
Claude Sevestre, ed. ESA 1980 79 p refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-2, Mar. - Apr. 1980 p 77-145
(ESA-TT-652) Avail: NTIS HC A05/MF A01

Topics include turbulence formation, flow separation over swept wings, a closed-cycle helium turbine for solar power applications, elliptical flow computation, characterization of aircraft radar echoes, and a dynamic computer memory allocation system.

N81-18246# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STRUCTURES OF FLOW SEPARATIONS OVER SWEPT WINGS
Henry Werle *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-2 (ESA-TT-652) 1980 p 9-33 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-2, Mar. - Apr. 1980 p 85-108 Original report in FRENCH previously announced as A80-46227

Avail: NTIS HC A05/MF A01

The systematic study of the singularities characterizing the various types of separations which develop over swept wings, particularly at high angles of attack were studied by means of flow visualization in a water tunnel. From these results obtained at low speed, a number of fundamental schemes can be derived that emphasize the complex vortex structure of these phenomena from their formation more or less close to the apex until their disorganization downstream. This analysis, which distinguishes full wings and wall-mounted half wings, covers the effects due to the main parameters of flow, aircraft configuration and wing shape. Author (ESA)

N81-18248# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AN IMPLICIT FINITE VOLUME METHOD FOR ELLIPTICAL FLOW COMPUTATION
Denis Dutoya and Pierre-Jacques Michard *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-2 (ESA-TT-652) 1980 p 51-59 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-2, Mar. - Apr. 1980 p 123-129 Original report in FRENCH previously announced as A80-46229

Avail: NTIS HC A05/MF A01

A time integration scheme is given for the conservation equations for aerothermodynamic problems. The space discretization employed uses the finite volume method, which retains the conservative character of the basic equations. The time integration procedure is based on a linearized, implicit second-order method, which anticipates the variation of aerodynamical quantities by implicitly coupling mass and momentum equations through a linearized pressure equation. In such a way, the numerical scheme escapes the CFL stability requirements, and thus allows fast calculation of low frequencies and fast convergence towards a stationary solution. Examples of calculation results are presented to illustrate applications in turbomachinery studies. Author (ESA)

N81-18256# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NUMERICAL COMPUTATION OF FLOWS WITH ROLLED-UP VORTEX SHEETS
Serge Huberson *In its* La Rech. Aerospatiale Bimonthly Bull. No. 1980-3 (ESA-TT-657) 1980 p 57-63 refs Transl. into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-3, May - Jun. 1980 p 197-207 Original report in FRENCH previously announced as A80-43548

Avail: NTIS HC A05/MF A01

Vortex sheet numerical simulation using point vortices cannot give a good representation of the flow in the highly rolled up part of the sheet. The proposed numerical simulation relies on an analytical algorithm due to Guiraud and Zeytounian according to which the irrotational flow with a embedded highly rolled vortex sheet is asymptotically equivalent to one with no vertex sheet. The flow in the core is governed by the incompressible Euler equations which are solved by a finite difference method and the remaining portion of the sheet is represented by classical point vortices. This method is applied to the symmetrical Kaden problem (trailing edge vortex sheet). Author (ESA)

N81-18257# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EXPERIMENTAL STUDY OF THE SEPARATION AT THE TRAILING EDGE OF AN AXISYMMETRICAL CONTOURED AFTER-BODY
Jean-Louis Solignac *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-3 (ESA-TT-657) 1980 p 65-71 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-3, May - Jun. 1980 p 205-211 Original report in FRENCH previously announced as A80-43549

Avail: NTIS HC A05/MF A01

External flow separation upstream of the trailing edge of a profiled body are analyzed on an axisymmetric afterbody. The aerodynamic field is examined using pressure probes, hot wires, and a laser velocimeter. These measurements are supplemented by visualizations. It is possible to define the structure of the mean flow and characterize turbulence properties in the separation and the adjacent mixing zones. Low frequency unsteady aspects which are seemingly associated with the generation of large turbulent structures in the mixing zone of the internal flow are also examined. Author (ESA)

N81-18258# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
IMPROVEMENTS IN THE DETERMINATION OF CONVECTIVE TRANSFERS FROM INFRARED THERMOGRAPHY
Daniel L. Balageas and Dominique Ory *In its* La Rech. Aerospatiale, Bimonthly Bull. No. 1980-3 (ESA-TT-657) 1980 p 73-79 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1980-3, May - Jun. 1980 p 213-219 Original report in FRENCH previously announced as A80-43550

Avail: NTIS HC A05/MF A01

Modeling of a semi-infinite plane wall was used to determine maps of convective transfer coefficients. A systematic evaluation of the error involved in the use of the model of the semi-infinite plane slab in the case of a model with a finite thickness was carried out. It was possible to show the existence of correlations between this error and dimensionless groups built from the Fourier and Biot numbers relative to the thickness of the wall. With respect to the side not subjected to aerodynamic flow, two cases were considered: heat insulation; and imposed temperature equal to the initial temperature. Author (ESA)

N81-18259# Blume (John A.) and Associates Research Div., San Francisco, Calif.
WIND LOADING AND RESPONSE OF A HIGH-RISE BUILDING
Russell S. Mills 1981 16 p refs Presented at the Conf. on the Dyn. Response of Struct., Atlanta, 14 Jan. 1981
(Contract DE-AC08-76DP-00099)
(CONF-810104-1) Avail: NTIS HC A02/MF A01

An instrumentation system suitable for the measurement of wind loading and structural response was implemented in a 16 story Las Vegas building. The use of a displacement measuring system consisting of a vertically aligned laser and a light sensitive diode permits evaluation of quasistatic as well as fluctuating response. Experimental results from several wind storms were compared to a method for analytically predicting alongwind structural response. The analytical method was found to underestimate the actual building response. DOE

N81-18318 Tennessee Univ., Knoxville.
FLUID-DYNAMIC AND AEROACOUSTIC INVESTIGATIONS OF SHROUDED JETS Ph.D. Thesis
Venugopal Veerasamy 1980 214 p
Avail: Univ. Microfilms Order No. 8104629

The fluid dynamic and aeroacoustic characteristics of a high subsonic jet discharging from a shrouded nozzle were investigated theoretically and experimentally to explore the possibility of jet noise reduction and thrust augmentation for STOL/VTOL aircraft. The preliminary design calculations of an adiabatic shrouded nozzle were performed by solving iteratively the one dimensional fluid dynamic equations governing the compressible flow. A two dimensional flow model, consisting of second order partial differential equations of a parabolic type, was used to find the effect of shroud length on the ejector performance. This model consists of the conservation laws with thin shear layer assumptions incorporating the Prandtl's mixing length hypothesis for turbuence closure. A numerical integration method was used to solve the governing fluid dynamic equations of motion. The aeroacoustic characteristics of the shrouded jet were analyzed based on the Lighthill's V(8) law. Dissert. Abstr.

N81-18322# Centre Technique des Industries Mecaniques, Senlis (France).
FLOW IN BENT PIPES Final Report [ECOULEMENT DANS LES CONDUITES COUDES]
Michel Pluviose Mar. 1980 21 p refs In FRENCH
(CETIM-14.F.091) Avail: NTIS HC A02/MF A01

The aerodynamic characteristics of a bent pipe were studied in an effort to improve the performance of high pressure gas turbines and to increase the reliability of the bent sections with regards to erosion/corrosion. Classic measurements of pressure distribution and energy dissipation were obtained using a water anemometer. Normal bends, laminar bends, elliptic bends, vaned bends, and bends with variable curvature were studied. Flow visualization by water injection shows that (1) the optimum medium line of the bend is circular; (2) losses are weakest when the straight line section reamins constant upstream and downstream of the bend; and (3) losses are very weak when the chosen straight line section is elliptic. According to the complexity of the circuit it can be of interest either to maintain elliptical pipes, or to supply the circuit with a transformation part, permitting return to a circular straight line section.
Transl. by A.R.H.

N81-18324# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
PHYSICAL AND NUMERICAL ASPECTS OF SHOCK BOUNDARY LAYER INTERACTIONS
Marc Brusseleers *In its* Shock-Boundary Layer Interaction in Turbomachines, Vol. 1 1980 131 p refs

Avail: NTIS HC A13/MF A01

The properties of shocks and boundary layers, their basic interactions, test methods, flow structures and shock patterns for both oblique and normal shock interactions, correlations, and flows around airfoils are reviewed. Available calculation methods are described, including discontinuity analysis, boundary layer integral methods, multideck methods for modeling the detailed flow structure, and solution of the interaction problem using the Navier-Stokes equations. Author (ESA)

N81-18325# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
INFLUENCE OF FREE-STREAM MACH NUMBER ON TRANSONIC SHOCK-WAVE BOUNDARY-LAYER INTERACTION
J. W. Kooi *In* Von Karman Inst. for Fluid Dyn. Shock Boundary Layer Interaction in Turbomachines, Vol. 1 1980 37 p refs Also presented at DGLR/GARTEUR 6 Symp. on Transonic Configuration, Bad Harzburg, West Germany, 13-15 Jun. 1978

(NLR-MP-78013-U) Avail: NTIS HC A13/MF A01

An experiment in which a nominal normal shock impinges on a turbulent flat plate boundary layer is described. The wall pressure distribution in the interaction region was measured for Mach number (1.40, 1.44, and 1.46) in front of the shock. The Reynolds number based on shock position was 18 million and based on momentum thichness at the start of the interaction it was 20,000. At all Mach numbers detailed pitot and static pressure surveys were made. The velocity profiles were integrated to give the integral properties whereas the skin friction was derived from Clauser plots. Increasing the Mach number results in a rapid growth of the separation bubble accompanied with the development of a supersonic tongue. A comparison with other data suggests that the Reynolds number also has a pronounced effect on the length of the separation bubble. Author (ESA)

N81-18331*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GEOMETRIC METHODS IN COMPUTATIONAL FLUID DYNAMICS
Peter R. Eiseman *In* Von Karman Inst. for Fluid Dyn. Shock-Boundary Layer Interaction in Turbomachines, Vol. 2 1980 181 p refs
(Contracts NAS3-22117; NAS1-15810; AGARD-OTAN-DPP-80-11007)
Avail: NTIS HC A14/MF A01 CSCL 20D

General methods for the construction of geometric computational fluid dynamic algorithms are presented which simulate a variety of flow fields in various nontrivial regions. Included are: basic developments with tensors; various forms for the equations of motion; generalized numerical methods and boundary conditions; and methods for mesh generation to meet the strong geometric constraints of turbomachines. Coordinate generation is shown generally to yield mesh descriptions from one or more transformations that are smoothly joined together to form a composite mesh. Author (ESA)

N81-18352 Alabama Univ., University.
PREDICTION OF PARTICLE PATHS FOR FLOW OF A GAS/SOLIDS SUSPENSION THROUGH A CASCADE OF FLAT PLATES Ph.D. Thesis
Leslie Crosby Hamer, Jr. 1980 239 p
Avail: Univ. Microfilms Order No. 8104072

The removal of particulate matter from gas/solids suspensions by the Louver separator was studied with emphasis on the importance of particle impingement on the elements of the separator. The governing equations for the flow field of the carrier gas were the continuity equation and the momentum equation. The flow field was assumed to be: (1) steady; (2) two dimensional; (3) irrotational; (4) incompressible. These assumptions assure the existence of a velocity potential and stream function which define the complex potential for the flow field, and which must satisfy the Cauchy-Riemann equations. The complex potential developed for the separator flow field was shown to satisfy the foregoing assumptions. Additionally, to ensure that the assumption of streamline flow was valid about the louver elements, the coefficient of lift for each case presented was less than that necessary to assure that flow separation does not occur. To determine the equations for the particle velocity and position within the flow field, Newton's second law of motion was utilized. Dissert. Abstr.

N81-18359# Washington Univ., Seattle.
RECENT IMPROVEMENTS ON GENERATING VOLTMETERS
H. Fauska 1980 4 p refs Presented at Symp. of Northeastern Accelerator Personnel, Madison, Wis., 13 Oct. 1980
(Contract DE-AC06-76ER-01388)
(DOE/ER-01388/463) Avail: NTIS HC A02/MF A01

Design improvements in the method of readout are discussed. The shape of rotor and stator for the generating voltmeter is described. DOE

N81-18374# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Thermomechanics Branch.
EXPERIMENTS WITH A SUPERSONIC MULTI-CHANNEL RADIAL DIFFUSER Final Report
Siegfried H. Hasinger Sep. 1980 48 p refs
(AF Proj. 2307)
(AD-A094192; AFWAL-TR-80-3029) Avail: NTIS HC A03/MF A01 CSCL 20/5

A supersonic radial flow diffuser of the type to be used for high energy radial flow lasers was investigated in cold flow experiments. The diffuser consisted of a multitude of small channels and it was the main purpose of the investigations to optimize the geometry of these channels. The nominal inlet Mach number of the diffuser was 3.5 and its axial length to diameter ratio referred to the inlet was 0.5. The maximum pressure recovery rate obtained with this diffuser was 80% of normal shock recovery. Selected channels tested individually reached a recovery rate of over 100%. Failure of the diffuser as a whole to reach this performance must be attributed to flow instabilities triggered by flow irregularities inherent to the present radial flow system. GRA

N81-18394# Shaker Research Corp., Ballston Lake, N. Y.
ROTOR-BEARING DYNAMICS TECHNOLOGY DESIGN GUIDE. PART 6: STATUS OF GAS BEARING TECHNOLOGY APPLICABLE TO AERO PROPULSION MACHINERY Interim Report, Jan. - May 1980
Coda H. T. Pan Wright-Patterson AFB, Ohio AFAPL Oct. 1980 107 p refs
(Contract F33615-76-C-2038; AF Proj. 3048)
(AD-A094167; SRC-80-TR-57-Pt-6; AFAPL-TR-78-6-Pt-6) Avail: NTIS HC A06/MF A01 CSCL 13/9

This report reviews gas lubrication technology as applicable to the support of aero propulsion equipment. It contains a historical sketch of the evolution of the field, a review of relevant fundamentals, a discussion of the whirl stability phenomena, the design of thrust bearings for turbomachines, a brief report on the current state of materials development, and a general review of gas lubricated compliant bearings. GRA

N81-18403 Shock and Vibration Information Center (Defense), Washington, D. C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION DIGEST, VOLUME 12, NUMBER 11
Judith Nagle-Eshleman, ed. Nov. 1980 83 p refs
(AD-A092384) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375; $15.00/set CSCL 20/1

Vibration and structural dynamics problems related to turbine rotors are addressed. Considerations significant to accurate analyses of blade vibrations are discussed. For individual titles, see N81-18404 through N81-18405.

N81-18404* Ohio State Univ., Columbus. Dept. of Engineering Mechanics.
VIBRATIONS OF TURBINE ENGINE BLADES BY SHELL ANALYSIS
In Shock and Vibration Information Center The Shock and Vibration Digest, V. 12, No. 11 Nov. 1980 p 3-10 refs

(Grant NAG3-36)
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375; $15.00/set CSCL 20/11

Several aspects are discussed which are pertinent to accurate analyses of blade vibration when the blades are modeled as shells. Two dimensional methods of analysis are developed and the characteristics of such analyses are summarized. R.C.T.

N81-18405 Akron Univ., Ohio. Dept. of Mechanical Engineering.
NONLINEAR ROTOR DYNAMICS ANALYSIS Final Report
M. L. Adams *In* Shock and Vibration Information Center The Shock and Vibration Digest, V. 12, No. 11 Nov. 1980 p 13-18 refs
Avail: NTIS Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20325; $15.00/set CSCL 20/11

A state of the art review is given of nonlinear rotor dynamics. Computerized simulation techniques are described which are shown to be computationally efficient. These techniques simulate transient and steady state system responses of complex multilinear effects. This computational capability is shown to be of great value in answering the increasing number of failure mode analysis questions. R.C.T.

N81-18410*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTURAL TESTS ON SPACE SHUTTLE THERMAL PROTECTION SYSTEM CONSTRUCTED WITH NONDENSIFIED AND DENSIFIED LI 900 AND LI 2200 TILE
Jerry G. Williams Jan. 1981 45 p ref
(NASA-TM-81903) Avail: NTIS HC A03/MF A01 CSCL 20K

Structural tests were conducted on thermal protection systems (TPS) LI 900 and LI 2200 tiles and .41 cm and .23 cm thick strain isolation pads. The bond surface of selected tiles was densified to obtain improved strength. Four basic types of experiments were conducted including tension tests, substrate mismatch (initial imperfection) tests, tension loads eccentrically applied, and pressure loads applied rapidly to the tile top surface. A small initial imperfection mismatch (2.29 m spherical radius on the substrate) did not influence significantly the ultimate failure strength. Densification of the tile bond region improved the strength of TPS constructed both of LI 900 tile and of LI 2200 tile. Pressure shock conditions studied did not significantly affect the TPS strength. R.C.T.

N81-18412*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A CRACK-CLOSURE MODEL FOR PREDICTING FATIGUE-CRACK GROWTH UNDER AIRCRAFT SPECTRUM LOADING
J. C. Newman, Jr. Jan. 1981 63 p refs
(NASA-TM-81941) Avail: NTIS HC A04/MF A01 CSCL 20K

The development and application of an analytical model of cycle crack growth is presented that includes the effects of crack closure. The model was used to correlate crack growth rates under constant amplitude loading and to predict crack growth under aircraft spectrum loading on 2219-T851 aluminum alloy sheet material. The predicted crack growth lives agreed well with experimental data. The ratio of predicted to experimental lives ranged from 0.66 to 1.48. These predictions were made using data from an ASTM E24.06.01 Round Robin. R.C.T.

N81-18419# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
INVESTIGATION OF EMAT BASE SYSTEM FOR THE DETECTION OF BOLT HOLE TYPE CRACKS. PART 1: DETECTION OF CRACKS IN THE INACCESSIBLE LOWER HALF WING LAP JOINTS USING EMATS Interim Report, 1 Apr. - 31 Aug. 1978
C. V. Vasile, R. H. Houston, and R. B. Thompson Jul. 1980 66 p refs
(Contract F33615-74-C-5180; DARPA Order 2828; AF Proj. 7351)
(AD-A094349; SC595.44C5A; AFWAL-TR-80-4081-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 01/3

The detection of saw slots in an aircraft wing lap joint is demonstrated with EMATS (Electromagnetic acoustic transducers)

utilizing 250 KHz horizontal shear acoustic waves reflected from the fastener area. A real time Fourier transform signal processor was developed and used to gather experimental data and generate plots of power vs. frequency as well as the complex transform. A simple ultrasonics model is described which is capable of explaining many of the features of the experimental data. GRA

N81-18420# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

INVESTIGATION OF EMAT BASE SYSTEM FOR THE DETECTION OF BOLT HOLE TYPE CRACKS. PART 2: RELIABILITY EVALUATION AND SYSTEM DEFINITION FOR DETECTION OF CRACKS UNDER FASTENERS BY EMATS Interim Report, 12 Apr. - 16 Sep. 1979

J. F. Martin, P. J. Hodgetts, and R. B. Thompson Jul. 1980 105 p refs

(Contract F33615-74-C-5180; DARPA Order 2828; AF Proj. 7351)

(AD-A094350; SC595.65IR; AFWAL-TR-80-4081-Pt-2) Avail: NTIS HC A06/MF A01 CSCL 01/3

The detection of laboratory grown fatigue cracks in aircraft wing lap joint fastener holes is demonstrated with EMATs (electromagnetic acoustic transducers). Operating at a 200 kHz central frequency, the EMATs employ acoustic waves in reflection and transmission to measure the presence of both fatigue cracks and loose fasteners. A minicomputer-based data acquisition and analysis system acquires, gates, apodizes and Fourier transforms each received time waveform. The resulting spectra are then compared to the spectra of uncracked holes with tight fasteners to determine the presence of a crack or loose fastener. A method for distinguishing the difference between a crack and a loose fastener is demonstrated. A suggested design for a fieldable instrument capable of the same abilities is presented. GRA

N81-18698 Rensselaer Polytechnic Inst., Troy, N. Y.

