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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 124

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 June 1980 in

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



Scientific and Technical Information Branch

1980

National Aeronautics and Space Administration

Washington, DC

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 450 reports, journal articles, and other documents originally announced in June 1980 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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

An annual cumulative index will be published.

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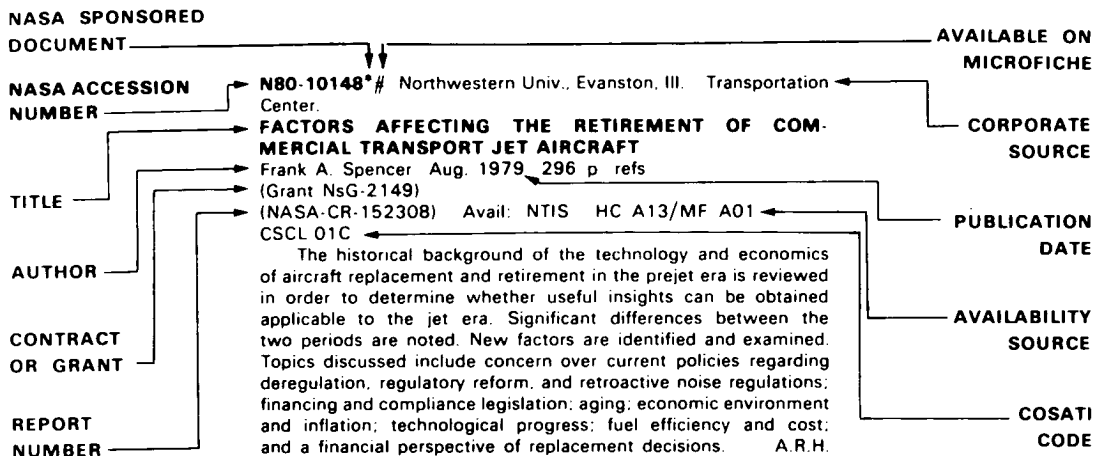
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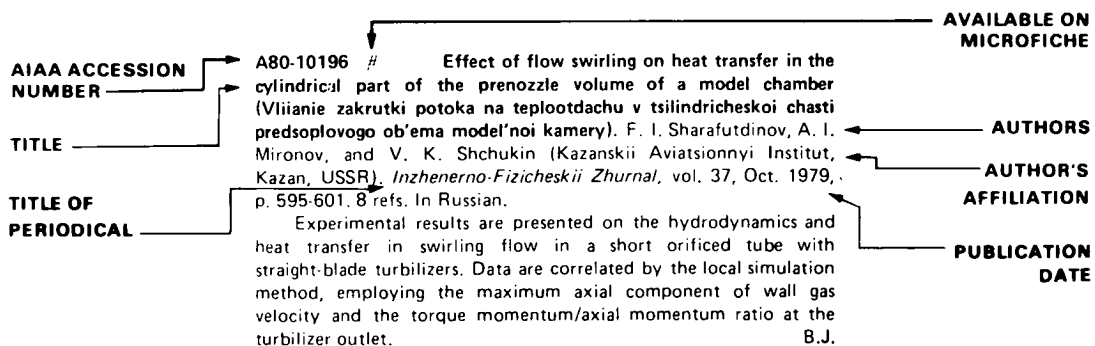
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TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 124)

JULY 1980

IAA ENTRIES

A80-29023 Direct computation of transonic solution for Nieuwland aerofoils. P. Niyogi (Indian Institute of Technology, Kharagpur, India) and T. K. Das (Jadavpur University, Calcutta, India). *Acta Mechanica*, vol. 34, no. 3-4, 1979, p. 285-289. 9 refs.

The approximate solution of Niyogi (1976, 1973) for symmetrical shock-free transonic flow past a thin body is applied to three Nieuwland quasi-elliptical airfoil sections and the NACA 0012 profile for which exact solutions are known. A second-order correction is introduced to take account of the blunt leading edge, and the solutions are obtained by an analytic integration in terms of the coefficients of the cubic splines representing the profile shapes. Surface pressure coefficients obtained as functions of longitudinal position for the quasi-elliptical sections 0.1200-0.7500-0.000, 0.1200-0.7000-0.000 and 0.1100-0.7500-0.9000 and the NACA 0012 profile are shown to be in excellent agreement with the exact solution, with an overall error of less than 5%. A.L.W.