MODEL REFERENCE ADAPTIVE CONTROL FOR MULTI-INPUT MULTI-OUTPUT SYSTEMS Ph.D. Thesis

Kenneth M. Sobel 1980 229 p

Avail: Univ. Microfilms Order No. 8103764

Three adaptive model reference control algorithms for linear multi-input, multi-output systems are developed. These algorithms do not require either satisfaction of the perfect model following conditions or explicit parameter identification. The first algorithm for continuous plants ensures asymptotic stability of the output error provided that the output stabilized plant transfer matrix is strictly positive real. The second algorithm guarantees a bounded error under less restrictive conditions. The third algorithm ensures a bounded error for discrete plants provided constraints analogous to the second algorithm are satisfied. Since the algorithms do not require either satisfaction of the perfect model following conditions for full state feedback, they are applicable to a larger class of systems than previous algorithms. The sufficient conditions required to ensure stability of the adaptive algorithms include the satisfaction of certain matrix inequality constraints. Methods are proposed for satisfying these constraints; both in the time domain and in the frequency domain. Dissert. Abstr.

N81-18733# Bunker-Ramo Corp., Westlake Village, Calif. Electronic Systems Div.

EVALUATION OF FACTORS UNIQUE TO MULTIFUNCTION CONTROLS/DISPLAYS DEVICES Final Report, 1 Mar. - 30 Nov. 1977

Gloria L. Calhoun, Emmett L. Herron, John M. Reising, and Robert P. Bateman Wright-Patterson AFB, Ohio AFWAL Nov. 1980 133 p refs

(Contract F33615-78-C-3614; AF Proj. 2049; AF Proj. 2403) (AD-A094227; AFWAL-TR-80-3131) Avail: NTIS HC A07/MF A01 CSCL 05/8

Aircraft which utilize computers will require the use of multifunction displays and keyboards (MFK). Eight arrangements of formats which present flight control, navigation, and status information were examined. All were found useable but arrangements in which attitude information was placed above navigation information and those utilizing electro-optical devices rather than conventional flight instruments were slightly better. Two types of MFK logic were also examined. MFK operation was more efficient with Tailored Logic (frequently used functions presented) than with Branching Logic (functions presented by systems). GRA

N81-18742*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PREDICTED AND EXPERIMENTAL STEADY AND UNSTEADY TRANSONIC FLOWS ABOUT A BICONVEX AIRFOIL

Lionel L. Levy, Jr. Feb. 1981 20 p refs

(NASA-TM-81262; A-8457) Avail: NTIS HC A02/MF A01 CSCL 20D

Results of computer code time dependent solutions of the two dimensional compressible Navier-Stokes equations and the results of independent experiments are compared to verify the Mach number range for instabilities in the transonic flow field about a 14 percent thick biconvex airfoil at an angle of attack of 0 deg and a Reynolds number of 7 million. The experiments were conducted in a transonic, slotted wall wind tunnel. The computer code included an algebraic eddy viscosity turbulence model developed for steady flows, and all computations were made using free flight boundary conditions. All of the features documented experimentally for both steady and unsteady flows were predicted qualitatively; even with the above simplifications, the predictions were, on the whole, in good quantitative agreement with experiment. In particular, predicted time histories of shock wave position, surface pressures, lift, and pitching moment were found to be in very good agreement with experiment for an unsteady flow. Depending upon the free stream Mach number for steady flows, the surface pressure downstream of the shock wave or the shock wave location was not well predicted. M.G.

N81-18798*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

FORWARD VELOCITY EFFECTS ON FAN NOISE AND THE SUPPRESSION CHARACTERISTICS OF ADVANCED INLETS AS MEASURED IN THE NASA AMES 40 BY 80 FOOT WIND TUNNEL: ACOUSTIC DATA REPORT Final Report

Michael T. Moore Jan. 1981 262 p refs

(Contract NAS2-8675)

(NASA-CR-152329) Avail: NTIS HC A12/MF A01 CSCL 20A

Forward velocity effects on the forward radiated fan noise and on the suppression characteristics of three advanced inlets relative to a baseline cylindrical inlet were measured in a wind tunnel. A modified JT15D turbofan engine in a quiet nacelle was the source of fan noise; the advanced inlets were a CTOL hybrid inlet, an STOL hybrid inlet, and a treated deflector inlet. Also measured were the static to flight effects on the baseline inlet noise and the effects on the fan noise of canting the baseline inlet 4 deg downward to simulate typical wing mounted turbofan engines. The 1/3 octave band noise data from these tests are given along with selected plots of 1/3 octave band spectra and directivity and full scale PNL directivities. The test facilities and data reduction techniques used are also described. M.G.

N81-18799*# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

ANALYTICAL PREDICTION OF THE INTERIOR NOISE FOR CYLINDRICAL MODELS OF AIRCRAFT FUSELAGES FOR PRESCRIBED EXTERIOR NOISE FIELDS. PHASE 1: DEVELOPMENT AND VALIDATION OF PRELIMINARY ANALYTICAL MODELS

L. D. Pope, D. C. Rennison, and E. G. Wilby Oct. 1980 225 p refs

(Contract NAS1-15782)

(NASA-CR-159363; BBN-4420) Avail: NTIS HC A10/MF A01 CSCL 20A

The basic theoretical work required to understand sound transmission into an enclosed space (that is, one closed by the transmitting structure) is developed for random pressure fields and for harmonic (tonal) excitation. The analysis is used to predict the noise reducton of unpressurized unstiffened cylinder, and also the interior response of the cylinder given a tonal (plane wave) excitation. Predictions and measurements are compared

and the transmission is analyzed. In addition, results for tonal (harmonic) mechanical excitation are considered. A.R.H.

N81-18808 California Univ., Los Angeles.
FLAP NOISE CHARACTERISTICS MEASURED BY PRESSURE CROSS CORRELATION TECHNIQUES Ph.D. Thesis
Wendell Roger Miller 1980 289 p
Avail: Univ. Microfilms Order No. 8104022

The aerodynamic sound generated by a realistic aircraft flap system was investigated through the use of cross correlations between surface pressure fluctuations and far field sound. Measurements were conducted in two subsonic wind tunnel studies to determine the strength, distribution, and directivity of the major sources of flap noise at speeds up to 79.0 m/sec. A pilot study was performed on a single flap model to test the measurement technique and provide initial data on the characteristics of flap noise. The major portion of this investigation studied the sound radiated by a realistic large scale model of a triple slotted flap system mounted on a sweptback 6.7 meter semispan model wing. The results of this investigation have identified the major sources of flap generated noise and their dependence of flow defining parameters. In addition, a possible avenue toward the reduction of flap generated noise has been identified via the placement of the flap actuator fairings on the flap system.
Dissert. Abstr.

N81-18853# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
POTENTIAL OF OPTICAL FOURIER ANALYSIS FOR MEASURING WINDSCREEN DISTORTION
Herschel C. Self Dec. 1980 34 p refs
(AF Proj. 7184)
(AD-A094127; AFAMRL-TR-80-104) Avail: NTIS HC A03/MF A01 CSCL 20/6

The potential of an optical Fourier technique for measuring the optical distortion of aircraft windscreens was examined. It was hypothesized that the compactness of the harmonics of the optical Fourier transforms of vertical and horizontal square wave targets photographed through windscreens would correlate highly with distortion in photographs of a gridboard. Eleven transparent optical distortion panels were used to produce gridboard pictures and vertical and horizontal transform pictures. Gridboard pictures were subjectively ranked by 23 observers for amount of optical distortion. Transform pictures were ranked for compactness of the third harmonic. All three picture sets were also measured by subjective magnitude estimation. Rank correlation between gridboard photograph distortion ranks and compactness ranks for the vertical Fourier transform was .950. Overall rankings of gridboard distortion photographs and compactness rankings was .977. Such high statistically significant correlations show that distortion judgements from gridboard photographs is accurately predictable from judged compactness of the third harmonic. Thus, the Fourier method may be useful for measuring optical distortion. Development of objective methods to measure the compactness and to calibrate such measures against conventional measurements is warranted. This development would lead to a rapid, accurate and objective method for measuring the optical distortion of aircraft windscreens. GRA

N81-18997*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WIND LOADS FOR BAR-TRUSS STRUCTURES
M. S. Katow *In its* The Telecommun. and Data Acquisition 15 Feb. 1981 p 149-153 refs

Avail: NTIS HC A09/MF A01 CSCL 20K

An analysis method developed to calculate the wind loads on the nodes or joints of the truss type support structure of the 64 meter antenna is described. The method uses the CBAR element and GRID coordinate cards of the NASTRAN or IDEAS structural analysis programs as inputs to the computer model of the structure. Cross flow principles and vector analysis are also used in the analysis. The algorithms used are described and probable accuracy of the solution is discussed. J.M.S.

N81-19001*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED AERODYNAMICS AND ACTIVE CONTROLS. SELECTED NASA RESEARCH
Feb. 1981 180 p refs Presented at the 4th Ann. Status Rev. of the NASA Aircraft Energy Efficiency (ACEE) Energy Efficient Transport Program, Mountain View, Calif. 7-9 Oct. 1980
(NASA-CP-2172; L-14278) Avail: NTIS HC A09/MF A01 CSCL 01B

Aerodynamic and active control concepts for application to commercial transport aircraft are discussed. Selected topics include in flight direct strike lightning research, triply redundant digital fly by wire control systems, tail configurations, winglets, and the drones for aerodynamic and structural testing (DAST) program. For individual titles, see N81-19002 through N81-19013.

N81-19002*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LANGLEY RESEARCH CENTER CONTRIBUTIONS IN ADVANCING ACTIVE CONTROL TECHNOLOGY
I. Abel and J. R. Newsom *In its* Advan. Aerodyn. and Active Controls Feb. 1981 p 1-19 refs

Avail: NTIS HC A09/MF A01 CSCL 01C

The application of active control technology to reduce aeroelastic response of aircraft structures offers a potential for significant payoffs in terms of aerodynamic efficiency and weight savings. *Some of the contributions of the Langley Research Center* in advancing active control technology are described. Contributions are categorized into the development of appropriate analysis tools, control law synthesis methodology, and experimental investigations aimed at verifying both analysis and synthesis methodology. E.D.K.

N81-19003*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATUS AND FUTURE PLANS OF THE DRONES FOR AERODYNAMIC AND STRUCTURAL TESTING (DAST) PROGRAM
Harold N. Murrow *In its* Advan. Aerodyn. and Active Controls Feb. 1981 p 21-36

Avail: NTIS HC A09/MF A01 CSCL 01C

Results from flight tests of the ARW-1 research wing are presented. Preliminary loads data and experiences with the active control system for flutter suppression are included along with comparative results of test and prediction for the flutter boundary of the supercritical research wing and on performance of the flutter suppression system. The status of the ARW-2 research wing is given. E.D.K.

N81-19005*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IN FLIGHT DIRECT STRIKE LIGHTNING RESEARCH
Felix L. Pitts *In its* Advan. Aerodyn. and Active Controls Feb. 1981 p 43-65 refs

Avail: NTIS HC A09/MF A01 CSCL 01C

The lightning generated electromagnetic environment effecting aircraft is studied. The program uses F-106B aircraft which operates in a thunderstorm environment and is specially instrumented for the lightning electromagnetic measurements. The instrumentation system is reviewed and typical results recorded by the research instrumentation during simulated lightning ground tests performed for a safety survey are presented along with several examples of direct strike data obtained during the summer of 1980. E.D.K.

N81-19006*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
GROUND AND FLIGHT TEST EXPERIENCE WITH A TRIPLE REDUNDANT DIGITAL FLY BY WIRE CONTROL SYSTEM

Calvin R. Jarvis and Kenneth J. Szalai *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb.

1981 p 67-84
Avail: NTIS HC A09/MF A01 CSCL 01C

A triplex digital fly by wire flight control system was developed and installed in an F-8C aircraft to provide fail operative, full authority control. Hardware and software redundancy management techniques were designed to detect and identify failures in the system. Control functions typical of those projected for future actively controlled vehicles were implemented. E.D.K.

N81-19007*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SMALL TRANSPORT AIRCRAFT TECHNOLOGY
Thomas L. Galloway *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 85-104 refs

Avail: NTIS HC A09/MF A01 CSCL 01C

The results of contracted studies identifying the potential benefits of advanced technology are presented. Current in house studies and research efforts are discussed. An overview of the proposed technology elements in STAT research is presented. E.D.K.

N81-19008*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INVESTIGATION OF POWERED NACELLES ON A HIGH ASPECT RATIO NASA SUPERCRITICAL WING, PHASE 2 Status Report
Stuart G. Flechner, James C. Patterson, Jr., and Paul G. Fournier *In its* Advan. Aerodyn. and Active Controls Feb. 1981 p 105-122

Avail: NTIS HC A09/MF A01 CSCL 01C

A modified wing with the long core separate flow nacelle and several E(3) nacelles was utilized. The effects of nacelle and pylon cant angles and nacelle longitudinal and vertical location were investigated over a Mach number range from 0.70 to 0.83. The results at the cruise condition 0.82 Mach number and 0.55 lift coefficient are presented. E.D.K.

N81-19009*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EET HORIZONTAL TAILS INVESTIGATION AND THE EET LATERAL CONTROLS INVESTIGATION Status Report

Peter F. Jacobs and Dennis W. Bartlett *In its* Advan. Aerodyn. and Active Controls Feb. 1981 p 123-133

Avail: NTIS HC A09/MF A01 CSCL 01C

In the energy efficient transport (EET) Horizontal Tails Investigation, aerodynamic data were measured for five different horizontal tails on a full span model with a wide body fuselage. Three of the horizontal tails were low tail configurations and two were T tail configurations. All tails were tested in conjunction with two wings, a current wide body wing and a high aspect ratio supercritical wing. Local downwash angles and dynamic pressures in the vicinity of the tails were measured using a yaw head rake. The results provide a comparison of the aerodynamic characteristics of the two wing configurations at trimmed conditions for Mach numbers between 0.60 and 0.90. In the EET Lateral Controls Investigation, the control effectiveness of a conventional set of lateral controls was measured over a Mach number range from 0.60 to 0.90 on a high aspect ratio supercritical wing semispan model. The conventional controls included a high speed aileron, a low speed aileron, and six spoiler segments. The wing was designed so that the last 25% of the chord is removable to facilitate testing of various control systems. The current status and an indication of the data obtained in these investigations are presented. E.D.K.

N81-19010*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
NATURAL LAMINAR FLOW FLIGHT EXPERIMENT
Louis L. Steers *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 135-144

Avail: NTIS HC A09/MF A01 CSCL 01A

A supercritical airfoil section was designed with favorable pressure gradients on both the upper and lower surfaces. Wind tunnel tests were conducted in the Langley 8 Foot Transonic Pressure Tunnel. The outer wing panels of the F-111 TACT airplane were modified to incorporate partial span test gloves having the natural laminar flow profile. Instrumentation was installed to provide surface pressure data as well as to determine transition location and boundary layer characteristics. The flight experiment encompassed 19 flights conducted with and without transition fixed at several locations for wing leading edge sweep angles which varied from 10 to 26 at Mach numbers from 0.80 to 0.85 and altitudes of 7620 meters and 9144 meters. Preliminary results indicate that a large portion of the test chord experienced laminar flow. E.D.K.

N81-19011*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
KC-135 WINGLET FLIGHT RESULTS
Lawrence C. Montoya *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 145-156

Avail: NTIS HC A09/MF A01 CSCL 01C

Three KC-135 winglet configurations were flight tested for cant/incidence angles of 15 deg/-4 deg, 15 deg/-2 deg, and 0 deg/-4 deg, as well as the basic wing. The flight results for the 15 deg/-4 deg and basic wing configurations confirm the wind tunnel predicted 7% incremental decrease in total drag at cruise conditions. The 15 deg/-4 configuration flight measured wing and winglet pressure distributions, loads, stability and control, flutter, and buffet also correlate well with predicted values. The only unexpected flight results as compared with analytical predictions is a flutter speed decrease for the 0 deg/-4 deg configuration. The 15 deg/-2 deg configuration results show essentially the same incremental drag reduction as the 15 deg/-4 deg configuration; however, the flight loads are approximately 30% higher for the 15 deg/-2 deg configuration. The drag data for the 0 deg/-4 deg configuration show only a flight drag reduction. E.D.K.

N81-19012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OVERVIEW OF ADVANCED WING DESIGN
Raymond M. Hicks *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 157-169 ref

Avail: NTIS HC A09/MF A01 CSCL 01C

Examples of experiment theory correlation are presented to give an indication of the capabilities and limitations of wing design and analysis for transonic applications by potential flow theory. The examples include correlations of experimental pressure distributions with theoretical results from isolated wing codes and wing-body codes. Both conservative and non conservative differencing as well as body and boundary layer corrections are considered. A full potential isolated wing code correlates well with data from an isolated wing test but may give poor prediction of the aerodynamic characteristics of some wing-body configurations. Potential flow wing body codes were found to improve the correlation for the wing-body configurations considered. E.D.K.

N81-19013*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ADVANCED TURBOPROP INSTALLATION AERODYNAMICS
R. C. Smith *In* NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 171-181 refs

Avail: NTIS HC A09/MF A01 CSCL 21E

The expected aerodynamic effects of a propfan installed on a thick supercritical wing are summarized qualitatively. Nacelle/wing and jet interactions, slipstream incremental velocity, nonuniform inflow, and swirl loss recovery are discussed. E.D.K.

N81-19014*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT INVESTIGATION OF A FOUR-DIMENSIONAL TERMINAL AREA GUIDANCE SYSTEM FOR STOL AIRCRAFT

Frank Neuman and Gordon Hardy Mar. 1981 43 p refs
(NASA-TM-81271; A-8491) Avail: NTIS HC A03/MF A01 CSCL 17G

A series of flight tests and fast-time simulations were conducted, using the augmentor wing jet STOL research aircraft and the STOLAND 4D-RNAV system to add to the growing data base of 4D-RNAV system performance capabilities. To obtain statistically meaningful data a limited amount of flight data were supplemented by a statistically significant amount of data obtained from fast-time simulation. The results of these tests are reported. Included are comparisons of the 4D-RNAV estimated winds with actual winds encountered in flight, as well as data on along-track navigation and guidance errors, and time-of-arrival errors at the final approach waypoint. In addition, a slight improvement of the STOLAND 4D-RNAV system is proposed and demonstrated, using the fast-time simulation. T.M.

N81-19015# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

APPLICATION OF SCHEDULING HEURISTICS ON THE AIRCRAFT MAINTENANCE DEPOT M.S. Thesis

Joseph William Adams, Jr. Dec. 1980 54 p refs
(AD-A094815; AFIT/GOR/OS/80D-1) Avail: NTIS HC A04/MF A01 CSCL 12/2

Scheduling heuristics were applied to a model of the aircraft maintenence depot at Warner Robins Air Logistics Center. Since the C-141 aircraft was being overloaded into depot, heuristics which gave the C-141 priority were tested in an effort to reduce the mean and variance of the distribution of times the C-141 aircraft spent at the depot. One heuristic was found which reduced the average depot time by 4%. The significafice of this decrease was calculated to be 91%. A similar heuristic reduced the variance by 81%, with a significance of 100%. Thus, the potential exists for improving the flow of the overloaded C-141 aircraft through the depot, using scheduling heuristics. GRA

N81-19016*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LEADING EDGE VORTEX FLAPS FOR DRAG REDUCTION Patent Application

Dhanvada M. Rao, inventor (to NASA) (Old Dominion Univ.) Filed 26 Nov. 1980 12 p Sponsored by NASA
(NASA-Case-LAR-12750-1; US-Patent-Appl-SN-210491) Avail: NTIS HC A02/MF A01 CSCL 01A

A leading edge flap system to control the coiled vortex formation on highly swept slender wings designed for supersonic flight is disclosed. The vortex flap is positioned forward of, and at an angle downward from, the leading edge of the wings. It is retracted beneath the wings during supersonic flight. Flow separation occurs on the highly deflected vortex flap creating a coiled vortex on the vortex flap surface. The suction of the coiled vortex produces an aerodynamic thrust component. The pitch up and lateral stability problem associated with coiled vortex formation on the wing surface are reduced. Segmented flaps with independent adjustment allow optimum flow conditions to be closely approximated. NASA

N81-19017*# McDonnell Aircraft Co., St. Louis, Mo. Aerodynamics Dept.

INVESTIGATION OF IMPINGEMENT REGION AND WALL JETS FORMED BY THE INTERACTION OF HIGH ASPECT RATIO LIFT JETS AND A GROUND PLANE Final Report, 19 Sep. 1977 - 19 Sep. 1978

Donald R. Kotansky and Lloyd W. Glaze 19 Sep. 1978 93 p refs
(Contract NAS2-9646)
(NASA-CR-152174) Avail: NTIS HC A05/MF A01 CSCL 01A

Flow characteristics of impinging jets emanating from rectangular exit area converging nozzles of exit area aspect ratio four, six, and eight were investigated. Azimuthal distributions of wall jet radial momentum flux in the ground plane were strongly directional and sensitive to rectangular nozzle exit area aspect ratio, jet impingement angle, and height above ground, H/D. Effects of jet exit velocity profile nonuniformities were also investigated. Data from the single nozzle rectangular jet impringement investigations were incorporated into an existing VTOL aircraft ground flow field computer program. It is suggested that this program together with the Douglas Neumann program modified for V/STOL applications may be used for the analysis and prediction of flow fields and resulting forces and moments on multijet V/STOL aircraft hovering in ground effect. E.A.K.

N81-19018*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

THEORETICAL ANALYSIS OF AN AUGMENTOR WING FOR A VTOL FIGHTER Final Report, May 1977 - Dec. 1978

Marnix F. E. Dillenius and Michael R. Mendenhall May 1979 53 p refs Sponsored in part by Navy
(Contract NAS2-9605)
(NASA-CR-152254; NEAR-TR-183) Avail: NTIS HC A04/MF A01 CSCL 01A

A method based on potential flow theory was developed for predicting forces and moments acting on augmentor wings for prescribed ejector jet characteristics. A three dimensional nonplanar vortex lattice is laid out on the chordal planes of the augmentor wing components. Jet induced effects are included in the boundary condition from which the horseshoe vortex strengths are obtained. The jet within the diffusor is made to expand from the primary nozzles to the diffusor exit and is represented by a distribution of vorticity on the jet boundary to provide proper entrainment. The jet downstream of the diffusor exit is modeled by a vorticity distribution and blockage panels and its centerline location and spreading rate are taken from experimental data. The vortex lattice and jet models are used in an iterative manner until the predicted diffusor exit velocity matches the specified one. Some comparisons with available data show good agreement at lower power settings. Author

N81-19019*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

AEROPROPULSIVE CHARACTERISTICS OF TWIN NONAXISYMMETRIC VECTORING NOZZLES INSTALLED WITH FORWARD-SWEPT AND AFT-SWEPT WINGS

Francis J. Capone Mar. 1981 260 p
(NASA-TP-1778; L-13902) Avail: NTIS HC A12/MF A01 CSCL 01A

An investigation was conducted in the Langley 16 Foot Transonic Tunnel to determine the aeropropulsive characteristics of a single expansion ramp nozzle (SERN) and a two dimensional convergent divergent nozzle (2-D C-D) installed with both an aft swept and a forward swept wing. The SERN was tested in both an upright and an inverted position. The effects of thrust vectoring at nozzle vector angles from -5 deg to 20 deg were studied. This investigation was conducted at Mach numbers from 0.40 to 1.20 and angles of attack from -2.0 deg to 16 deg. Nozzle pressure ratio was varied from 1.0 (jet off) to about 9.0. Reynolds number based on the wing mean geometric chord varied from about 3 million to 4.8 million, depending upon free stream number. E.D.K.

N81-19020*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

UNSTEADY TRANSONIC SMALL DISTURBANCE THEORY WITH STRONG SHOCK WAVES

G. David Kerlick, David Nixon, and William F. Ballhaus, Jr. Sep. 1980 22 p refs
(NASA Order A-70215-B; NASA Order A-77455-B)
(NASA-CR-166157; NEAR-TR-230) Avail: NTIS HC A02/MF A01 CSCL 01A

A theory to correct the transonic small disturbance (TSD) equation to treat strong shock waves in unsteady flow is developed. The technique involves the addition of higher order terms, which are formally of negligible magnitude, to the low frequency TSD equation. These terms are then chosen such that any shock waves in the flow have strengths approximately equal to the appropriate Rankine-Hugoniot shock strength. Two correcting

approaches are investigated. The first is to derive a correction for the mean steady flow and then simply use this corrected form for oscillatory flows. The second is to derive a correction for both steady and oscillatory parts of the flow. This second development is the most satisfactory and comparisons of the present results with Euler equation results are generally favorable, particularly regarding shock location, although there are some discrepancies in the pressure distribution in the leading edge region. M.G.

N81-19021*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
A THEORETICAL INVESTIGATION OF GROUND EFFECTS ON USB CONFIGURATIONS
C. Edward Lan Jan. 1979 134 p refs
(Grant NsG-1139)
(NASA-CR-159005; CRINC-FRL-281-3) Avail: NTIS HC A07/MF A01 CSCL 01A

A formulation predicts the variation of circulation forces and jet reaction forces in ground proximity as a function of ground height. The predicted results agree well with available experimental data. It is shown that the wing-alone theory is not capable of predicting the ground effect for USB configurations. T.M.

N81-19022*# Boeing Commercial Airplane Co., Seattle, Wash.
A HIGHER ORDER PANEL METHOD FOR LINEARIZED SUPERSONIC FLOW
F. Edward Ehlers, Michael A. Epton, Forrester T. Johnson, Alfred E. Magnus, and Paul E. Rubbert May 1979 268 p refs
(Contract NAS2-7729)
(NASA-CR-3062; D6-48058) Avail: NTIS HC A12/MF A01 CSCL 01A

The basic integral equations of linearized supersonic theory for an advanced supersonic panel method are derived. Methods using only linear varying source strength over each panel or only quadratic doublet strength over each panel gave good agreement with analytic solutions over cones and zero thickness cambered wings. For three dimensional bodies and wings of general shape, combined source and doublet panels with interior boundary conditions to eliminate the internal perturbations lead to a stable method providing good agreement experiment. A panel system with all edges contiguous resulted from dividing the basic four point non-planar panel into eight trangular subpanels, and the doublet strength was made continuous at all edges by a quadratic distribution over each subpanel. Superinclined panels were developed and tested on s simple nacelle and on an airplane model having engine inlets, with excellent results. Author

N81-19023*# Wichita State Univ., Kans.
PRESSURE DISTRIBUTIONS FOR THE GA(W)-2 AIRFOIL WITH 20% AILERON, 25% SLOTTED FLAP AND 30% FOWLER FLAP
W. H. Wentz, Jr. and K. A. Fiscko Feb. 1978 86 p refs
(Grant NsG-1165)
(NASA-CR-2948; AR-76-3) Avail: NTIS HC A05/MF A01 CSCL 01A

Surface pressure distributions were measured for the 13% thick GA(W)-2 airfoil section fitted with 20% aileron, 25% slotted flap and 30% Fowler flap. All tests were conducted at a Reynolds number of 2.2 x 10 to the 6th power and a Mach number of 0.13. Pressure distribution and force and moment coefficient measurements are compared with theoretical results for a number of cases. Agreement between theory and experiment is generally good for low angles of attack and small flap deflections. For high angles and large flap deflections where regions of separation are present, the theory is inadequate. Theoretical drag predictions are poor for all flap-extended cases. Author

N81-19024*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF WING-TRANSITION LOCATION AND SLOTTED AND UNSLOTTED FLAPS ON AERODYNAMIC CHARACTERISTICS OF A FIGHTER MODEL AT HIGH SUBSONIC SPEEDS
Theodore G. Ayers Sep. 1969 46 p refs
(NASA-TM-X-1849; L-6613) Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation was conducted in the Langley 8 foot transonic pressure tunnel to determine the effects of wing transition location and of slotted and unslotted full span flaps on the longitudinal aerodynamic characteristics of a 1/15 scale model of a variable wing sweep tactical fighter model. Tests were at Mach numbers from 0.70 to 0.85 for a wing leading edge sweep of 26 deg. T.M.

N81-19025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL INVESTIGATION AT MACH NUMBERS FROM 0.26 TO 1.01 OF A TRANSPORT CONFIGURATION DESIGNED TO CRUISE AT NEAR-SONIC SPEEDS
Richard A. Langhans and Stuart G. Flechner Aug. 1972 103 p refs
(NASA-TM-X-2622; L-8226) Avail: NTIS HC A06/MF A01 CSCL 01A

The results of the investigation showed that the configuration exhibits a sufficiently high drag divergence Mach number to cruise at near sonic speeds. The configuration is longitudinally stable through the cruise Mach number and lift coefficient range, but at higher lift coefficients displays pitchup and becomes unstable. The configuration was directionally stable at all test conditions and laterally stable in the angle of attack range required for cruise. T.M.

N81-19026*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE VORTEX CONDITIONS OF WINGS WITH LARGE SWEEPBACK BY EXTRAPOLATION OF THE JONES METHOD
P. Hirsch Dec. 1980 24 p Transl. into ENGLISH from "Essai d'etude du regime tourbillonnaire des ailes de forte fleche par extrapolation de la methode de Jones", Lille, Paper NT80-25, 1979 22 p Presented at the 16th Symp. of Appl. Aerodynamics, Lille, France, 13-15 Nov. 1979 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-75863) Avail: NTIS HC A02/MF A01 CSCL 01A

The pockets of separation originating on the leading edges are surrounded by vortex sheets. Their configuration and intensity were determined by four conditions with the JONES approximation, which is itself corrected by a simple logic. Field pressures and stresses were computed for different cases and are compared with test results (pure deltas, swallow tails, truncations, strakes, ducks, fuselage). T.M.

N81-19027*# National Aeronautics and Space Administration, Washington, D. C.
SEPARATION BEHAVIOR OF BOUNDARY LAYERS ON THREE-DIMENSIONAL WINGS
H. W. Stock Feb. 1981 76 p refs Transl. into ENGLISH of "Ablaeseverhalten von Grenzschichten an Dreidemensionalen Fluegeln" Final Rept. 79/71B Friedrichshafen, West Germany, Oct. 1979 86 p Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Dornier-Werke G.m.b.H., Friedrichshafen, West Germany
(Contract NASw-3199)
(NASA-TM-75877) Avail: NTIS HC A05/MF A01 CSCL 01A

An inverse boundary layer procedure for calculating separated, turbulent boundary layers at infinitely long, crabbing wing was developed. The procedure was developed for calculating three dimensional, incompressible turbulent boundary layers was expanded to adiabatic, compressible flows. Example calculations with transsonic wings were made including viscose effects. In this case an approximated calculation method described for areas of separated, turbulent boundary layers, permitting calculation of this displacement thickness. The laminar boundary layer development was calculated with inclined ellipsoids. R.C.T.

N81-19029# Aeronautical Research Labs., Melbourne (Australia).
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF TRAILING-EDGE STRIPS ON THE UNSTEADY AERODYNAMIC FORCES ON TABS
G. Long and P. A. Farrell Mar. 1980 37 p refs
(AD-A084989; ARL/STRUC/NOTE-459; AR-001-808) Avail: NTIS HC A03/MF A01 CSCL 01/3

A fairly common problem on new aircraft is that of achieving good control surface effectiveness. Often boundary layer thickness and interference from other surfaces may cause flow separation on all or part of the control. This reduces control efficiency and can cause serious problems in achieving good control of aircraft response. These types of problems are difficult to predict analytically or from wind-tunnel tests. Usually the first evidence of such difficulties occurs during prototype flying and consequently serious efforts must be made to find a 'fix' which can be introduced fairly simply and cheaply at a late stage in the design. These 'fixes' often involve vortex generators, placed on or ahead of the control, or thickening of the trailing edge of the control. The latter may be simply achieved by attaching a small angle to one or both sides to the control along the trailing edge. The aim of these and other methods is to improve the effectiveness of the control and hopefully to increase this to its theoretical or design value. While the effect of such modifications is fairly well known for steady flow, little evidence is available of the effect in unsteady flow. There are no theoretical methods of predicting unsteady aerodynamic forces on oscillating control surfaces which have vortex generators or trailing-edge angles. Usually complete reliance is based on classical thin lifting surface theories for predicting flutter speeds and frequencies. The work described was undertaken as a result of an accident to the Nomad aircraft in which flutter occurred as a result of fitting trailing-edge strips to the tailplane tabs. GRA

N81-19030# Air Force Academy, Colo. Dept. of Aeronautics.
MEASUREMENT OF CANARD WAKES Final Report, 1 Oct. 1979 - 30 Sep. 1980
G. Sisson, R. Crandall, and R. W. Gallington 2 Feb. 1981 52 p refs
(AD-A095063; USAFA-TN-81-1; USAFA-TR-80-17) Avail: NTIS HC A04/MF A01 CSCL 20/4

This technical note consists of two separate papers. The first covers the manufacture and calibration of miniature seven hole probes. The second paper covers the flow field data collection and presentation. Together, the two papers describe the entire process developed to quickly and economically measure the flow field properties in canard model wakes. The first paper describes a method for measuring local direction and total and static pressures of a flow by means of a fixed probe, provided that the local air flow does not make an angle of more than 80 degrees with the axis of the probe. Rapid surveys of the wakes formed behind variously-configured lifting body models during wind tunnel testing require such a probe. The probe is easily manufactured from standard-sized tubing materials. The power series calibration method used with the probe results in explicit polynomial expressions for the desired aerodynamic properties. The calibration method is easily programmed on a data acquisition system. This paper includes an example of a complete incompressible calibration and discusses a logical method for extending the calibration technique to compressible flows. GRA

N81-19030# Nielsen Engineering and Research, Inc., Mountain View, Calif.
EXPERIMENTAL AND THEORETICAL STUDY OF FLOW FIELDS AND STORE FORCES IN CLOSE PROXIMITY TO A TRIPLE EJECTION RACK AT TRANSONIC SPEEDS Final Report, Jun. 1979 - Jun. 1980
Frederick K. Goodwin and Jack N. Nielsen China Lake, Calif. Naval Weapons Center Sep. 1980 248 p refs
(Contract N60530-79-C-0169; ZF32300000)
(AD-A094751; AD-E900055; NEAR-TR-222; NWC-TP-6210) Avail: NTIS HC A07/MF A01 CSCL 01/1

Systematic data were taken in an airplane build-up sequence including additions of the wing pylon, rack, one shoulder store and two shoulder stores from M infinity equals 0.6 to 0.95. Strong interference effects were found within less than one store diameter of the rack which greatly affected the values of the attached loads. Systematic comparisons were made between experimental and the predictions of a store separation computer program for induced flow fields and store loads due to addition of the pylon, rack, and shoulder stores. For the effects of the rack and shoulder stores improvements are required in the computer program to obtain better load predictions for the store near the attached position. Specific suggestions on how to effect these improvements are made. GRA

N81-19031# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CALCULATION OF AIRLOADS FOR A FLEXIBLE WING VIA NASTRAN M.S. Thesis
Lance Eliot Chrisinger Dec. 1980 78 p refs
(AD-A094770; AFIT/GAE/AA/80D-2) Avail: NTIS HC A05/MF A01 CSCL 20/4

This thesis describes the use of the NASTRAN program (Level 17.0) in the calculation of flexible wing airloads and stresses. The problems of interfacing aerodynamic and structural models are discussed with assumptions needed to solve them. Two different methods of transferring the aerodynamic forces into a structural load vector are presented. A Direct Matrix Abstraction Program was developed for use in these calculations. This sequence is limited to the use of one doublet-lattice panel for the aerodynamic model and requires several new data blocks for execution. Although these data blocks were input with the bulk data deck to test the sequence, a new preliminary module has been constructed to build them internally. The results of this investigation show that NASTRAN can be used in calculating the airloads and stresses for a flexible wing. This new sequence has extended the capability of NASTRAN to allow for the application of internally generated steady airloads to the structural model. GRA

N81-19032# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A HIGHER-ORDER TRAPEZOIDAL VECTOR VORTEX PANEL FOR SUBSONIC FLOW M.S. Thesis
Ronald E. Luther Dec. 1980 95 p refs
(AD-A094775; AFIT/GAE/AA/80D-14) Avail: NTIS HC A05/MF A01 CSCL 20/4

A higher-order trapezoidal vector vortex panel method is developed for application to linearized subsonic potential flow. Each panel is subdivided into two triangular subregions on which a quadratic vorticity strength distribution is prescribed for both the spanwise and chordwise components of the vorticity vector. The vorticity strength distribution is expressed as a function of the components of the vorticity vector at selected nodes of the boundary of each triangular subregion. Nodal values on the shared boundary of the subregions are made equal, assuring continuity of the vorticity distribution function throughout the trapezoidal panel. A lifting surface of no thickness is modeled with a network of the trapezoidal panels. Again, nodal values on the common panel boundaries are matched to achieve complete continuity of the vorticity distribution throughout the lifting surface. Aerodynamic data for several wing planforms is obtained with the flow model. Results from this method are compared to those from other computational and theoretical methods. GRA

N81-19033# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INTERACTIVE COMPUTATIONAL AERODYNAMICS ANALYSIS PROGRAM M.S. Thesis
Enrique G. Hernandez Dec. 1980 248 p refs
(AD-A094765; AFIT/GAE/AA/80D-9) Avail: NTIS HC A11/MF A01 CSCL 01/1

This report details how existing aerodynamic analysis programs were combined and integrated into a fully interactive analysis program. The resulting program has several levels of user assistance, complete error protection, and protection against fatal terminations. The program was built around an aerodynamics analysis code which is capable of predicting the real fluid sectional characteristics of airfoils in flows with subcritical Mach numbers.

In addition to the viscous flow solution, the program is also capable of several airfoil modification functions. The program was developed as the basic building block upon which several other aerodynamics analysis codes will be added in the future. GRA

N81-19035*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 1980 AIRCRAFT SAFETY AND OPERATING PROBLEMS, PART 1
Joseph W. Stickle, comp. Mar. 1981 380 p refs Conf. held in Hampton, Va., 5-7 Nov. 1980 2 Vol.
(NASA-CP-2170-Pt-1; L-14254) Avail: NTIS HC A17/MF A01 CSCL 01C

It is difficult to categorize aircraft operating problems, human factors and safety. Much of NASA's research involves all three and considers the important inter-relationships between man, the machine and the environment, whether the environment be man-made or natural. Topics covered in 20 papers include terminal-area operations; avionics and human factors; and the atmospheric environment.

N81-19036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TEST RESULTS OF FLIGHT GUIDANCE FOR FUEL CONSERVATIVE DESCENTS IN A TIME-BASED METERED AIR TRAFFIC ENVIRONMENT
Charles E. Knox and Lee H. Person, Jr. *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 7-27 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The NASA developed, implemented, and flight tested a flight management algorithm designed to improve the accuracy of delivering an airplane in a fuel-conservative manner to a metering fix at a time designated by air traffic control. This algorithm provides a 3D path with time control (4D) for the TCV B-737 airplane to make an idle-thrust, clean configured (landing gear up, flaps zero, and speed brakes retracted) descent to arrive at the metering fix at a predetermined time, altitude, and airspeed. The descent path is calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard pressure and temperature effects. The flight management descent algorithms are described and flight test results are presented. A.R.H.