A80-29025 Post-crash fuel fire hazard measurements in a wide body aircraft cabin. R. G. Hill and C. P. Sarkos (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.). *Journal of Fire and Flammability*, vol. 11, Apr. 1980, p. 151-163. 8 refs.

This paper describes a full-scale wide-body test article for studying post-crash cabin fire hazards produced by an external fuel fire adjacent to a cabin door opening. Seventy two tests were conducted at various ambient wind conditions and fire sizes without interior materials. This work was the first phase of a study to realistically characterize post-crash cabin fire hazards. Data are presented and discussed pertaining to the effect of ambient wind on the rate of hazard accumulation inside the cabin, stratification of heat, smoke and toxic gases, the effect of fire size on thermal radiation through the opening, and the relative importance of heat, smoke and carbon monoxide in a fuel-dominant fire. (Author)

A80-29039 # Aircraft collision avoidance - Perspectives on the utilization of an onboard system of detection and resolution of air-air conflicts (L'anticollision des avions - Perspectives d'utilisation d'un système embarqué de détection et résolution des conflits air-air). Mr. Michel (Direction Générale de l'Aviation Civile, Service Technique de la Navigation Aérienne, Paris, France). *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Anticollision et Collisions Organisées, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 14, 1979, Paper 79 1174*. 24 p. In French.

The complex problem of the avoidance of air collisions using the onboard Beacon-based Collision Avoidance System (BCAS). By means of signals at 1030 and 1090 MHz, the BCAS is intended to locate and follow the movements of nearby aircraft with a maximum of efficiency and a minimum of false alarms. Depending on the distance of separation, conflicts are resolved by prohibiting, limiting, or initiating maneuvers. Consideration is also given to questions concerning the utilization of the system: its compatibility with air traffic control as well as psychological and juridical problems. J.P.B.

A80-29040 # Evolution in the vertical landing plane (Evolution dans le plan vertical à l'atterrissage). Mr. Coffin. *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Anticollision et Collisions Organisées, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 14, 1979, Paper 79 1177*. 13 p. In French.

Evolution in the vertical landing plane is discussed with regard to public transport aircraft, considering the approach and landing phases. Attention is given to manual piloting, automatic piloting, and the utilization of autothrottle, in each phase. Operational aspects of landing are also discussed in terms of visual approach as well as approach during conditions of poor visibility. J.P.B.

A80-29041 # Precision DME (Le DME de précision). M. Schilliger (Le Matériel Téléphonique Th-CSF, France). *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Radiopositionnement, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 28, 1979, Paper 79 1203*. 30 p. In French.

Precision DME, used for landing assistance, indicates the distance between an aircraft and a land marker utilizing the L band and temporal measurements. Emphasis is placed on the definition of precision DME signals in the L band by: utilizing the DME without modification of signal format but adding improvements to ground and onboard equipment; complete modification of the signal format utilizing impulse compression techniques; or adopting an intermediate solution with the least possible modification of the signal format in order to obtain at the same time sufficient precision and complete interoperability with existing DME. J.P.B.

A80-29042 # The new MLS landing system (Le nouveau système d'atterrissage MLS). L. Deneufchatel (Direction Générale de l'Aviation Civile, Service Technique de la Navigation Aérienne, Paris, France). *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Radiopositionnement, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 28, 1979, Paper 79 1204*. 8 p. In French.

The Microwave Landing System (MLS) a three dimensional positioning system intended to replace the instrument landing system, is described. MLS comprises an azimuth angular system indicating bearings with regard to the runway axis, a site angular system furnishing horizontal angular position, a distance measuring system and a ground-air data transmission channel. Also discussed are the advantages and inconveniences of using high frequency, such as signal blocking due to obstacles and the difficulty of obtaining antennas with the precise mechanical tolerances. J.P.B.