N81-19037*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PILOT'S SUBJECTIVE ANALYSIS OF A COCKPIT DISPLAY OF TRAFFIC INFORMATION (CDTI)
Gerald L. Keyser, Jr. *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 29-49 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Both the advent of electronic displays for cockpit applications and the availability of high-capacity data transmission systems, linking aircraft with ATC ground computers, offer the opportunity of expanding the pilots' role in the distributive management process. A critical element in this process is believed to be the presentation to the pilot of his traffic situation. A representative cockpit display of traffic information (CDTI) system is presented as viewed from the pilot in the cockpit, and the research results from flight tests presented. The use of advanced controls and displays allows for presentation to the pilot, large quantities of information that he has not had before. The real challenge in the design of an operational CDTI system will be the satisfaction of needs for information and the presentation of all necessary information, only in a useable format in order to avoid clutter. Even though a reasonably large display was utilized in these tests, display clutter was the primary problem from the standpoint of information assimilation. A.R.H.

N81-19038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GUIDANCE AND CONTROL SYSTEM RESEARCH FOR IMPROVED TERMINAL AREA OPERATIONS
R. M. Hueschen, J. F. Creedon, W. T. Bundick, and J. C. Young *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 51-81 refs Prepared in cooperation with Information and Control Systems, Inc., Hampton, Va., Boeing Co., Seattle, Wash., and Analytical Mechanics Associates, Inc., Hampton, Va.

Avail: NTIS HC A17/MF A01 CSCL 01C

Several guidance and control system research and development activities aimed at improving the operational capabilities of commercial aircraft in the terminal area are described. The guidance and control systems were designed to improve the capacity and efficiency of terminal area operations, enhance the approach and landing capability of aircraft in adverse weather conditions, and reduce the impact of aircraft noise perceived on the ground. Specific performance features include the ability to capture and track steep glideslopes, use short final approaches, perform flares with reduced longitudinal touchdown dispersion and execute high speed runway rollout and turnoff. Results obtained from simulation studies or flight tests are shown for each of the algorithms. Author

N81-19039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL CONSIDERATIONS IN UTILIZATION OF MICROWAVE LANDING SYSTEM APPROACH AND LANDING GUIDANCE
William F. White and Leonard V. Clark *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 83-112

Avail: NTIS HC A17/MF A01 CSCL 01C

The characteristics and performance of MLS equipment utilized by the TCV B-737. Several classes of MLS service and approach procedures are discussed in light of TCV experience. Since the early uses of MLS involves procedures identical to ILS, most of the discussion is concerned with exploitation of MLS capabilities not possessed by ILS. Examples are given of how this could be done by using MLS to enhance the safety and utility of procedures presently in use for noise abatement. Some areas which require definition of new procedures and conventions are indicated. Author

N81-19040*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
AUTOMATED PILOT ADVISORY SYSTEM TEST AND EVALUATION AT MANASSAS MUNICIPAL AIRPORT
John L. Parks, Jr. *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 113-125 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

In cooperation with the Federal Aviation Administration, NASA developed an experimental automated pilot advisory system (APAS) to provide airport and air traffic advisories at high density uncontrolled airports. The APAS concept is to utilize low cost automated systems to provide the necessary information for pilots to more safely plan and execute approach and landing at uncontrolled high density airports. The system is designed to be a natural extension of the procedural visual flight rules system used at uncontrolled airports and, as an advisory system, will enhance the 'see-and-be-seen' rule and an evaluation of the APAS concept was obtained from pilots who used the system at the Manassas, Virginia airport. These evaluations and the system performance are presented. A.R.H.

N81-19041*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A METHOD FOR DETERMINING LANDING RUNWAY LENGTH FOR A STOL AIRCRAFT
D. M. Watson, G. H. Hardy, J. F. Moran, and D. N. Warner, Jr. *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 127-144 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Based on data obtained from flight tests of the augmentor wing jet STOL research aircraft, a method is proposed for determining the length of the landing runway for powered-lift STOL aircraft. The suggested method determines runway

landing length by summing three segments: the touchdown-dispersion distance, the transition distance from touchdown to application of brakes, and the stopping distance after brakes are applied. It is shown how the landing field length can be reduced either through improved autoland system design or by providing the pilot with appropriate information to allow him to identify a 'low probability' long or short landing and to execute a go-around. The proposed method appears to determine a safe runway landing length for the STOL application and offers the potential for reducing runway length if great emphasis is placed on a short-runway capability. FAR Parts 25 and 121 appear conservative and suitable for the situation where no great emphasis is placed on reducing the runway length requirement. A.R.H.

N81-19042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT TESTS OF IFR LANDING APPROACH SYSTEMS FOR HELICOPTERS

J. S. Bull, D. M. Hegarty, L. L. Peach, J. D. Phillips, D. J. Anderson, D. C. Dugan, and V. L. Ross *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 145-164 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Joint NASA/FAA helicopter flight tests were conducted to investigate airborne radar approaches (ARA) and microwave landing system (MLS) approaches. Flight-test results were utilized to prove NASA with a data base to be used as a performance measure for advanced guidance and navigation concepts, and to provide FAA with data for establishment of TERPS criteria. The first flight-test investigation consisted of helicopter IFR approaches to offshore oil rigs in the Gulf of Mexico, using weather/mapping radar, operational pilots, and a Bell 212 helicopter. The second flight-test investigation consisted of IFR MLS approaches at Crows Landing (near Ames Research Center), with a Bell UH-1H helicopter, using NASA, FAA, and operational industry pilots. Tests are described and results discussed. A.R.H.

N81-19043*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A HEAD-UP DISPLAY FORMAT FOR TRANSPORT AIRCRAFT APPROACH AND LANDING

Richard S. Bray and Barry C. Scott (FAA) *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 165-193 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept applied to transport aircraft landing. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to electronic flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. Author

N81-19044*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EVALUATION OF HEAD-UP DISPLAYS IN CIVIL TRANSPORT OPERATIONS

John K. Lauber, Richard S. Bray, and Barry C. Scott (FAA) *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 197-199 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

To determine the advantages and disadvantages of head-up displays (HUD) in civil transport approach and landing operations, an operational evaluation was conducted on the flight simulator for advanced aircraft at Ames. A non-conformal HUD concept which contained raw data and Flight Director command information, and a conformal, flight path HUD concept was designed to permit terminal area maneuvering, intercept, final approach, flare, and landing operations. Twelve B-727 line pilots (Captains) flew a series of precision and non-precision approaches under a variety of environmental and operational conditions, including wind shear, turbulence and low ceilings and visibilities. A preliminary comparison of various system and pilot performance measures as a function of display type (Flight Director HUD, Flight Path HUD, or No HUD) indicates improvements in precision and accuracy of aircraft flight path control when using the HUDs. The results also demonstrated some potentially unique advantages of a flight path HUD during non-precision approaches. A.R.H.

N81-19045*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

GENERAL AVIATION SINGLE PILOT IFR AUTOPILOT STUDY

Hugh P. Bergeron *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 201-217 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Five levels of autopilot complexity were flown in a single engine instrument flight rules (IFR) simulation for several different IFR terminal operations. A comparison was made of the five levels of complexity ranging from no-autopilot to a fully coupled lateral and vertical guidance mode to determine the relative benefits vs. complexity/cost of state of the art autopilot capability in the IFR terminal area. Of the five levels tested, the heading select mode made the largest relative difference in decreasing workload and simplifying the approach task. It was also found that the largest number of blunders was detected with the most highly automated mode. The data also showed that, regardless of the autopilot mode, performance during an IFR approach was highly dependent on the type of approach being flown. These results indicate that automation can be useful when making IFR approaches in a high workload environment, but also that some disturbing trends are associated with some of the higher levels of automation found in state of the art autopilots. M.G.

N81-19046*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF THE EPIDEMIOLOGICAL MODEL IN STUDYING HUMAN ERROR IN AVIATION

Ed S. Cheaney (Battelle Columbus Labs., Mountain View, Calif.) and Charles E. Billings *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 219-236 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

An epidemiological model is described in conjunction with the analytical process through which aviation occurrence reports are composed into the events and factors pertinent to it. The model represents a process in which disease, emanating from environmental conditions, manifests itself in symptoms that may lead to fatal illness, recoverable illness, or no illness depending on individual circumstances of patient vulnerability, preventive actions, and intervention. In the aviation system the analogy of the disease process is the predilection for error of human participants. This arises from factors in the operating or physical environment and results in errors of commission or omission that, again depending on the individual circumstances, may lead to accidents, system perturbations, or harmless corrections. A discussion of the previous investigations, each of which manifests the application of the epidemiological method, exemplifies its use and effectiveness. M.G.

N81-19047*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

HOW A PILOT LOOKS AT ALTITUDE

Amos A. Spady, Jr. and Randall L. Harris, Sr. *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 237-248 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Commerical pilot eye scanning data previously collected were reanalyzed to evaluate how pilot used the drum pointer altimeter. The results of these tests showed that the pilots seldom used the drum window apparently because it was difficult to read as indicated by average drum window dwell times of .6 seconds. It is suggested that pilot scanning data be collected for other type of altimeters in order to find those with good scanning characteristics. M.G.

N81-19048*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUMMARY OF FLIGHT TESTS OF AN AIRBORNE LIGHTING LOCATOR SYSTEM AND COMPARISON WITH GROUND-BASED MEASUREMENTS OF PRECIPITATION AND TURBULENCE
Bruce D. Fisher and Norman L. Crabill *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 251-277 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

Data from an airborne lightning locator system and data relating to storm intensity obtained by ground-based Doppler radars and the S-band research radar are presented. When comparing lightning locations from the airborne lightning locator system with ground-based Doppler radar measurements of reflectivity and spectrum width, the lightning locations tended to be further from the aircraft position than the Doppler radar contours, but at the same relative bearing from the aircraft as the Doppler contours. The results also show that convective storms generate little or no lightning for a significant part of their life cycle, but can produce at least moderate turbulence. Therefore, it is concluded that a lack of lightning activity cannot be accepted as an inference of a corresponding lack of other hazards to the flight of aircraft through convective storms. M.G.

N81-19049*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
WALLOPS SEVERE STORMS MEASUREMENT CAPABILITY
Robert E. Carr and John C. Gerlach *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 279-291 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Some of the instrumentation system used in support of NASA'S Storm Hazards Program are described. These systems include the Radar Atmospheric Research Facility (RARF) with its Space Range Radar and a near real time display from the National Weather Service WSR-57 radar, a lightning detection and ranging system (LDAR), and a Ryan Stormscope. The RARF system can detect, track, and quantify the properties of severe storms. Simultaneous measurements in the UHF (70 cm), S (10 cm), and C (5 cm) bands can be made of clouds and precipitation to deduce particle size and characteristics, including quantitive cross sections of individual hailstones and raindrops. Relative attenuation at these wavelenghts can be used to calculate path integrated rainfall and water content. The track of an instrument aircraft can be displayed on S-band reflectivity map of the individual storm cells. The LDAR system can determine the location of lightning discharges in real time and measure and record the electric field waveform for further study. The Ryan Stormscope can detect and range lightning out to 320 kilometers. M.G.

N81-19050*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE 1979 CLEAR AIR TURBULENCE FLIGHT TEST PROGRAM
E. A. Weaver, L. J. Ehernberger, B. L. Gary, R. L. Kurkowski, P. M. Kuhn (NOAA), and L. P. Stearns (NOAA) *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 293-311 refs Prepared in cooperation with JPL, California Inst. of Tech., Pasadena and Ames Research Center
Avail: NTIS HC A17/MF A01 CSCL 01C

The flight experiments for clear air turbulence (CAT) detection and measurement concepts are described. The test were conducted over the western part of the United States during the winter season of 1979 aboard NASA's Galileo 2 flying laboratory. A carbon dioxide pulsed Doppler lidar and an infrared radiometer were tested for the remote detection and measurement of CAT. Two microwave radiometers were evaluated for their ability to provide encounter warning and altitude avoidance information. M.G.

N81-19051*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PULSED DOPPLER LIDAR FOR THE DETECTION OF TURBULENCE IN CLEAR AIR
E. A. Weaver, J. W. Bilbro, J. A. Dunkin, S. C. Johnson, W. D. Jones, C. E. Harris (Raytheon Co.), and C. A. Dimarzio (Raytheon Co.) *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 313-327 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

A pulsed CO2 Doppler lidar system is described and demonstration tests in ground-based and airborne flight operations are discussed. As a ground-based system, it can detect wind shears in thunderstorm gust fronts to a range of 6 km. When in the airborne configuration, the lidar can detect clear air turbulence in advance of the aircraft encountering clear air turbulence. The data provided by the lidar included turbulence location and intensity with intensity being indicated by the measured spectral width which is proportional to the wind gust velocity. M.G.

N81-19052*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TESTS OF A CLEAR-AIR TURBULENCE ALERTING SYSTEM
Richard L. Kurkowski, Peter M. Kuhn (Raven Systems and Research, Inc.), and Lois P. Stearns (NOAA) *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 329-349 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The detection of clear-air turbulence (CAT) ahead of an aircraft in real-time by an infrared (IR) radiometer is discussed. It is noted that the alter time and reliability depend on the band-pass of the IR filter used and on the altitude of the aircraft. Results of flights tests indicate that a bandpass of 20 to 40 microns appears optimal for altering the aircraft crew to CAT at times before encounter of 2 to 9 min. Alert time increases with altitude, as the atmospheric absorption determining the horizontal weighting is reduced. M.G.

N81-19053*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CLEAR AIR TURBULENCE STUDIES WITH MICROWAVE RADIOMETERS
Bruce L. Gary *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 351-359 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

The flight testing of two passive microwave radiometers for the detection of clear air turbulence (CAT) is discussed. A 55.3 GHz radiometer was used to measure altitude temperature profiles, and a 180 GHz radiometer was used for monitoring line-of-sight integrated water vapor content. The sequence of altitude temperature profiles, spaced 17 seconds apart (3.5 km), enable inversion layer and tropopause properties to be studied. On some occasions, the altitude distribution of CAT severity correlated well with inversion layer location. On other occasions, turbulence was not located within 55.3 GHz measured layers, possibly indicating cases of topography-generated CAT, where inversion layer would not necessarily be expected. Evidence was obtained supporting the hypothesis that CAT is generated within layers containing levels of wind shear that cannot be supported by the layer's lapse rate; i.e., that Kelvin-Helmholtz wave breakdown can generate CAT. The 180 GHz radiometer failed to warn of CAT events. It is suggested that the radiometer's sensitivity (1 K) was inadequate for detecting the small variations in line-of-sight water vapor content. M.G.

N81-19054*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IN-FLIGHT DIRECT-STRIKE LIGHTNING RESEARCH
Felix L. Pitts and Mitchel E. Thomas *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 359-372 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

Tests designed to investigate the lightning-generated electromagnetic environment affecting aircraft are discussed. An F-106B

aircraft specially instrumented for lightning electromagnetic measurements was used. The instrumentation system is reviewed and typical results recorded by the instrumentation during simulated-lightning ground tests performed for a safety survey are presented. Several examples of data obtained during summer flight testing are presented and future plans are discussed. M.G.

N81-19055*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAGNITUDE AND FREQUENCY OF WIND SPEED SHEARS AND ASSOCIATED DOWNDRAFTS
Margaret B. Alexander and C. Warren Campbell *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 373-383 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Data are presented indicating the frequency of occurrence of wind shear and downdrafts together with information on the simultaneous occurrence of these two phenomena. High resolution wind profile measurements recorded at a 150 meter ground winds tower facility were used for the analysis. From instantaneous measurements during horizontal wind speeds of gale-force and below intensity, vertical motion at the 10, 60, and 150 m levels was approximately 60 percent downward and 40 percent upward. At the 18 level the percentages were reversed. Updraft maxima were an order of magnitude or two greater than downdrafts at all levels. Frequency of vertical motion > or = 9.7 kts for a year at four levels was 338 occurrences upward and 274 downward. Approximately 90 percent of these updrafts occurred at the 18 m level almost equally during summer and winter, and 65 percent of the downdrafts were at the 150 m level during summer. M.G.

N81-19056*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 1980 AIRCRAFT SAFETY AND OPERATING PROBLEMS, PART 2
Joseph W. Stickle, comp. Mar. 1981 390 p refs Conf. held at Hampton, Va., 5-7 Nov. 1980 2 Vol.
(NASA-CP-2170-Pt-2; L-14254) Avail: NTIS HC A17/MF A01 CSCL 01C

Terminal area operations, avionics and human factors, atmospheric environment, and operating problems and potential solutions are discussed. Other topics include flight experiences, ground operations, and acoustics and noise reduction.

N81-19057*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
WADE VORTEX ATTENUATION FLIGHT TESTS: A STATUS REPORT
Marvin R. Barber and Joseph J. Tymczyszyn *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 387-408 refs Prepared in cooperation with FAA, Western Region, Los Angeles

Avail: NTIS HC A17/MF A01 CSCL 01C

Flight tests were conducted to evaluate the magnitude of aerodynamic attenuation of the wake vortices of large transport aircraft that can be achieved through the use of static spoiler deflection and lateral control oscillation. These methods of attenuation were tested on Boeing B-747 and Lockheed L-1011 commercial transport aircraft. Evaluations were made using probe aircraft, photographic and visual observations, and ground based measurements of the vortex velocity profiles. The magnitude of attenuation resulting from static spoiler deflection was evaluated both in and out of ground effect. A remotely piloted QF-86 drone aircraft was used to probe the attenuated vortices in flight in and out of ground effect, and to make landings behind an attenuated B-747 airplane at reduced separation distances. E.D.K.

N81-19058*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BASIC RESEARCH IN WAKE VORTEX ALLEVIATION USING A VARIABLE TWIST WING
Dana J. Morris and G. Thomas Holbrook *In its* the 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 409-423 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The variable twist wing concept was used to investigate the relative effects of lift and turbulence distribution on the rolled up vortex wake. Several methods of reducing the vortex strength behind an aircraft were identified. These involve the redistribution of lift spanwise on the wing and drag distribution along the wing. Initial attempts to use the variable twist wing velocity data to validate the WAKE computer code have shown a strong correlation, although the vorticity levels were not exactly matched. E.D.K.

N81-19059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PNEUMATIC BOOT FOR HELICOPTER ROTOR DEICING
Bernard J. Blaha and Peggy L. Evanich *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 425-443 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Pneumatic deicer boots for helicopter rotor blades were tested. The tests were conducted in the 6 by 9 ft icing research tunnel on a stationary section of a UH-1H helicopter main rotor blade. The boots were effective in removing ice and in reducing aerodynamic drag due to ice. E.D.K.

N81-19060*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT OPERATING EFFICIENCY ON THE NORTH ATLANTIC, A CHALLENGE FOR THE 1980'S
Robert Steinberg *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 445-451
Avail: NTIS HC A17/MF A01 CSCL 01C

A number of changes are expected to occur in the near future which could have important consequences for Atlantic flight operations for the next decade. These changes are identified and their impact on aircraft operating efficiency is discussed. Possible alternatives for North Atlantic air carriers are reviewed and strategies and actions are suggested which may give a considerable impact on fuel savings for years to come. E.D.K.

N81-19061*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIREWORTHINESS OF TRANSPORT AIRCRAFT INTERIOR SYSTEMS
John A. Parker and D. A. Kourtides *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 453-479 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The key materials question is addressed concerning the effect of interior systems on the survival of passengers and crew in the case of an uncontrolled transport aircraft fire. Technical opportunities are examined which are available through the modification of aircraft interior subsystem components, modifications that may reasonably be expected to provide improvements in aircraft fire safety. Subsystem components discussed are interior panels, seats, and windows. By virtue of their role in real fire situations and as indicated by the results of large scale simulation tests, these components appear to offer the most immediate and highest payoff possible by modifying interior materials of existing aircraft. These modifications have the potential of reducing the rate of fire growth, with a consequent reduction of heat, toxic gas, and smoke emission throughout the habitable interior of an aircraft, whatever the initial source of the fire. E.D.K.