A80-29043 # The Transit system in radio navigation (Système Transit en radio navigation). M. Gaubert (Compagnie de Signaux et d'Entreprises Electriques, Paris, France). *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Radiopositionnement, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 28, 1979, Paper 79 1205*. 33 p. In French.

The Transit system of position determination, comprising satellites that emit signals at 150 and 400 MHz is described. The localization principle of the Transit system determines distance by measuring successive satellite positions at well-determined time intervals, using Doppler shift integration. Attention is given to the frequency of position resetting, translating geographic to geodesic coordinates, and Sylosat type Transit equipment. J.P.B.

A80-29044 # The NAVSTAR system (Le système NAVSTAR). L. S. De Chezelles (Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon, Eure, France). *Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etudes sur Radiopositionnement, Ecole Supérieure d'Electricité, Gif-sur-Yvette, Essonne, France, Nov. 28, 1979, Paper 79 1206*. 25 p. In French.

The technical and operational characteristics of the NAVSTAR program of the U.S. Air Force are discussed, as well as the current state of development. The NAVSTAR system comprises 24 satellites to provide jamming-resistant continuous 3-dimensional determinations of position and speed at all global points and times for passive users. By measuring the time of propagation of a signal emitted by satellite and received by the user (aircraft, land vehicles or ships), localization to within 5 m horizontal and 7 m vertical is possible, synchronization being better than 1 nanosec. The navigation signal, either c/a or P type, is generated utilizing the 6 or 42 MHz band.

J.P.B.

A80-29050 # Optimal control of flight vehicle motion in a turbulent atmosphere (Optimal'noe upravlenie dvizheniem letatel'nogo apparata v turbulentnoi atmosfere). A. D. Drozdov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriya I - Matematika, Mekhanika*, Jan.-Feb. 1980, p. 79-83. In Russian.

The light of an aircraft in the vertical plane in a turbulent atmosphere is analyzed on the basis of a system of equations of motion derived, neglecting the earth's rotation and the curvature of the earth's surface. The aircraft is treated as an absolutely solid body with an aerodynamic moment and thrust and gravity forces applied to its center of mass. A control law which ensures realization of a prescribed trajectory is derived.

V.P.

A80-29070 # The problem of aeroacoustic interactions /Review/ (Problema aeroakusticheskikh vzaimodeistvii /Obzor/). E. V. Vlasov and A. S. Ginevskii. *Akusticheskii Zhurnal*, vol. 26, Jan.-Feb. 1980, p. 1-12. 47 refs. In Russian.

The paper examines aerodynamic/acoustic interactions in turbulent jets with particular reference to turbojet-engine processes. Attention is given to coherent structures in turbulent flow, and to the effects of acoustic disturbances on the aerodynamic and acoustic characteristics of turbulent jets.

B.J.

A80-29083 # Computation of steady inviscid transonic flows using pseudo-unsteady methods. J.-P. Veuillot and H. Viviani (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Gesellschaft für angewandte Mathematik und Mechanik, Workshop on Numerical Methods for the Computation of Inviscid Transonic Flow with Shock Waves, Stockholm, Sweden, Sept. 12-18, 1979.*) ONERA, TP no. 1979-156, 1979. 14 p. 7 refs. Research supported by the Direction des Recherches, Etudes et Techniques.

The computation of steady inviscid transonic flows using two pseudo-unsteady methods is presented. The first method makes use of the steady Bernoulli relation to replace the unsteady energy equation for isoenergetic steady flows, together with the unsteady continuity and momentum equations, while the second also considers the uniformity of the specific entropy. The conservative forms of the hyperbolic pseudo-unsteady equations of both methods are discretized directly in the physical plane in arbitrary curvilinear meshes by means of a predictor-corrector scheme. The compatibility relations of the hyperbolic system associated with the characteristic planes parallel to the boundary are used as boundary conditions, and are discretized by the same scheme. Results obtained by the two methods for the calculation of a channel flow, flow over a NACA 0012 airfoil for three sets of free-stream conditions and over the RAE 2822 profile are presented.