N81-19063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE USE OF ANTIMISTING KEROSENE (AMK) IN TURBOJET ENGINES
Harold W. Schmidt *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 499-510
Avail: NTIS HC A17/MF A01 CSCL 01C

The effect of antimisting kerosene (AMK) flow characteristics on fan jet engines and the impact of degradation requirements on the fuel system was evaluated. It was determined from the present program that AMK fuel cannot be used without predegradation, although some degradation occurs throughout the fuel feed system, expecially in the fuel pumps. There is a tendency toward FM-9 AMK additive agglomeration and gel formation when the liquid flows at a critical velocity through very small passages. The data indicate this phenomenon to be a function of the degree of degradation, the passage size, the differential pressure, the fluid temperature, and the accumulated flow time. Additionally, test results indicate that the long term cumulative effects of this phenomenon may require more degradation than the theoretical requirement determined from short term tests. E.D.K.

N81-19064*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NASA/FAA GENERAL AVIATION CRASH DYNAMICS PROGRAM

Robert G. Thomson, Robert J. Hayduk, and Huey D. Carden *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 511-540 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The program involves controlled full scale crash testing, nonlinear structural analyses to predict large deflection elastoplastic response, and load attenuating concepts for use in improved seat and subfloor structure. Both analytical and experimental methods are used to develop expertise in these areas. Analyses include simplified procedures for estimating energy dissipating capabilities and comprehensive computerized procedures for predicting airframe response. These analyses are developed to provide designers with methods for predicting accelerations, loads, and displacements on collapsing structure. Tests on typical full scale aircraft and on full and subscale structural components are performed to verify the analyses and to demonstrate load attenuating concepts. A special apparatus was built to test emergency locator transmitters when attached to representative aircraft structure. The apparatus is shown to provide a good simulation of the longitudinal crash pulse observed in full scale aircraft crash tests. E.D.K.

N81-19065*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CURRENT RESEARCH IN AIRCRAFT TIRE DESIGN AND PERFORMANCE

John A. Tanner, John L. McCarthy (Michigan Univ., Ann Arbor), and S. K. Clark *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 543-553 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

A review of the tire research programs which address the various needs identified by landing gear designers and airplane users is presented. The experimental programs are designed to increase tire tread lifetimes, relate static and dynamic tire properties, establish the tire hydroplaning spin up speed, study gear response to tire failures, and define tire temperature profiles during taxi, braking, and cornering operations. The analytical programs are aimed at providing insights into the mechanisms of heat generation in rolling tires and developing the tools necessary to streamline the tire design process and to aid in the analysis of landing gear problems. E.D.K.

N81-19066*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

REVIEW OF ANTISKID AND BRAKE DYNAMICS RESEARCH

Sandy M. Stubbs and John A. Tanner *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 555-568 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The behavior of various antiskid systems was investigated under controlled conditions. Results from utilizing a single main wheel of a DC-9 aircraft suggest that the systems investigated perform well under most circumstances but there may be room for improvement. For example, it was demonstrated that pressure bias modulation can adversely affect the response of antiskid systems to rapid changes in the runway friction level. Results also indicate that antiskid systems designed to operate at a slip ratio of approximately 0.1 can provide a maximum braking effort without undue loss in the cornering capability of the tire. Time histories of braking friction coefficient were shown to provide a means of determining antiskid system performance and for systems that employed pressure bias modulation it was shown that performance could also be estimated from time histories of brake pressure and torque. R.C.T.

N81-19067*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STUDIES OF SOME UNCONVENTIONAL SYSTEMS FOR SOLVING VARIOUS LANDING PROBLEMS

T. J. Leland, J. R. McGehee, and R. C Dreher *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 569-582 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Solutions to various landing problems were obtained through unconventional systems. The first, of these is the air cushion landing system, where efforts were concentrated on development of adequate braking and steering systems and an improved understanding of scaling laws and behavior. The second was concentrated on use of a wire brush skid as a drag producing device, which was shown to have good friction coefficients and reasonable wear rates at ground bearing pressures up to 689 kPa and forward speeds up to 80 km/hr. The third showed great promise in an active control landing gear where significant load reductions were possible during landing impact and subsequent rollout. R.C.T.

N81-19068*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RECENT PROGRESS TOWARD PREDICTING AIRCRAFT GROUND HANDLING PERFORMANCE

Thomas J. Yager and Ellis J. White *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 583-611 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

The significant progress which has been achieved in development of aircraft ground handling simulation capability is reviewed and additional improvements in software modeling identified. The problem associated with providing necessary simulator input data for adequate modeling of aircraft tire/runway friction behavior is discussed and efforts to improve this complex model, and hence simulator fidelity, are described. Aircraft braking performance data obtained on several wet runway surfaces is compared to ground vehicle friction measurements and, by use of empirically derived methods, good agreement between actual and estimated aircraft braking friction from ground vehilce data is shown. The performance of a relatively new friction measuring device, the friction tester, showed great promise in providing data applicable to aircraft friction performance. Additional research efforts to improve methods of predicting tire friction performance are discussed including use of an instrumented tire test vehicle to expand the tire friction data bank and a study of surface texture measurement techniques. R.C.T.

N81-19069*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE NASA DIGITAL VGH PROGRAM, EARLY RESULTS

Norman L. Crabill and Garland J. Morris *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 613-624 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Data from airline digital flight data recorders provides relevant statistical data for estimating fatigue life consumption of the current airliner fleet and for design criteria updating for future designs. The data indicates real operating effects due to the autopilot, i.e., gust response frequency peak increase by 2 or 3 times, and the existence of the low frequency low amplitude limit cycle motion in altitude hold. The extension of more data types for ground operations is considered. Onboard processing of simple data types is also considered. R.C.T.

N81-19070*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EVALUATION OF EMERGENCY-LOCATOR-TRANSMITTER

PERFORMANCE IN REAL AND SIMULATED CRASH TESTS
Huey D. Carden *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 625-653 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Emergency locator transmitter (ELT) activation problems were investigated by testing a sampling of ELT units in actual airplane crashes and in a special test apparatus which simulated longitudinal crash pulses with superimposed local structural resonances. Probable causes of excessive false alarms and nonactivations of ELT's during crash situations were determined and solutions to the current operational and technical problems were obtained. The results, which considered placement, mounting, and activation of ELT's under simulated crash impacts, and an evaluation of the sensitivity of ELT impact switches to orientation and to local structural vibrations are discussed. R.C.T.

N81-19072*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT DEVELOPMENTS IN AIRCRAFT ENGINE NOISE REDUCTION TECHNOLOGY
James R. Stone and Charles E. Feiler *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 671-698 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Some of the more important developments and progress in jet and fan noise reduction and flight effects are reviewed. *Experiments are reported which show that nonaxisymmetric* coannular nozzles have the potential to reduce jet noise for conventional and inverted velocity profiles. It is shown that an improved understanding of suppressive linear behavior, coupled with the new understanding of fan source noise, will soon allow the joint optimization of acoustic liner and fan design for low noise. It is also shown that fan noise source reduction concepts are applicable to advanced turboprops. Advances in inflow control device design are reviewed that appear to offer an adequate approach to the ground simulation of inflight fan noise. R.C.T.

N81-19073*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOURCES, CONTROL, AND EFFECTS OF NOISE FROM AIRCRAFT PROPELLERS AND ROTORS
John S. Mixson, George C. Greene, and Thomas K. Dempsey *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 699-720 refs

Avail: NTIS HC A17/MF A01 CSCL 01C

Source noise predictions are compared with measurements for conventional low-speed propellers, for new high speed *propellers (propfans), and for a helicopter. Results from a light* aircraft demonstration program are described, indicating that about 5-dB reduction of flyover noise can be obtained without significant performance penalty. Sidewall design studies are described for interior noise control in light general aviation aircraft and in large transports using propfan propulsion. The weight of the added acoustic treatment is estimated and tradeoffs between weight and noise reduction are discussed. A laboratory study of passenger response to combined broadband and tonal propeller like noise is described. Subject discomfort ratings of combined tone broadband noises are compared with ratings of broadband (boundary layer) noise alone, and the relative importance of the propeller tones is examined. R.C.T.

N81-19074*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NASA PROGRESS IN AIRCRAFT NOISE PREDICTION
J. P. Raney, S. L. Padula, and W. E. Zorumski *In its* The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 721-757 refs
Avail: NTIS HC A17/MF A01 CSCL 01C

Some of the essential features of aircraft noise prediction *are described and the basis for evaluating its capability and* future potential is discussed. A takeoff noise optimizing procedure is described which calculates a minimum noise takeoff procedure subject to multiple site noise constraints. R.C.T.

N81-19077# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT REPORT: AIR PENNSYLVANIA 501, PIPER PA-31-350, N5MS PHILADELPHIA, PENNSYLVANIA, JULY 25, 1980
21 Jan. 1981 27 p
(PB81-910401; NTSB-AAR-81-1) Avail: NTIS HC A03/MF A01 CSCL 01C

The crash of the Air Pennsylvania 50 1, a Piper PA-31-350 Navajo aircraft, while making a visual approach at Philadelphia International Airport is examined. The aircraft, a scheduled commuter flight from Reading, Pennsylvania, arrived in the Philadelphia approach control area as a VFR pop-up flight and was sequenced to land behind United Flight 555, a Boeing 727 IFR arrival. Witnesses stated that, when Flight 501 was about 1/2 mile on final approach, it rolled from side to side, pitched up, rolled inverted to the left, and flew into the ground nose first. All three persons aboard the aircraft was killed and the aircraft was destroyed. It was determined that the probable cause of the accident was the loss of aircraft control due to an encounter with wake turbulence from the preceding aircraft at *an altitude too low for recovery and the pilot's failure to follow* established separation and flightpath selection procedures for wake turbulence avoidance. M.G.

N81-19078*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURVEY OF AIRCRAFT ICING SIMULATION TEST FACILITIES IN NORTH AMERICA
William Olsen Feb. 1981 26 p refs
(NASA-TM-81707; E-736) Avail: NTIS HC A03/MF A01 CSCL 01C

A survey was made of the aircraft icing simulation facilities in North America: there are 12 wind tunnels, 28 engine test facilities, 6 aircraft tankers and 14 low velocity facilities, that perform aircraft icing tests full or part time. The location and size of the facility, its speed and temperature range, icing cloud parameters, and the technical person to contact are surveyed. Results are presented in tabular form. The capabilities of each facility were estimated by its technical contact person. The adequacy of these facilities for various types of icing tests is discussed. S.F.

N81-19079*# Rockwell International Corp., Los Angeles, Calif. Thermodynamics Group.
LIGHT TRANSPORT AND GENERAL AVIATION AIRCRAFT ICING RESEARCH REQUIREMENTS Final Report
R. K. Breeze and G. M. Clark 20 Mar. 1981 348 p refs
(Contract NAS3-22186)
(NASA-CR-165290; NA-81-110) Avail: NTIS HC A15/MF A01 CSCL 01C

A short term and a long term icing research and technology program plan was drafted for NASA LeRC based on 33 separate research items. The specific items listed resulted from a comprehensive literature search, organized and assisted by a computer management file and an industry/Government agency survey. Assessment of the current facilities and icing technology was accomplished by presenting summaries of ice sensitive components and protection methods; and assessments of penalty evaluation, the experimental data base, ice accretion prediction methods, research facilities, new protection methods, ice protection requirements, and icing instrumentation. The intent of the research plan was to determine what icing research NASA LeRC must do or sponsor to ultimately provide for increased utilization and safety of light transport and general aviation aircraft. Author

N81-19080# Naval Air Engineering Center, Lakehurst, N.J. Ship and Shore Installations Engineering Dept.
SYSTEM SAFETY PROGRAM REPORT MK 1 MOD 0 LSO HUD CONSOLE SYSTEM Final Report
John Glenn 30 Jan. 1981 26 p
(AD-A095009; NAEC-91-7983) Avail: NTIS HC A03/MF A01 CSCL 01/2

The MK 1 MOD 0 LSO HUD Console System provides aircraft recovery information to the Landing Signal Officer aboard

aircraft carriers. This report documents the System Safety Program accomplishments (safety analysis, verification, and test) and assesses system safety. GRA

N81-19083# National Academy of Sciences - National Research Council, Washington, D. C.
IMPROVING AIRCRAFT SAFETY
Jun. 1980 131 p refs
(Contract DTOS59-80-C-00028)
(PB81-114886; ISBN-0-309-03091-9; LC-80-82605) Avail: NTIS HC A07/MF A01 CSCL 01C

A six month assessment of the adequacy of the Federal Aviation Administration's policies and procedures for certifying the airworthiness of commercial transport aircraft was undertaken. Airworthiness is the aspect of air safety related to the design, manufacture, and maintenance of airplanes and does not embrace such other key safety matters as airlines and flight crew operations or air traffic control. The ways in which the FAA approves the design, fabrication, and production of each new aircraft, as well as the maintenance and continuing airworthiness of each airplane were considered. Concentrating on the large passenger aircraft used by the major commercial airlines, the committee's charter excluded from its study the certification of engines, airplanes operated by commuter airlines, businesses, and individuals, as well as aircraft under 12,500 pounds. GRA

N81-19084# Massachusetts Inst. of Tech., Cambridge.
ACTIVE BCAS: DESIGN AND VALIDATION OF THE SURVEILLANCE SUBSYSTEM
William H. Harman, Jerry D. Welch, Raymond R. LaFrey, and M. Loren Wood 17 Dec. 1980 118 p refs
(Contracts F19628-80-C-0002; DOT-FA72WAI-817; FAA Proj. 054-241-04)
(AD-A095049; ATC-103; FAA-RD-80-134) Avail: NTIS HC A06/MF A01 CSCL 17/7

Lincoln Laboratory, under FAA sponsorship, is developing an Active Beacon Collision Avoidance System (BCAS), concentrating primarily on the air-to-air surveillance subsystem. The surveillance functions required are to detect the presence of nearby aircraft (whether they are equipped with ATCRBS transponders or DABS transponders), and then generate a surveillance track on each aircraft, issuing range and altitude reports once per second. The development effort consisted of airborne measurements complemented by simulation studies and analyses. The basic effects of ground-bounce multipath, interference, and power fading were assessed by air-to-air measurements. In other measurements, the BCAS interrogation and reply signal formats were transmitted between aircraft, and the results recorded for later playback and computer processing using the BCAS surveillance algorithms. This is a flexible means of experimentation which allows many of the design parameters to be changed as the effects are noted. In the most recent phase of the program, Lincoln designed and built realtime BCAS Experimental Units (BEUs), flight tested them, and then delivered them to the FAA for more extensive flight testing. In one of these flight tests, a BEU-equipped Boeing 727 flew to New York, Atlanta, and other major terminal areas in the eastern U.S. An analysis of BEU performance during this 'Eastern Tour' is given in this report. GRA

N81-19085# Federal Aviation Administration, Atlantic City, N.J.
MATH MODEL STUDY, RUNWAY 16R INSTRUMENT LANDING SYSTEM LOCALIZER AT SEATTLE-TACOMA AIRPORT, WASHINGTON Data Report, period ending Aug. 1980
Jesse D. Jones Jan. 1981 25 p refs
(AD-A095076; FAA-CT-80-61) Avail: NTIS HC A02/MF A01 CSCL 17/7

Results of a math model study for the runway 16R instrument landing system (ILS) localizer at the Seattle-Tacoma Airport, Washington, are presented. This study was performed at the request of the Northwest Region of the Federal Aviation Administration (FAA) to determine the effects to the course structure of a proposed building and the replacement of the existing ILS localizer system. Resultant course structure plots are presented for both the existing Texas Instruments Basic Parabolic Category II Localizer and the proposed Wilcox 14/6 Category III Localizer, with and without the effects of the proposed Boeing building. The course structure plots are the output from the ILSLOC mathematical model computer program developed by the Transportation Systems Center and run on the Honeywell 66/60 computer at the FAA Technical Center. GRA

N81-19087* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPENSATING LINKAGE FOR MAIN ROTOR CONTROL Patent
Philip A. E. Jeffery (United Aircraft Corp., Stratford, Conn.) and Rudolf F. Huber, inventors (to NASA) (United Aircraft Corp., Stratford, Conn.) Issued 20 Jan. 1981 6 p Filed 25 Dec. 1978 Supersedes N79-15057 (17 - 06, p 0694) Sponsored by NASA
(NASA-Case-LAR-11797-1; US-Patent-4,245,956; US-Patent-Appl-SN-969755; US-Patent-Class-416-114; US-Patent-Class-244-17.25; US-Patent-Class-416-500; US-Patent-Class-74-519) Avail: US Patent and Trademark Office CSCL 01C

A compensating linkage for the rotor control system on rotary wing aircraft is described. The main rotor and transmission are isolated from the airframe structure by elastic suspension. The compensating linkage prevents unwanted signal inputs to the rotor control system caused by relative motion of the airframe structure and the main rotor and transmission.

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

N81-19088*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 1: MAIN PROGRAM. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 197 p refs 6 Vol.
(Contract NAS2-9352)
(NASA-CR-152303-Vol-1-Pt-1) Avail: NTIS HC A09/MF A01 CSCL 01C

The General Aviation synthesis program performs tasks generally associated with aircraft preliminary design and allows an analyst the capability of performing parametric studies in a rapid manner. GASP emphasizes small fixed-wing aircraft employing propulsion systems varying froma single piston engine with fixed pitch propeller through twin turboprop/ turbofan powered business or transport type aircraft. The program, which may be operated from a computer terminal in either the batch or interactive graphic mode, is comprised of modules representing the various technical disciplines integrated into a computational flow which ensures that the interacting effects of design variables are continuously accounted for in the aircraft sizing procedure. The model is a useful tool for comparing configurations, assessing aircraft performance and economics, performing tradeoff and sensitivity studies, and assessing the impact of advanced technologies on aircraft performance and economics. A.R.H.

N81-19089*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 2: GEOMETRY. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 26 p refs 6 Vol.
(Contract NAS2-9352)
(NASA-CR-152303-Vol-2-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 01C

The gross characteristics of an aircraft under study are specified to the subroutines SIZE. The principal quantities specified are both geometric (lengths and areas) and operational (altitude and Mach number). The sequence of computations carried out by SIZE is controlled by the parameter NPC which is passed into SIZE by COMMON. When NPC-0, the computation is initialized. Subsequently, NPC is set to 2 and the program advances through the geometric computations. Geometry models for the fuselage, wing, empennage, cabin pressurization, and nacelle area are examined. A.R.H.

N81-19090*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 3: AERODYNAMICS. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 103 p refs 6 Vol.
(Contract NAS2-9352)

(NASA-CR-152303-Vol-3-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 01C

Aerodynamics calculations are treated in routines which concern moments as they vary with flight conditions and attitude. The subroutines discussed: (1) compute component equivalent flat plate and wetted areas and profile drag; (2) print and plot low and high speed drag polars; (3) determine life coefficient or angle of attack; (4) determine drag coefficient; (5) determine maximum lift coefficient and drag increment for various flap types and flap settings; and (6) determine required lift coefficient and drag coefficient in cruise flight. A.R.H.

N81-19091*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 4: PROPULSION. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 191 p refs 6 Vol.
(Contract NAS2-9352)
(NASA-CR-152303-Vol-4-Pt-1) Avail: NTIS HC A09/MF A01 CSCL 01C

Propulsion system performance is computed during engine sizing and whenever aircraft performance is computed. The propulsion model user's and programmer's manual is presented. Routines are provided for jet and propeller driven aircraft. A.R.H.

N81-19092*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 5: WEIGHTS. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 151 p refs 6 Vol.
(Contract NAS2-9352)
(NASA-CR-152303-Vol-5-Pt-1) Avail: NTIS HC A08/MF A01 CSCL 01C

Subroutines for determining the weights of propulsion system related components and the airframe components of an aircraft configuration are presented. Subroutines that deal with design load conditions, aircraft balance, and tail sizing are included. Options for turbine and internal combustion engines are provided. A.R.H.

N81-19093*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 6: PERFORMANCE. PART 1: THEORETICAL DEVELOPMENT
D. Hague Jan. 1978 121 p refs 6 Vol.
(Contract NAS2-9352)
(NASA-CR-152303-Vol-6-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 01C

Aircraft performance modeling requires consideration of propulsion, aerodynamics, and weight characteristics. Eleven subroutines used in modeling aircraft performance are presented and their interactions considered. Manuals for performance model users and programmers are included. A.R.H.