A.L.W.

A80-29096 # Pressure rise of axial flow fans with whirling outflow. M. Blaho, T. Lajos, and L. Preszler (Budapesti Muszaki Egyetem, Budapest, Hungary). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 97-106. 7 refs.

The use of straighteners to measure static pressure rise at the point from which the linear pressure line of a whirl-free pipe flow starts is discussed. Whirl decay and the effect of 13 different straighteners have been investigated, and a 1:3 proportion for the wall:center pressure difference is found to be satisfactory. It is

proposed that a straightener consisting of a single cross with a length of 2 D be used on the discharge side of an axial fan. J.P.B.

A80-29097 # Experimental results on axial flow compressor stages with high subsonic Mach numbers. P. Boos (Bergmann-Borsig/Görlitzer Maschinenbau Werk, Berlin, East Germany). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 107-116. 7 refs.

Using data on cascades obtained by high speed wind tunnel tests the variation of the total pressure loss coefficient and the deviation are shown for defined maximum permissible inlet Mach numbers. Measurements show, that for the mean radius range of the blade rows the data of two-dimensional flows are transferable to stator and rotor blading. The measured results also show the great difference between total pressure losses and deviations in the boundary layer at the annulus walls and at the wall of the wind tunnel. These measured data on total pressure losses and deviations enable improved design of axial compressor stages.

(Author)

A80-29102 # Some aspects of off-design testing of turbo-compressors. E. Carnevale and S. Volpi (Istituto di Ingegneria Meccanica, Florence, Italy). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 179-188.

Research supported by the Ministero della Pubblica Istruzione and Consiglio Nazionale delle Ricerche.

The paper presents some similarity considerations referring to turbocompressors performances analysis and discusses two prediction procedures usually employed in this field. Particular attention is paid to the definition of the limits of validity and effectiveness of the above procedures. Two practical examples of application are also shown in order to point out some problems connected to performance prediction.

(Author)

A80-29103 # The present state in the axial-flow transonic compressor design. K. Celikovskiy (Vyzkumnyy a Skusebni Letecy Ustav, Prague, Czechoslovakia). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 189-199. 8 refs.

The paper describes the arrangement of the axial flow transonic compressor and recommended procedure for gas dynamic calculation. The three-dimensional analysis of flow is treated with respect to the solution of indirect problem. Some results of theoretical and experimental investigation of flow through a supersonic elementary cascade on the surface of revolution are presented.

(Author)

A80-29106 # Some aspect of aerodynamic erosion in fans. T. Chmielniak (Slask, Politechnika, Gliwice, Poland). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 220-229. 8 refs.

The paper examines the motion of particles in a fan blade system. Attention is given to the influence of several quantities on particle trajectory and speed. It is noted that in the present work, while analyzing the particle motion of a discrete component, the potential character of the basic component flow is assumed and the influence of the particle of the additional component on the motion of the basic component is not taken into account. Finally, the general concept of an integral model of erosive wear is given. M.E.P.

A80-29108 # Secondary losses in axial compressor. V. Cyrus (Statni Vyzkumny Ustav Konstrukce Stroj, Bechovice, Czechoslovakia). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 260-269. 5 refs.

The paper presents some results of loss measurement of blade rows of an axial compressor stage. From experiments on the compressor stage as well as plane cascades, new semiempirical correlation has been suggested for prediction of secondary losses in

case of presence and absence of the clearance between end-wall and blade. (Author)

A80-29113 # A contribution to the design of radial compressor impellers with double-curved blades. W. Fister (Bochum, Ruhr-Universität, Bochum, West Germany) and J. Eikermann. In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 365-374.

A computer-aided procedure is presented for the design of radial compressor impellers with double-curved blades. Within the proposed design algorithm, the boundary curves of the blade at the hub surface and the shroud surface are determined according to a procedure suggested by Wislicenus (1947), while the surface within the bounds is designed using Coons' surface interpolation (1967). The parameters of an impeller designed according to the proposed procedure are compared to the parameters of an impeller designed by conventional methods. V.L.

A80-29114 # Numerical strain and stress analysis of radial compressor impellers with riveted cover disks. W. Fister (Bochum, Ruhr-Universität, Bochum, West Germany) and H. Heiderich. In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 375-384. 9 refs.

A programmed computing method for the calculation of radial compressor impellers with a riveted cover disk is presented. The bladed part of the impeller with the riveted cover disk is approximated with a special finite element procedure, the framework method; the non-bladed impeller hub is treated by means of analytical shell calculations. The estimated boundary conditions for the determination of the rivet joint with elastic and plastic rivet deformations are described. Select calculation results for an impeller with riveted cover disk are interpreted and compared with those for an impeller with an integral cover disk. (Author)

A80-29116 # The effects of the end-wall boundary layers on the performance of an axial compressor. V. Foltá and V. Cyrus (Statni Vyzkumny Ustav Konstrukce Stroju, Bechovice, Czechoslovakia). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 1. Budapest, Akademiai Kiado, 1979, p. 404-412. 6 refs.

A80-29130 # Performance of conical diffusers up to the choking condition. E. Markland and P. North. In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 703-714. 7 refs. Research supported by the Ministry of Aviation.

The paper presents the measured performance of 10 deg conical diffusers of area ratios 1.6, 2.0, and 4.0. The inlet velocity profile was varied by placing various lengths of plain tube upstream, and the Mach number at inlet was varied from 0.2 to choking. Diffuser performance is expressed in terms of parameters which relate to an effective mean flow. (Author)

A80-29131 # The influence of losses on the evaluation of the 'rotating stall'. Z. Moravec (Statni Vyzkumny Ustav Konstrukce Stroju, Bechovice, Czechoslovakia). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 735-742.

The flow in blade compressors distinctly deteriorates at low flow rates. It often arises the so called 'rotating stall'. One of the criteria for its occurrence has been suggested by Fabri. The flow through a compressor stage is strongly affected by losses. However, the present study shows that the effect of losses on the value of Fabri's criterion is negligible. This result makes it possible to predict the occurrence of the rotating stall and also to evaluate the shape of the aerodynamic characteristic. This conclusion has been experimentally verified on a model stage. (Author)

A80-29133 # Pressure losses in the inlet and outlet channels of high-pressure single- and two-stage axial-flow fans. J. K. Nowakowski (Instytut Techniki Cieplnej, Lodz, Poland). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 760-769.

The performance characteristics of high-pressure axial-flow fans provided with various inlet and outlet channels were measured at a test stand described in the paper. Six different obstructed-channel systems were tested for both single- and two-stage fans. The obtained results were compared with the results of analytical calculation based on experimentally determined pressure loss coefficients for the individual flow elements located in a channel. The paper is concluded with comments on the adopted method for determining pressure losses in fan inlet and outlet channels and some suggestions regarding the designing of optimum high-pressure axial-flow fan systems. (Author)

A80-29136 # Determination of the profile losses on the turbine blades. V. Pimsner and N. Baran (Bucuresti, Institutul Politehnic, Bucharest, Rumania). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 857-867. 7 refs.

The present paper presents a calculation method of the profile losses on a turbine blade located in a grid. The method is based on the numerical integration of the turbulent boundary layer equations, by which the characteristic values of the turbulent boundary layer on the profile have been determined. Meanwhile, a method of setting the conventional thickness of the boundary layer at the trailing edge of the blade in case of its separation from the blade surface is being proposed, and the profile losses for different conditions of fluid flow through the blade grid are determined, too. (Author)

A80-29137 # The determination of aerodynamic coefficients of a straight cascade whose blades have a small curvature and are very much inclined against the cascade axis. B. Ristic (Nis, Univerzitet, Nis, Yugoslavia). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 946-954. 5 refs.

The paper is concerned with determining aerodynamic coefficients of a straight cascade with very inclined blades. Attention is given to evaluating the lift coefficient and the drag coefficient. The results obtained indicate that very inclined blades have small lift coefficients and large drag coefficients. S.D.