N81-19094*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 7: ECONOMICS. PART 1: THEORETICAL DEVELOPMENT
Jan. 1978 39 p refs
(Contract NAS2-9352)
(NASA-CR-152303-Vol-7-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 01C

The economic analysis includes: manufacturing costs; labor costs; parts costs; operating costs; markups and consumer price. A user's manual for a computer program to calculate the final consumer price is included. S.F.

N81-19095*# Grumman Aerospace Corp., Bethpage, N.Y.
VTOL IN GROUND EFFECT FLOWS FOR CLOSELY SPACED JETS Final Report
David Migdal, William G. Hill, Jr., and Richard C. Jenkins Dec. 1979 195 p refs
(Contract NAS2-10097)
(NASA-CR-152321) Avail: NTIS HC A09/MF A01 CSCL 01C

Results of a series of in ground effect twin jet tests are presented along with flow models for closely spaced jets to help predict pressure and upwash forces on simulated aircraft surfaces. The isolated twin jet tests revealed unstable fountains over a range of spacings and jet heights, regions of below ambient pressure on the ground, and negative pressure differential in the upwash flow field. A separate computer code was developed for vertically oriented, incompressible jets. This model more accurately reflects fountain behavior without fully formed wall jets, and adequately predicts ground isobars, upwash dynamic pressure decay, and fountain lift force variation with height above ground. E.A.K.

N81-19096*# Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 1: NONPLANAR, NONLINEAR WING/JET LIFTING SURFACE METHOD
C. A. Shollenberger and D. N. Smyth Mar. 1978 91 p refs
(Contract NAS2-9319)
(NASA-CR-152087-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 01C

A nonlinear, nonplanar three dimensional jet flap analysis, applicable to the ground effect problem, is presented. Lifting surface methodology is developed for a wing with arbitrary planform operating in an inviscid and incompressible fluid. The classical, infintely thin jet flap model is employed to simulate power induced effects. An iterative solution procedure is applied within the analysis to successively approximate the jet shape until a converged solution is obtained which closely satisfies jet and wing boundary conditions. Solution characteristics of the method are discussed and example results are presented for unpowered, basic powered and complex powered configurations. Comparisons between predictions of the present method and experimental measurements indicate that the improvement of the jet with the ground plane is important in the analyses of powered lift systems operating in ground proximity. Further development of the method is suggested in the areas of improved solution convergence, more realistic modeling of jet impingement and calculation efficiency enhancements. Author

N81-19097*# Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 2: NONPLANAR, NONLINEAR METHOD APPLICABLE TO THREE DIMENSIONAL JETS OF FINITE THICKNESS
C. A. Shollenberger Mar. 1978 36 p refs
(Contract NAS2-9319)
(NASA-CR-152088-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 01C

The ability of the potential flow analysis (POTFAN) to predict the influence of ground proximity on lift systems is examined. A two dimensional study employing vortex lattice methodology provides confidence that ground effect phenomenon can be predicted using discrete singularity representation. Two dimensional quasi-steady ascent and descent behavior determined provides guidance in interpreting three dimensional results. Steady and quasi-steady ground effect aerodynamic characteristics predicted by POTFAN are presented for several basic unpowered configurations. POTFAN results are compared with experimental data and results of other analytical methods. Modification of POTFAN to incorporate multienergy flow analysis is discussed. General aspects of thick jet models are examined to provide a basic for extending POTFAN's scope to include analysis of propulsive lift interactions. S.F.

N81-19098*# Systems Control, Inc., Palo Alto, Calif.
DEVELOPMENT OF ADVANCED TECHNIQUES FOR ROTORCRAFT STATE ESTIMATION AND PARAMETER IDENTIFICATION
W. E. Hall, Jr., J. G. Bohn, and J. H. Vincent Nov. 1980 265 p refs
(Contract NAS1-14549)
(NASA-CR-159297) Avail: NTIS HC A12/MF A01 CSCL 01C

An integrated methodology for rotorcraft system identification consists of rotorcraft mathematical modeling, three distinct data processing steps, and a technique for designing inputs to improve the identifiability of the data. These elements are as follows: (1) a Kalman filter smoother algorithm which estimates states and sensor errors from error corrupted data. Gust time histories and statistics may also be estimated; (2) a model structure estimation algorithm for isolating a model which adequately

explains the data; (3) a maximum likelihood algorithm for estimating the parameters and estimates for the variance of these estimates; and (4) an input design algorithm, based on a maximum likelihood approach, which provides inputs to improve the accuracy of parameter estimates. Each step is discussed with examples to both flight and simulated data cases. A.R.H.

N81-19099*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF ENGINE NACELLES ON A TRANSPORT CONFIGURATION WITH HIGH LIFT DRAG RATIOS TO A MACH NUMBER OF 1.00
Stuart G. Flechner 16 Feb. 1971 20 p ref
(NASA-TM-82312; LWP-939) Avail: NTIS HC A02/MF A01 CSCL 01C

Wind tunnel tests to determine the effect of engine nacelles added to a low wing fuselage vertical tail configuration utilizing the NASA supercritical airfoil and a refined area ruled fuselage are discussed. The engine arrangement consisted of two aft fuselage, side mounted flow through nacelles and a solid body of revolution mounted above the fuselage in a manner similar to the Boeing 727. A preliminary analysis of the wind tunnel data shows that favorable interference drag can be obtained with the proper longitudinal locations of the nacelles, by canting the nacelle inlets, and by cusping the rearward region of the nacelle. M.G.

N81-19100*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HISTORICAL OVERVIEW OF V/STOL AIRCRAFT TECHNOLOGY
Seth B. Anderson Mar. 1981 16 p
(NASA-TM-81280; A-8511) Avail: NTIS HC A02/MF A01 CSCL 01C

The requirements for satisfactory characteristics in several key technology areas are discussed and a review is made of various V/STOL aircraft for the purpose of assessing the success or failure of each design in meeting design requirements. Special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects. T.M.

N81-19101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ROLE OF THE RESEARCH SIMULATOR IN THE SYSTEMS DEVELOPMENT OF ROTORCRAFT
Irving C. Statler and Arlin Deel Mar. 1981 25 p refs Prepared in cooperation with Army Aviation and Development Command, Moffet Field, Calif.
(NASA-TM-81276; USAAVRADCOM-TR-81-A-7) Avail: NTIS HC A02/MF A01 CSCL 01C

The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is examined. Current simulation capabilities for fixed-wing aircraft are reviewed and the requirements of a rotorcraft simulator are defined. The visual system components, vertical motion simulator, cab, and computation system for a research simulator under development are described. M.G.

N81-19102# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
WIND TUNNEL TESTS TO DETERMINE THE BEHAVIOR DURING EJECTION OF EXTERIOR STORES AT HIGH AND LOW SPEEDS [WINDKANALUNTERSUCHUNGEN ZUR ERMITTLUNG DES ABGANGSVERHALTENS VON AUSSENLASTEN IM NIEDER- UND HOCHGESCHWINDIGKEITSBEREICH]
P. Esch and T. Windeck 1979 13 p refs In GERMAN Presented at DGLR Symp. on der Abgang von Lasten und Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979
(DLGR-79-096) Avail: NTIS HC A02/MF A01

Wind tunnel simulation of an actual flying test was undertaken to test the ejection behavior of external loads. Experiments with these dynamic procedures require examining of questionable conditions which require complicated research methods and techniques when testing for low speed and high speed ranges. The wind tunnel technique which uses hypotheses and speed measurements, the Froude number, the heavy model method, and the light model method, is routinely employed in low and high speed research. Besides a description of the research methods and techniques, the influences of different parameters are shown and examples are given of comparisons between the launching of simulated and actual models. Transl. by E.A.K.

N81-19103# Naval Research Lab., Washington, D. C. Information Processing Systems Branch.
EVALUATION OF THE A-7 REQUIREMENTS DOCUMENT BY ANALYSIS OF CHANGE DATA Interim Report
Victor R. Basili (Maryland Univ.) and David M. Weiss 29 Dec. 1980 21 p refs
(RR0140941)
(AD-A094888; NRL-8445) Avail: NTIS HC A02/MF A01 CSCL 09/2

We describe in this report an effective data collection method for evaluating software development methodologies, from definition of the objectives of the data collection to analysis of the results. We show how the data analysis can answer questions with respect to how successfully the goals of the development methodology are met. The A-7 requirements document is used as an example. We provide the results of data analyses conducted partway through the A-7 flight software development cycle, and we discuss the utility of information obtained by such partial analyses. Results from the study show that data collection is feasible and useful when performed as part of configuration control, that data distributions based on partial data provided useful feedback to the developers, and that the A-7 requirements document is easily maintained and changed. GRA

N81-19105# Lockheed-Georgia Co., Marietta.
FEASIBILITY STUDY FOR C-141B REDUCTION OF WING LOADS BY UPRIGGING THE AILERONS
Gene S. Jamison 10 Sep. 1980 35 p refs
(Grant F09603-80-G-0417)
(AD-A094634; LG80ER0144) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report summarizes an investigation into the feasibility of uprigging the ailerons on the C-141B to reduce wing loads. The potential wing loads reductions were based on early wind tunnel data and were corroborated by recent flight test data at a mid-span location. Crack growth computations were made for four wing locations. Significant increases in structural safety limits for the two lower surface locations ranged from an improvement factor of 1.18 (3 deg uprig) to 2.731 (6 deg uprig) depending on location. Similar percentage increases could be expected in inspection intervals and structural durability. Two wing upper surface locations showed no significant change from aileron uprigging. An examination of the potential impact on pitch trim requirements, roll response and dutch roll characteristics indicated only negligible effects from moderate aileron uprigging. GRA

N81-19106# Bell Helicopter Co., Fort Worth, Tex.
HELICOPTER EXTERNAL LOAD ACQUISITION TECHNOLOGY INVESTIGATION Final Report
Herman Franks and B. C. Bowen Dec. 1980 94 p refs
(Contract DAAK51-79-C-0058; DA Proj. 1L1-62209-AH-76)
(AD-A094672; USAAVRADCOM-TR-80-D-28) Avail: NTIS HC A05/MF A01 CSCL 01/2

The purpose of this study was to identify, analyze, and evaluate methods of improving the acquisition of sling and/or netted loads by a hovering helicopter under poor visibility and other hazardous conditions. Flight and ground crew tasks required to support the external cargo operations were analyzed and resulting baseline crew workloads defined. Hazard analyses of the mission phases were accomplished and hazard categories identified. The results of these analyses were then used as criteria for selecting potential concept candidates for improvement in external load acquisition. Ten candidate concepts were identified. Each was evaluated against established baselines and then ranked in order of improvement over the baseline concept. GRA

N81-19107# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

TIME-CONSTRAINED MAXIMUM-ENERGY TURNS M.S. Thesis

Steven Petersen Dec. 1980 73 p refs
(AD-A094733; AFIT/GAE/AA/80D-17) Avail: NTIS HC A04/MF A01 CSCL 01/2

The object of this study is to find the trajectories which a high performance aircraft would employ to maximize the change in specific energy during a prescribed turn. These values of the change in specific energy are compared to the changes in specific energy which result from a minimum time turn. A suboptimal control approach, which uses both gradient and second order techniques, is employed to find the maximum specific energy trajectories. The results of the study show that turning times slightly greater than the minimum turning time allow large increases in aircraft specific energy and that the trajectories can be flown with simple control inputs. GRA

N81-19109# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

INVESTIGATION OF AN IMPROVED FLUTTER SPEED PREDICTION TECHNIQUE FOR DAMAGED T-38 HORIZONTAL STABILATORS USING NASTRAN M.S. Thesis

Roger Kent Thomson Dec. 1980 154 p refs
(AD-A094769; AFIT/GAE/AA/80D-21) Avail: NTIS HC A08/MF A01 CSCL 01/3

This thesis concerns the development of a finite element model of the T-38 horizontal stabilator for use on NASTRAN. The model is to be used to analyse degradations in flutter speed due to repair. Static analysis has shown the model to be lacking in torsional stiffness, the probable cause being the inability of NASTRAN plate bending elements to model torsion cells. An increase of elastic and shear moduli of plate bending elements in the model by 30 percent produced more accurate results but additional investigation is necessary. Modal analysis has pointed to a modeling error in the root, trailing edge area. The affect has caused an additional node to appear on the trailing edge for modes above 100 cps in a free-free condition. Investigation of the steady aerodynamic pressure distribution over the stabilator shows good correlation with experimental results. A flutter analysis procedure was established and the affects of the errors found in the structural model were investigated. With no corrections made to the model, a flutter speed equivalent to that predicted using strip theory was achieved for the sea level condition. GRA

N81-19111*# RAND Corp., Santa Monica, Calif.

PREDICTING COST/RELIABILITY/MAINTAINABILITY OF ADVANCED GENERAL AVIATION AVIONICS EQUIPMENT Final Report

M. R. Davis, M. Kamins, and W. E. Mooz Jun. 1978 126 p refs
(Contract NAS2-9450)
(NASA-CR-152149; RAND/WN-10233-NASA) Avail: NTIS HC A07/MF A01 CSCL 01D

A methodology is provided for assisting NASA in estimating the cost, reliability, and maintenance (CRM) requirements for general avionics equipment operating in the 1980's. Practical problems of predicting these factors are examined. The usefulness and short comings of different approaches for modeling coast and reliability estimates are discussed together with special problems caused by the lack of historical data on the cost of maintaining general aviation avionics. Suggestions are offered on how NASA might proceed in assessing cost reliability CRM implications in the absence of reliable generalized predictive models. A.R.H.

N81-19112*# Sperry Flight Systems, Phoenix, Ariz.

V/STOL AND DIGITAL AVIONICS SYSTEM FOR UH-1H Final Report

Sam Liden Oct. 1978 216 p refs
(Contract NAS2-7306)
(NASA-CR-152179) Avail: NTIS HC A10/MF A01 CSCL 01D

A hardware and software system for the Bell UH-1H helicopter was developed that provides sophisticated navigation, guidance, control, display, and data acquisition capabilities for performing terminal area navigation, guidance and control research. Two Sperry 1819B general purpose digital computers were used. One contains the development software that performs all the specified system flight computations. The second computer is available to NASA for experimental programs that run simultaneously with the other computer programs and which may, at the push of a button, replace selected computer computations. Other features that provide research flexibility include keyboard selectable gains and parameters and software generated alphanumeric and CRT displays. T.M.

N81-19113# Boeing Military Airplane Development, Seattle, Wash. Advanced Airplane Branch.

INTEGRATED STRIKE AVIONICS STUDY, VOLUME 1 Final Report, 6 Aug. 1979 - 22 Sep. 1980

Harry R. Fox, G. L. Helser, F. M. Kim, R. L. Kinnaman, and M. R. Wallace Oct. 1980 225 p ref
(Contract F33615-79-C-1932)
(AD-A094705; D180-26023-1; AFWAL-TR-80-1145-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 19/5

This document reports the results of the integrated strike avionics study (ISAS). Advanced fire control concepts emphasizing the modular integration of current and emerging sensors and reduced crew workload were formulated and evaluated. A preferred system concept embodying the best features of the systems evaluated consisted of a Ku-SAR multimode radar, FLIR and Silicon TV EO sensors and a 3D Target Classifier. The mechanization was automatic with crewman participation. Post-autocuer/autoclassifier integration of sensors, manual-automatic mechanization of concepts, and improved terminal weapon guidance were recommended. GRA

N81-19114# Department of Transportation, Washington, D. C. Transportation Information Div.

GENERAL AVIATION AVIONICS STATISTICS Annual Report

Judith C. Schwenk, Paula Shafer, Preeti Pandit, and Wilson Hill (Wilson Hill Associates) Dec. 1980 125 p refs
(Contract DOT-TSC-1750)
(AD-A095148; FAA-MS-80-7; TSC-FAA-80-25) Avail: NTIS HC A06/MF A01 CSCL 01/3

This report presents avionics statistics for the 1978 general aviation (GA) aircraft fleet and is the fifth in a series titled General Aviation Avionics Statistics. The statistics are presented in a capability group framework which enables one to relate airborne avionics equipment to the capability for a GA aircraft to function in the National Airspace System. The word 'capability' is used in this report to mean in what segments of the airspace an aircraft can fly, under what flight rules it can fly, and at what airports it can land. The framework permits the GA fleet to be divided into groups according to their capabilities as dictated by the avionics configurations of the aircraft. Differences in various characteristics of the aircraft are examined among the capability groups. The FAA's Sample File of results from the 1978 GA Activity and Avionics Survey is the source of all the statistical data used in this report. GRA

N81-19115* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPARATUS FOR SENSOR FAILURE DETECTION AND CORRECTION IN A GAS TURBINE ENGINE CONTROL SYSTEM Patent

Henry A. Spang, III (GE, Cincinnati) and Robert P. Wanger, inventors (to NASA) (GE, Cincinnati) Issued 3 Feb. 1981 14 p Filed 24 May 1978 Continuation in part of abandoned US Patent Appl. SN-752050, filed 20 Dec. 1976 Sponsored by NASA
(NASA-Case-LEW-12907-2; US-Patent-4,249,238; US-Patent-Appl-SN-909235; US-Patent-Appl-SN-752050; US-Patent-Class-364-106; US-Patent-Class-60-39.24; US-Patent-Class-364-431) Avail: US Patent and Trademark Office CSCL 21E

A gas turbine engine control system maintains a selected level of engine performance despite the failure or abnormal operation of one or more engine parameter sensors. The control system employs a continuously updated engine model which simulates engine performance and generates signals representing real time estimates of the engine parameter sensor signals.

The estimate signals are transmitted to a control computational unit which utilizes them in lieu of the actual engine parameter sensor signals to control the operation of the engine. The estimate signals are also compared with the corresponding actual engine parameter sensor signals and the resulting difference signals are utilized to update the engine model. If a particular difference signal exceeds specific tolerance limits, the difference signal is inhibited from updating the model and a sensor failure indication is provided to the engine operator.

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

N81-19116* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INTEGRATED CONTROL SYSTEM FOR A GAS TURBINE ENGINE Patent

Jack E. Cornett (GE, Cincinnati), Andrew A. Saunders, Jr. (GE, Cincinnati), Ira E. Marvin (GE, Cincinnati), and Richard S. Beitler, inventors (to NASA) (GE, Cincinnati) Issued 6 Jan. 1981 10 p Filed 25 May 1978 Continuation in part of abandoned US Patent Appl. SN-741056, filed 11 Nov. 1976 Sponsored by NASA

(NASA-Case-LEW-12594-2; US-Patent-4,242,864; US-Patent-Appl-SN-909608; US-Patent-Appl-SN-741056; US-Patent-Class-60-226R; US-Patent-Class-60-236; US-Patent-Class-60-238; US-Patent-Class-60-239) Avail: US Patent and Trademark Office CSCL 21E

A control system for a turbofan engine receives signals from a number of engine sensors and from the engine operator, and generates control signals. One control signal regulates the fan exhaust nozzle area in order to control inlet throat Mach number to maintain a low level of engine noise. Additional control signals regulate fuel flow to control engine thrust and fan pitch to control fan speed. A number of schedules are utilized to maintain a predetermined relationship between the controlled parameters and a number of fixed and calculated limits can override the control signals to prevent unsatisfactory engine performance.

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

N81-19117*# AiResearch Mfg. Co., Phoenix, Ariz.

GENERAL AVIATION TURBINE ENGINE (GATE) STUDY Final Report

C. F. Baerst and D. G. Furst 5 Feb. 1979 274 p refs

(Contract NAS3-20755)

(NASA-CR-159482; AiResearch-21-2997) Avail: NTIS HC A12/MF A01 CSCL 21E

The feasibility of turbine engines for the smaller general aviation aircraft was investigated and a technology program for developing the necessary technology was identified. Major results included the definition of the 1988 general aviation market, the identification of turboprop and turboshaft engines that meet the requirements of the aircraft studies, a benefit analysis showing the superiority of gas turbine engines for portions of the market studied, and detailed plans for the development of the necessary technology. J.M.S.

N81-19118*# Detroit Diesel Allison, Indianapolis, Ind.

CERAMIC APPLICATIONS IN TURBINE ENGINES Semiannual Progress Report, 1 Jul. 1979 - 3 Dec. 1979

Michael S. Hudson, Michael A. Janovicz, and Franklin A. Rockwood May 1980 157 p refs

(Contracts DEN3-17; EC-77-A-31-1040)

(NASA-CR-159865; EDR-10156) Avail: NTIS HC A08/MF A01 CSCL 21E

Ceramic material characterization and testing of ceramic nozzle vanes, turbine tip shrouds, and regenerators disks at 36 C above the baseline engine TIT and the design, analysis, fabrication and development activities are described. The design of ceramic components for the next generation engine to be operated at 2070 F was completed. Coupons simulating the critical 2070 F rotor blade was hot spin tested for failure with sufficient margin to quality sintered silicon nitride and sintered silicon carbide, validating both the attachment design and finite element strength. Progress made in increasing strength, minimizing variability, and developing nondestructive evaluation techniques is reported. E.A.K.

N81-19119*# AiResearch Mfg. Co., Phoenix, Ariz.

QCGAT MIXER COMPOUND EXHAUST SYSTEM DESIGN AND STATIC BIG MODEL TEST REPORT

W. L. Blackmore and C. E. Thompson 31 Oct. 1978 336 p refs

(Contract NAS3-20585)

(NASA-CR-135386; AiResearch-21-2861) Avail: NTIS HC A15/MF A01 CSCL 21E

A mixer exhaust system was designed to meet the proposed performance and exhaust jet noise goals for the AiResearch QCGAT engine. Some 0.35 scale models of the various nozzles were fabricated and aerodynamically and acoustically tested. Preliminary optimization, engine cycle matching, model test data and analysis are presented. A final mixer exhaust system is selected for optimum performance for the overall flight regime. A.R.H.

N81-19120*# Avco Lycoming Div., Stratford, Conn.

DESIGN OF AN EXHAUST MIXER NOZZLE FOR THE AVCO-LYCOMING QUIET CLEAN GENERAL AVIATION TURBOFAN (QCGAT)

John F. Hurley, Leonard Anson, and Craig Wilson Aug. 1978 46 p refs

(Contract NAS3-20584)

(NASA-CR-159426; LYC-78-36) Avail: NTIS HC A03/MF A01 CSCL 21E

This report describes the design configuration and method used to design the forced engine exhaust to bypass air mixing system for Lycoming's QCGAT engine. This mixer is an integral part of the total engine and nacelle system and was configured to reduce the propulsion system noise and fuel consumption levels. Author

N81-19122*# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.

MEASUREMENTS OF AERODYNAMIC DAMPING IN THE MIT TRANSONIC ROTOR

Edward F. Crawley Feb. 1981 123 p refs

(Grant NsG-3079)

(NASA-CR-163988; GTL-157) Avail: NTIS HC A06/MF A01 CSCL 21E

A method was developed and demonstrated for the direct measurement of aerodynamic forcing and aerodynamic damping of a transonic compressor. The method is based on the inverse solution of the structural dynamic equations of motion of the blade disk system in order to determine the forces acting on the system. The disturbing and damping forces acting on a given blade are determined if the equations of motion are expressed in individual blade coordinates. If the structural dynamic equations are transformed to multiblade coordinates, the damping can be measured for blade disk modes, and related to a reeuced frequency and interblade phase angle. In order to measure the aerodynamic damping in this way, the free response to a known excitation is studied. Author

N81-19123# Avco Lycoming Div., Stratford, Conn.

REGENERATIVE ENGINE ANALYSIS PROGRAM Final Study Report, Oct. 1979 - Jul. 1980

P. Schwaar, J. Dale, and J. Banks Jan. 1981 199 p refs

(Contract DAAK51-79-C-0056; DA Proj. 1L1-62209-AH-76)

(AD-A095144; LYC-80-73) Avail: NTIS HC A09/MF A01 CSCL 21/5

A parametric cycle analysis and a preliminary recuperator design study were conducted for a 500 hp intermediate rated power (IRP) recuperative helicopter engine. The U-tube recuperator with airflow inside the tubes and single cross flow gas path was found to be the lightest design in the .6 - .8 effectiveness range considered for the cycle analysis. GRA

N81-19124# Pennsylvania State Univ., University Park. Applied Research Lab.

COUPLING OF UNSTEADY LIFT TO ACOUSTIC DUCT MODES IN AN AXIAL FLOW FAN

C. S. Lee 15 Sep. 1980 135 p refs

(Contract N00024-79-C-6043)

(AD-A095080; ARL/PSU/TM-80-188) Avail: NTIS HC A07/MF A01 CSCL 21/5

By using distortion screens, plane (0,0) and spinning (-1,0) acoustic modes were generated in an axial flow research fan. The unsteady lift on the rotor blade and the acoustic pressure along the duct were measured simultaneously by a lift gage sensor and a flush-mounted microphone respectively. The screens were calibrated by circumferentially traversing a five-hole probe. The typical background noise of unsteady lift and acoustic pressure was well below the desired signals. A phase-locked ensemble averaging technique was used to obtain the amplitude and phase of the periodic unsteady signals. The measured acoustic pressures were decomposed into modal pressures and compared with theoretical prediction; a reasonable trend was reached, but the discrepancies were large. The unsteady lift measurements of (-1,0) mode generation agreed with predictions except near the cutoff frequency indicating a back-reaction effect of considerable magnitude. The predictions overestimated the unsteady lift for the condition of 'aerodynamic resonance' when the plane wave was generated. GRA

N81-19126# Rolls-Royce Ltd., Derby (England).
ON THE INFLUENCE OF STEADY STATE TEMPERATURE AND PRESSURE DISTORTION ON THE FLOW CHARACTERISTICS IN AN INSTALLED MULTISTAGE JET ENGINE COMPRESSOR
Hermann Kuenkler (Technische Hochschule, Aachen) and Hans Toenskoetter (Technische Hochschule, Aachen) 1980 32 p refs Transl. into ENGLISH from Z. Flugwiss. Weltraumforsch. 3, v. 6, 1979 p 360-378
(Contract DFG-SFB-38)
(PNR-90022; Trans-15068) Avail: NTIS HC A03/MF A01

An experimental determination of the local variation of flow fields due to steady state circular distortion in a multistage jet engine compressor was made, taking into account the operating conditions and restraints of the complete turbine engine interaction. To simulate disturbances a four quadrant intake section was placed before the engine (a single shaft ATAR). Temperature disturbances were produced by mixing hot air into the intake flow. A qualititative analysis was made in advance on the effects of the disturbances on the flow characteristics considering the interaction between the disturbed and undisturbed compressor flow. With this prediction and by use of computer aided test methods it is possible to significantly reduce the complexity of the test and the test equipment facilities. Author (ESA)

N81-19127# Rolls-Royce Ltd., Derby (England).
THE CALCULATION OF QUASI-THREE-DIMENSIONAL FRICTIONLESS COMPRESSIBLE FLOW IN AXIAL TURBOMACHINES
S. Biniaris 1980 14 p Transl. into ENGLISH from VDI Ber., No. 193, 1973
(PNR-90047; Trans-15292) Avail: NTIS HC A02/MF A01

A method of calculating quasi-three dimensional frictionless flow in axial turbomachines is presented. The flow field is calculated not only in the bladeless spaces but also within the rows of blades. The compressibility, the blade forces and the blade thickness are taken into account. A finite difference method, an extension of earlier work with which initially the quasi-three dimensional flow could only be calculated within a stationary or rotating row of blades is used. As calculation examples, the flow parameters in the complete field of three axial turbine stages are given. Author (ESA)

N81-19128# Elektroschmelzwerk Kenpten G.m.b.H., Munich (West Germany).
DEVELOPMENT AND FABRICATION OF REFRACTORY SILICON CARBIDE BODIES, ESPECIALLY FOR GAS TURBINE ENGINES Final Report
Jochen Kriegesmann, Alfred Lipp, Klaus Reinmuth, Karl A. Schwetz, and Detlef vonStruensee Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 42 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-137; ISSN-0340-7608) Avail: NTIS HC A03/MF A01

The production parameters and the properties of hot pressed silicon carbide forms were investigated. Both alpha and beta silicon carbide powders were used as starting materials for hot pressing. Hot pressed silicon carbide parts, especially rotors used in gas turbine engines, were examined by thermoshock and spin testing. Results show that the properties of the resulting forms, especially the high temperature strength and fracture behavior, strongly depend upon the kind and the quantity of the sintering powder. Regardless which silicon carbide powder is used, precompacted and presintered silicon carbide parts are further densified by hot isostatic pressing. Author (ESA)

N81-19129# Annawerk Keramische Betriebe G.m.b.H., Roedental (West Germany). Bereich Ceranox.
DEVELOPMENT OF GAS TURBINE COMPONENTS, USING SILICON NITRIDE Final Report
Ernst Gugel, Norbert Mueller, Albrecht Fickel, Heinz Kessel, Gerhard Leimer, Hans Lindner, Antonin Novotny, Isfried Petzenhauser, Detlef Steinmann (Degussa), Adam Both (Degussa) et al Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 109 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-152; ISSN-0340-7608) Avail: NTIS HC A06/MF A01

Ceramic, gas turbine component development is described. Designs comprehend working temperatures up to 1350 C. Both reaction sintering (RS) and hot pressing (HP) of silicon nitride materials are considered. OF all molding methods examined, injection molding and slip casting for RS components and axial as well as quasi-isostatic hot pressing for HP components prove most successful. As to compounding technology, the post-hot pressing technique is shown very promising. A large number of molded parts, i.e., turbine blades, blade rings, nose cones, flame tubes, and HP/RS rotor prestages, were produced and successfully tested. Spin speeds of 69,000 rpm for the RS turbine blades and 110,000 rpm for an HP rotor hub are reported. A large number of special testing methods were developed and are described in reference to their application. Results show that bending strength is increased for RS and HP silicon nitride parts up to values of > or equal 250 N/sq mm and > or equal 700 N/sq mm, respectively. Creep stability is also satisfactory. Author (ESA)

N81-19130* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THRUST AUGMENTED SPIN RECOVERY DEVICE Patent
Bobby L. Berrier, inventor (to NASA) Issued 2 Dec. 1980 6 p Filed 27 Apr. 1979 Supersedes N80-18048 (18 - 09, p 1095) Continuation of US Patent Appl. SN-272503, filed 28 Sep. 1976
(NASA-Case-LAR-11970-2; US-Patent-4,236,684; US-Patent-Appl-SN-034104; US-Patent-Appl-SN-727503; US-Patent-Class-244-52; US-Patent-Class-244-87; US-Patent-Class-244-12.5) Avail: US Patent and Trademark Office CSCL 01C

Yaw control surfaces were developed for a jet propelled aircraft. A thrust augmented rudder is disposed above the jet exhaust stream and a thrust rudder tab extends downward into the jet exhaust stream. These components are cooperatively deflected to generate yawing moments for directional control of the aircraft. T.M.

N81-19131*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT-TEST EVALUATION OF STOL CONTROL AND FLIGHT DIRECTOR CONCEPTS IN A POWERED-LIFT AIRCRAFT FLYING CURVED DECELERATING APPROACHES
W. S. Hindson (National Research Council of Canada, Ottawa, Ontario), G. H. Hardy, and R. C. Innis Mar. 1981 96 p refs (NASA-TP-1641; A-8190) Avail: NTIS HC A05/MF A01 CSCL 01C

Flight tests were carried out to assess the feasibility of piloted steep curved, and decelerating approach profiles in powered lift STOL aircraft. Several STOL control concepts representative of a variety of aircraft were evaluated in conjunction with suitably designed flight directions. The tests were carried out in a real

navigation environment, employed special electronic cockpit displays, and included the development of the performance achieved and the control utilization involved in flying 180 deg turning, descending, and decelerating approach profiles to landing. The results suggest that such moderately complex piloted instrument approaches may indeed be feasible from a pilot acceptance point of view, given an acceptable navigation environment. Systems with the capability of those used in this experiment can provide the potential of achieving instrument operations on curved, descending, and decelerating landing approaches to weather minima corresponding to CTOL Category 2 criteria, while also providing a means of realizing more efficient operations during visual flight conditions. Author

N81-19132*# National Aeronautics and Space Administration, Washington, D. C.
A BRIEF ANALYSIS AND ITS EXPERIMENT OF THE HYDRAULIC-ELECTRIC LOADING SERVOSYSTEM
Ma Liango-fu Dec. 1980 23 p refs Transl. into ENGLISH of Rept. HK80071, Aug. 1980 p 1-21 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Chinese Aeronautical Establishment, Beijing
(Contract NASw-3199)
(NASA-TM-76458; HK80071) Avail: NTIS HC A02/MF A01 CSCL 01C

The servosystem is a force simulator. It can be used to simulate the hinge moment of the control surface for aircraft, and still be a stick force generator. According to the experiences of a real system, theoretical analyses of the loading system and its characteristics were performed and the possibility of improving its performances is discussed. T.M.

N81-19133# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Advanced Aircraft Navigation Section.
ESTIMATION AND STATISTICAL AVERAGING APPLIED TO REDUNDANT STRAPPED DOWN INERTIAL SENSORS FOR NAVIGATION AND FLIGHT CONTROL Final Report, 1 Aug. 1978 - 1 Feb. 1980
Jack W. Bell Sep. 1980 143 p refs
(AF Proj. 666A)
(AD-A094465; AFWAL-TR-80-1088) Avail: NTIS HC A07/MF A01 CSCL 17/7

The concept of providing inertial data to satisfy on-board avionic functions from an integrated, strapped down, redundant inertial sensor reference system is presently receiving attention for military and commercial aircraft applications. Strapped down inertial sensors are well suited for flight control. However, in the highly dynamic environment of high performance aircraft, the present accuracy provided by strapped down inertial reference systems (IRS) is insufficient to meet navigation and weapon delivery requirements. Performance improvement of an IRS employing redundant strapped down inertial sensors of specified ensemble is the subject of this study. Two techniques to improve the performance are considered. One technique is to combine all redundant data from non-failed sensors, through a statistical average, into a orthogonal triad inertial reference frame. This is accomplished by weighted-least-squares averaging. A second technique is the use of an improved gyro and accelerometer output and output rate estimation scheme. Estimation algorithms are developed using Kalman Filter theory and evaluated in a highly dynamic environment. Least-squares averaging of the redundant sensor data can significantly improve the navigation system performance. However, sensor misalignment errors must be minimized such that they are not the dominant sensor error source. GRA

N81-19135# European Space Agency, Paris (France).
IN-FLIGHT HANDLING QUALITIES INVESTIGATION OF A310 AIRBUS DLC-CONFIGURATIONS ON LANDING APPROACH, USING THE DFVLR-HFB 320 IN-FLIGHT SIMULATOR (VARIABLE STABILITY AIRCRAFT)
Dietrich Hanke Nov. 1980 85 p refs Transl. into ENGLISH of Fliegbarkeitsuntersuchung von DLC-Konfigurationen fuer den Airbus A310 im Landeanflug mit dem In-Flight-Simulator DFVLR-HFB 320, DFVLR, Brunswick, Rept. DFVLR-FB-79-18, Feb. 1979 Original report in GERMAN previously announced as N81-10078
(ESA-TT-630; DFVLR-FB-79-18) Avail: NTIS HC A05/MF A01

The in-flight simulation of the longitudinal and lateral/directional dynamics of the planned Airbus A310 aircraft using the DFVLR-HFB 320 variable stability aircraft is described. Emphasis is on the evaluation of different spoiler direct lift control (DLC) concepts for longitudinal control. The invluence of these concepts on handling qualities and pilot vehicle performance under real ILS approach environmental conditions is determined. Two pilots flew 63 ILS approaches evaluating four aircraft/DLC configurations. The flight path to pitch attitude phase is found to be the main handling quality parameter for DLC enhanced longitudinal control. A generally applicable flight path to pitch attitude phase criterion is proposed. Author (ESA)

N81-19136*# Systems Control, Inc., Palo Alto, Calif.
SIMULATION AND CONTROL ENGINEERING STUDIES OF NASA-AMES 40 FOOT BY 80 FOOT/80 FOOT BY 120 FOOT WIND TUNNELS Final Report, Aug. 1977 - Mar. 1978
Jeff G. Bohn and J. Edwin Jones 26 May 1978 316 p refs (Contract NAS2-9665)
(NASA-CR-152145) Avail: NTIS HC A14/MF A01 CSCL 14B

The development and use of a digital computer simulation of the proposed wind tunnel facility is described. The feasibility of automatic control of wind tunnel airspeed and other parameters was examined. Specifications and implementation recommendations for a computer based automatic control and monitoring system are presented. T.M.

N81-19137*# National Aeronautics and Space Administration, Washington, D. C.
ROTATIVE BALANCE OF THE I.M.F. LILLE AND ASSOCIATED EXPERIMENTAL TECHNIQUES
R. Verbrugge Jan. 1981 51 p Transl. into ENGLISH of "Balance rotative de l'I.M.F. Lille et techniques experimentales associees" AAAF Paper NT 80-13 Lille, 1979 50 p Presented at the 16th Colloq. Aerodyn. Appl., Lille, 13-15 Nov. 1979 Original language document was announced as A80-36844 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. de Mecanique des Fluides de Lille
(Contract NASw-3199)
(NASA-TM-75886) Avail: NTIS HC A04/MF A01 CSCL 14B

The study of aerodynamic effects at high incidence associated with motions of wide amplitude incorporating continuous rotations requires the consideration of coupled effects, which are generally nonlinear, in a formulation of equations of motion. A rotative balance designed to simulate such maneuvers in a windtunnel was created to form a test medium for analytical studies. A general description of the assembly is provided by considering two main ranges of application. The capacities and performance of the assembly are discussed. T.M.

N81-19139*# National Aeronautics and Space Administration, Washington, D. C.
FIRST RESULTS OBTAINED BY THE AMD-BA COMPANY FROM THE ROTARY ASSEMBLY OF THE AMF LILLE
C. Couedor Jan. 1981 21 p Transl. into ENGLISH of conf. paper presented at the 16th Colloq. d'Aerodyn. Appl. p 1-21 Colloq. held in Lille, France, 13-15 Nov. 1979 Original language document was announced as A80-36845 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-75887) Avail: NTIS HC A02/MF A01 CSCL 14B

Efforts were made to extend flight range of combat airplanes to high incidences. The static and dynamic results obtained on a modern combat airplane with data wings are presented. R.C.T.

N81-19140# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
THE PROBLEMS WITH THE INTERFACE SYSTEM OF THE VISUAL SIMULATOR AS A CAUSE OF PILOT INDUCED OSCILLATIONS (PIO'S) IN FLIGHT SIMULATORS [PROBLEME DER SIMULATOR-/SICHTSYSTEM-NAHTSTELLE

ALS URSACHE FUER PILOT-INDUCED OSCILLATIONS (PIO'S) IN FLUGSIMULATOREN]
P. Koenig and W. Metze 4 Mar. 1980 18 p refs In GERMAN
(MBB-UA-528-80-Oe) Avail: NTIS HC A02/MF A01

Regulations on technical aspects of pilot induced oscillations inflight simulators are discussed. The problems in the system implementation are the experience of integration from the visual simulator into the MRCA training simulation. Technical conditions and solutions to solve the problem are presented.
Transl. by E.A.K.

N81-19141# Honeywell Systems and Research Center, Minneapolis, Minn.
REAL-TIME FEASIBILITY FOR GENERATION OF NONLINEAR TEXTURED TERRAIN Final Report
Duane Soland, Mark Voth, and Pat M. Narendra AFSC Brooks AFB, Texas Jan. 1981 115 p
(Contract F33615-77-C-0073; AF Proj. 1958)
(AD-A095070; AFHRL-TR-79-27) Avail: NTIS HC A06/MF A01 CSCL 14/2

This study was conducted by Honeywell for the Air Force Human Resources Laboratory (AFHRL) in order to evaluate and study a potential new approach for the simulation of visual and sensor imagery for Air Force training applications. This report describes the hardware implementation of a curved-surface method for computer image generation (CIG) of textured terrain imagery. General comments and details of the algorithms are presented. This is followed by a discussion of the hardware required for a real-time implementation of this technique. The approach involves the display of terrain as curved surfaces represented by bicubic splines. Texture patterns may then be mapped to these terrain surfaces. Buildings or man-made features may be drawn using polygonal surfaces. This curved approach is of interest because it may represent a more cost-effective method to include more detail in the simulated imagery. Current systems are constrained to the use of straight edges in the representation of real-world features and require large numbers of edges to display complex, irregular objects such as terrain. Therefore, the curved surface approach may demonstrate many advantages over the straight edge technique. GRA

N81-19142# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECTS OF WINDOW CONFIGURATION ON MODEL PRESSURE DISTRIBUTION IN WIND TUNNELS WITH PERFORATED WALLS Final Report, Oct. 1978 - Sep. 1979
F. L. Heltsley AEDC Jan. 1981 59 p refs
(AD-A094213; AEDC-TR-80-1) Avail: NTIS HC A04/MF A01 CSCL 14/2

Larger optical windows for access to the model flow field in the Arnold Engineering Development Center (AEDC) transonic wind tunnels will be required for optimum utilization of the laser velocimeter (LV). A combined analytical and experimental investigation was performed to assess the effects of such windows upon the performance of the perforated walls. The experimental results from the Aerodynamic Wind Tunnel (1T) indicate that although the wall interference characteristics of some window configurations approach the standard porous wall, none of the configurations tested exhibited adequate wave cancellation for all Mach numbers from M at infinity = 1.0 through 1.4. A variable porosity wall arrangement is described which appears to be capable of providing acceptable optical access without adversely affecting the tunnel flow field. GRA

N81-19143# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
VALIDATION OF THE WRIGHT-PATTERSON VERTICAL WIND TUNNEL M.S. Thesis
James W. Hickman Dec. 1980 56 p refs
(AD-A094777; AFIT/GAE/AA/80D-10) Avail: NTIS HC A04/MF A01 CSCL 14/2

A spin capability evaluation of the Wright-Patterson vertical wind tunnel was completed using a model of the Bell X-5. The X-5 model was previously spin tested in the NASA vertical wind tunnel at Langley AFB, Va. The study compared results obtained at the NASA-Langley vertical wind tunnel with the test results obtained at the Wright-Patterson vertical wind tunnel. The Langley results were used as the basis for this evaluation. Information was available on spin characteristics of the model with respect to various control surface configurations and recovery attempts using control deflections. The spin tests revealed a stable equilibrium spin and recovery, where applicable, could be established and observed for each corresponding stable equilibrium spin and recovery that was observed at Langley. GRA

N81-19212# Army Missile Command, Redstone Arsenal, Ala. Systems Simulation and Development Directorate.
INVESTIGATION OF PLUME INDUCED SEPARATION ON A FULL-SIZE MISSILE AT SUPERSONIC VELOCITIES
T. A. Martin 20 Jun. 1980 26 p
(AD-A094742; AD-E950082; DRSMI/RD-80-12-TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

A large amount of data to determine plume effects have been obtained from various simulation techniques. To provide data for evaluating the adequacy of these simulations, a test utilizing a rocket sled to measure surface pressures on a full-size, live, high thrust rocket at Mach number up to Moo 1.6. Selected portions of the data are presented to show Mach number and thrust level effects. GRA

N81-19232*# Lockheed-California Co., Burbank.
ADVANCED COMPOSITE AILERON FOR L-1011 TRANSPORT AIRCRAFT, TASK 1 Final Report, 19 Sep. 1977 - 24 Mar. 1978
C. F. Griffin, L. D. Fogg, R. L. Stone, and E. G. Dunning Jul. 1978 57 p refs
(Contract NAS1-15069)
(NASA-CR-145370; LR-28568) Avail: NTIS HC A04/MF A01 CSCL 11F

Structural design and maintainability criteria were established and used as a guideline for evaluating a variety of configurations and materials for each of the major subcomponents. From this array of subcomponent designs, several aileron assemblies were formulated and analyzed. The selected design is a multirib configuration with sheet skin covers mechanically fastened to channel section ribs and spars. Qualitative analysis of currently available composite material systems led to the selection of three candiate materials on which comparative structural tests were conducted to measure the effects of environment and impact damage on mechanical property retention. In addition, each system was evaluated for producibility characteristics. From these tests, Thornel 300/5208 unidirectional tape was selected for the front spar and covers, and Thornel 300 fabric/5208 was chosen for the ribs. A.R.H.

N81-19305# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
EVALUATION OF POWDER COATINGS FOR APPLICATION TO AIRCRAFT COMPONENT PARTS Final Report
Everett Charves 4 Sep. 1980 66 p refs
(AD-A094724; NADC-79199-60) Avail: NTIS HC A04/MF A01 CSCL 11/3

Powder coatings, electrostatically applied to bare and primed aluminum and magnesium substrates, were evaluated as possible candidate coatings for aircraft and engine component parts. The powdered coatings were compared to the solvent based MIL-P-23377 primer and MIL-C-81773 topcoat system. When selected for specific applications, powdered coatings were superior to the solvent based coatings system in abrasion (wear) and chemical resistance. GRA

N81-19316*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
AN ASSESSMENT OF THE USE OF ANTIMISTING FUEL IN TURBOFAN ENGINES Final Report, Sep. 1979 - Nov. 1980
A. Fiorentino, R. DeSaro, and T. Franz Nov. 1980 146 p refs

(Contract NAS3-22045)
(NASA-CR-165258; PWA-5697-29) Avail: NTIS HC A07/MF A01 CSCL 21D

The effects of antimisting kerosene on the performance of the components from the fuel system and the combustor of a JT8D aircraft engine were evaluated. The problems associated with antimisting kerosene were identified and the extent of shearing or degradation required to allow the engine components to achieve satisfactory operation were determined. The performance of the combustor was assessed in a high pressure facility and in an altitude relight/cold ignition facility. The performance of the fuel pump and control system was evaluated in an open loop simulation. R.C.T.

N81-19323# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EVALUATION OF FUEL CHARACTER EFFECTS J79 SMOKELESS COMBUSTOR Final Technical Report, 1 Jul. 1979 - Jun. 1980
C. C. Gleason, T. L. Oller, M. W. Shayeson, and M. J. Kenworthy Nov. 1980 194 p refs
(*Contract F33615-79-C-2033; AF Proj. 3048*)
(AD-A095057; R80AEG618; AFWAL-TR-80-2092; AFESC/ESL-TR-80-46) Avail: NTIS HC A09/MF A01 CSCL 21/4

Results of a program to determine the effects of broad variations in fuel properties on the performance, emissions, and durability of the J79-17C turbojet engine combustion system are presented. Thirteen different fuels were tested, covering a range of hydrogen contents, aromatic types, boiling ranges, and viscosities. At high power operating conditions, fuel hydrogen content was found to be a very significant fuel property with respect to linear temperature, flame radiation, smoke, and NOx emission levels. At idle and cruise operating conditions, CO and HC emission levels were found to be dependent on both fuel hydrogen content and relative spray droplet size. At cold day ground start conditions lightoff correlated with the relative fuel droplet size. Altitude relight limits at low flight Mach numbers were fuel dependent and also correlated with the relative fuel droplet size. Combustor liner life analyses, based on the test data, yielded relative life predictions of 1.00, 0.93, 0.83, and 0.73 for fuel hydrogen contents of 14.5, 14.0, 13.0, and 12.0 percent, respectively. High temperature cyclic fuel nozzle fouling tests revealed significant effects of fuel quality and operating temperature on nozzle life. The results correlated with laboratory thermal stability ratings of the fuels. GRA

N81-19412*# Flight Dynamics Research Corp., Van Nuys, Calif.
JET-DIFFUSER EJECTOR - ATTACHED NOZZLE DESIGN Final Report
Morton Alperin and Jiunn-Jeng Wu May 1980 41 p refs Sponsored in part by Navy
(Contract NAS2-10059)
(NASA-CR-152361) Avail: NTIS HC A03/MF A01 CSCL 20D

Attached primary nozzles were developed to replace the detached nozzles of jet-diffuser ejectors. Slotted primary nozzles located at the inlet lip and injecting fluid normal to the thrust axis, and rotating the fluid into the thrust direction using the Coanda Effect were investigated. Experiments indicated excessive skin friction or momentum cancellation due to impingement of opposing jets resulted in performance degradation. This indicated a desirability for location and orientation of the injection point at positions removed from the immediate vicinity of the inlet surface, and at an acute angle with respect to the thrust axis. Various nozzle designs were tested over a range of positions and orientations. The problems of aircraft integration of the ejector, and internal and external nozzle losses were also considered and a geometry for the attached nozzles was selected. The effect of leaks, protrusions, and asymmetries in the ejector surfaces was examined. The results indicated a relative insensitivity to all surface irregularities, except for large protrusions at the throat of the ejector. J.M.S.

N81-19439*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIDELOOKING LASER ALTIMETER FOR A FLIGHT SIMULATOR Patent Application
Larry D. Webster, inventor (to NASA) Filed 13 Feb. 1981 29 p
(NASA-Case-ARC-11312-1; US-Patent-Appl-SN-234244) Avail: NTIS HC A03/MF A01 CSCL 20E

A laser altimeter for a flight simulator which allows measurement of the height of the simulator probe above the terrain directly below the probe tip is disclosed. A laser beam is directed from the probe at an angle to the horizontal to produce a beam spot on the terrain. The angle that the laser beam makes with the horizontal is varied so as to bring the beam spot into coincidence with a plumb line coaxial with the longitudinal axis of the probe. A television altimeter camera observes the beam spot and has a raster line aligned with the plumb line. Spot detector circuit coupled to the output of the TV camera monitors the position of the beam spot relative to the plumb line. An error signal is produced by computer driving, via a servo motor, the laser beam optics so as to cause the beam spot coincidence with the plumb line. At coincidence, computer looks up in a table the altitude of the probe for the given angle and reads out the altitude to an altimeter readout. Author

N81-19456 Iowa State Univ. of Science and Technology, Ames.
DESIGN OF TURBINE CASCADES WITH TRANSITIONAL PROFILE BOUNDARY LAYERS Ph.D. Thesis
Gabriel Acacio Alarcon 1980 250 p
Avail: Univ. Microfilms Order No. 8103427

A computer based 'direct' design system for two dimensional turbine airfoils in cascade involves a sequence of calculation in which the airfoil profile is arbitrarily designed from velocity diagram requirements and inviscid blade-to-blade flow calculation of the velocity distribution and the exit angle is made. A transitional boundary layer analysis is then carried out followed by a wake mixing analysis to calculate profile losses and the viscous exit gas angle. The profile design can be rapidly iterated on through adjustment of a number of geometry parameters and the flow analysis repeated until a design is found yielding the lowest profile losses. The inviscid-viscous calculation method developed yields results for total pressure loss and exit gas angle which agree well with experimental cascade data. Dissert. Abstr.

N81-19464# Department of Energy, Washington, D. C. Office of Transportation Programs.
AUTOMOTIVE TECHNOLOGY DEVELOPMENT PROGRAM Annual Report to Congress, 30 Sep. 1980
30 Sep. 1980 30 p
(DOE/CS-0069/1; AR-2) Avail: NTIS HC A03/MF A01

Advanced gas turbine (AGT) engines, advanced Stirling engines (ASE), vehicles and vehicle components to use with advanced, energy conserving automotive propulsion systems are described. For the AGT, accomplishments included: awarded contracts for AGT development; completed reference powertrain design; initiated design and fabrication of testing facilities; and testing of components. For the ASE, components were tested up to 4000 h. A turbocompound diesel engine completed 54,000 miles of road testing and showed a 5 percent fuel economy improvement. Ten thousand miles of road testing a prototype Diesel Organic Rankine Bottoming Cycle in a heavy truck engine showed a 10 percent fuel economy gain. Three hundred standard GSA vehicles, operated with a Controlled Speed Accessory Drive showed, a 6 to 8 percent fuel economy gain. DOE

N81-19479*# Textron Bell Aerospace Co., Buffalo, N. Y.
AEROELASTIC AND DYNAMIC FINITE ELEMENT ANALYSES OF A BLADDER SHROUDED DISK
G. C. C. Smith and V. Elchuri Mar. 1980 152 p refs
(Contract NAS3-20382)
(NASA-CR-159728; D2536-941001) Avail: NTIS HC A08/MF A01 CSCL 20K

The delivery and demonstration of a computer program for the analysis of aeroelastic and dynamic properties is reported. Approaches to flutter and forced vibration of mistuned discs, and transient aerothermoelasticity are described. R.C.T.

N81-19480*# Textron Bell Aerospace Co., Buffalo, N. Y.
NASTRAN LEVEL 16 THEORETICAL MANUAL UPDATES FOR AEROELASTIC ANALYSIS OF BLADED DISCS
V. Elchuri and G. C. C. Smith Mar. 1980 24 p refs
(Contract NAS3-20382)
(NASA-CR-159823; D2536-941002) Avail: NTIS HC A02/MF A01 CSCL 20K

A computer program based on state of the art compressor and structural technologies applied to bladed shrouded disc was developed and made operational in NASTRAN Level 16. Aeroelastic analyses, modes and flutter. Theoretical manual updates are included. S.F.

N81-19481*# Textron Bell Aerospace Co., Buffalo, N. Y.
NASTRAN LEVEL 16 USER'S MANUAL UPDATES FOR AEROELASTIC ANALYSIS OF BLADED DISCS
V. Elchuri and A. M. Gallo Mar. 1980 167 p refs
(Contract NAS3-20382)
(NASA-CR-159824; D2536-941003) Avail: NTIS HC A08/MF A01 CSCL 20K

The NASTRAN aeroelastic and flutter capability was extended to solve a class of problems associated with axial flow turbomachines. The capabilities of the program are briefly discussed. The aerodynamic data pertaining to the bladed disc sector, the associated aerodynamic modeling, the steady aerothermoelastic 'design/analysis' formulations, and the modal, flutter, and subcritical roots analyses are described. Sample problems and their solutions are included. R.C.T.

N81-19482*# Textron Bell Aerospace Co., Buffalo, N. Y.
NASTRAN LEVEL 16 PROGRAMMER'S MANUAL UPDATES FOR AEROELASTIC ANALYSIS OF BLADED DISCS
A. M. Gallo and B. Dale Mar. 1980 88 p refs
(Contract NAS3-20382)
(NASA-CR-159825; D2536-941004) Avail: NTIS HC A05/MF A01 CSCL 20K

The programming routines for the NASTRAN Level 16 program are presented. Particular emphasis is placed on its application to aeroelastic analyses, mode development, and flutter analysis for turbomachine blades. R.C.T.

N81-19483*# Textron Bell Aerospace Co., Buffalo, N. Y.
NASTRAN LEVEL 16 DEMONSTRATION MANUAL UPDATES FOR AEROELASTIC ANALYSIS OF BLADED DISCS
V. Elchuri and A. M. Gallo Mar. 1980 15 p refs
(Contract NAS3-20382)
(NASA-CR-159826; D2536-941005) Avail: NTIS HC A02/MF A01 CSCL 20K

A computer program based on state of the art compressor and structural technologies applied to bladed shrouded discs was developed and made operational in NASTRAN level 16. The problems encompassed include aeroelastic analyses, modes, and flutter. The demonstration manual updates are described. L.F.M.

N81-19484*# Bell Aerospace Co., Buffalo, N. Y.
DESIGN AND FABRICATION OF A STRINGER STIFFENED DISCRETE-TUBE ACTIVELY COOLED PANEL FOR A HYPERSONIC AIRCRAFT Final Contractor Report
Frank M. Anthony and Robert G. Halenbrook Washington NASA Feb. 1981 89 p refs
(Contract NAS1-12806)
(NASA-CR-3403; Rept-7430-927001) Avail: NTIS HC A05/MF A01 CSCL 20K

A 0.61 x 1.22 m (2 x 4 ft) test panel was fabricated and delivered to the Langley Research Center for assessment of the thermal and structural features of the optimized panel design. The panel concept incorporated an aluminum alloy surface panel actively cooled by a network of discrete, parallel, redundant, counterflow passage interconnected with appropriate manifolding, and assembled by adhesive bonding. The cooled skin was stiffened with a mechanically fastened conventional substructure of stringers and frames. A 40 water/60 glycol solution was the coolant. Low pressure leak testing, radiography, holography and infrared scanning were applied at various stages of fabrication to assess integrity and uniformity By nondestructively inspecting selected specimens which were subsequently tested to destruction, it was possible to refine inspection standards as applied to this cooled panel design. A.R.H.

N81-19497# Atomic Energy Commission Research Establishment, Riso (Denmark). Engineering Dept.
STATIC DEFLECTION AND EIGENFREQUENCY ANALYSIS OF THE NIBE WIND TURBINE ROTORS. THEORETICAL BACKGROUND
Per Lundsager Feb. 1980 31 p refs
(RISOE-M-2199; ISBN-87-550-0627-2; ISSN-0418-6435)
Avail: NTIS HC A03/MF A01

The theory of thin-walled multicell structures is used to calculate the cross-sectional properties of rotor blades. The theory is developed for beams of inhomogeneous materials. The blade is then modeled using the finite element method. A stayed and a cantilevered blade, each consisting of a steel part and a glass fiber part, were analyzed. Static deflection caused by extreme wind load along with the five to ten lowest eigenfrequencies were calculated. Results deviated less than 15 percent from theoretical predictions. Author (ESA)

N81-19526*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEASAT ALTIMETER HEIGHT CALIBRATION
Ronald Kolenkiewicz and Chreston F. Martin (EG and G Washington Analytical Services Center, Inc., Riverdale, Md.) Mar. 1981 42 p refs Submitted for publication
(NASA-TM-82040) Avail: NTIS HC A03/MF A01 CSCL 05B

The Seasat altimeter was calibrated for height bias using four overflight passes of Bermuda which were supported by the Bermuda laser. The altimeter data was corrected for: tides, using recorded tide gauge data; propagation effects, using meteorological data taken around the time of each pass; acceleration lag; and sea state bias, including both surface effects and instrumental effects. Altimeter data for each of the four passes was smoothed and extrapolated across the island. Interpolation between passes then produced an equivalent altimeter measurement to the geoid at the laser site, so that the altimeter bias could be estimated without the use of a geoid model. The estimated height bias was 0.0 + or - 0.07. J.M.S.

N81-19964*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SCIENTIFIC AND TECHNICAL INFORMATION OUTPUT OF THE LANGLEY RESEARCH CENTER, FOR CALENDAR YEAR 1976
1976 123 p refs
(NASA-TM-82310) Avail: NTIS HC A06/MF A01 CSCL 05B

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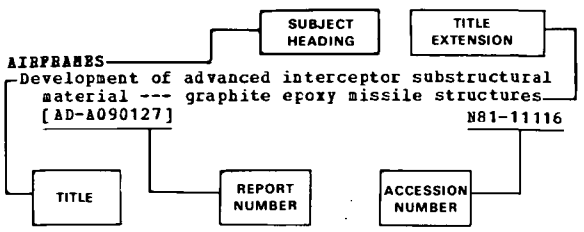

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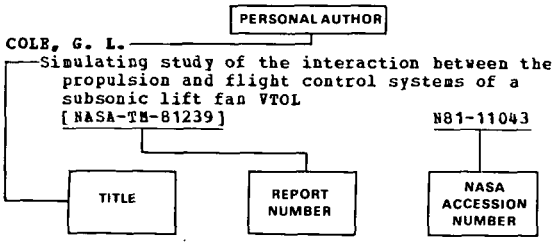

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