A80-29138 # Secondary flow and losses in straight turbine cascades. A. Satta (Genova, Università, Genoa, Italy). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 980-990.

The paper presents the experiments made in a low speed cascade tunnel with discharge to atmosphere at the exit of the test section. The tunnel has a configuration which allows variation of the inlet flow angle, of the stagger angle, of the end wall boundary layer at the inlet and of the blade height. The tests are carried out on two steam turbine blades. Measurements of the flow are made at various axial planes upstream, downstream and within the cascade passages. Detailed results of total pressure and flow angle distributions are presented. (Author)

A80-29139 # Investigations on vortex frequencies in wakes of cascade blades. H. Sauer (Bergmann-Borsig/Görlitzer Maschinenbau Werk, Berlin, East Germany). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 991-999. 7 refs.

Characteristic oscillations can be found in the wakes of cascade blades dependent on the width of the wakes. A general vortex number as a modified Strouhal number can be defined dependent on the ratio of the velocity at the stalling point and the maximum

velocity at the exit of the cascade. It is possible that the periodic vortices are the main reason for the disturbing frequencies and instabilities in the laminar boundary layer of cascade blades. By using the general vortex number one can determine the range where the transition into the turbulent boundary layer is to be expected. The theoretical results are compared with experimental results obtained by wind tunnel experiments. The transition point has an important influence on the profile losses in cascades and also on the heat transfer in cooled blades of gas turbines. (Author)

A80-29140 # Calculation method of the turbine stages with cylindrical blades. L. Sobanski (Instytut Techniki Ciepłej, Lodz, Poland) and J. Kryszynski (Lodz, Politechnika, Lodz, Poland). In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 1060-1068. 6 refs.

The calculation method presented deals with axialflow turbine stages having cylindrical blades. The losses in a stage are calculated on the basis of experimental results for plane cascades. The obtained efficiency is corrected then to get an agreement with experimental results given by the model - stage tests. The function which has been introduced for correction of the efficiency is based on a hypothesis defining the relation between losses determined from experimental coefficients of cascades and those given by tests of the model - stage. (Author)

A80-29143 # Minimizing axial flow fan noise. T. Szentmartyony and I. Kurutz. In: Conference on Fluid Machinery, 6th, Budapest, Hungary, September 17-22, 1979, Proceedings. Volume 2. Budapest, Akademiai Kiado, 1979, p. 1169-1177.

The paper examines minimizing of axial flow fan noise. Prediction of the sound power level generated by an axial flow by an empirical formula can be supported by a theory based on fluid mechanics; its dependence on the rate of flow and on the total pressure rise may indicate an arrangement of two fans in series each producing half the pressure rise required. However, this theory misrepresents the empirical prediction formula and the two fans in series radiate less sound power than one with the same performance. It is concluded that in the drive to reduce the noise of rapidly growing ventilating and airconditioning systems, it will be necessary to examine its noisiest part, the fan. A.T.

A80-29205 # Investigation of the permissible H x V phase space of safe landing maneuvers (Issledovanie dopustimogo fazovogo H x V prostranstva bezavariinogo predposadochnogo manevrirovaniia). K. G. Valeev and G. L. Ter-Saakians. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 17-22. 6 refs. In Russian.

The paper deals with the problem of determining the permissible velocity-altitude range for an aircraft circling above an airport. These altitudes and velocities form a H x V phase space defined by the dynamic characteristics of the aircraft power plant and the aircraft itself. A universal algorithm for determining the permissible altitude and velocity ranges and the aircraft parameters in landing approaches is proposed. The algorithm permits determination of the maneuverability characteristics of airplanes of various types. V.P.

A80-29208 # Method of calculating the velocity at the surface of an arbitrary wing in an ideal fluid (Metod rascheta skorosti na poverkhnosti proizvol'nogo kryla v ideal'noi zhidkosti). Z. Kh. Nugmanov. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 35-40. 7 refs. In Russian.

In the present paper, the potential flow of an ideal incompressible fluid over an arbitrary wing of finite span is analyzed. The flow over the wing is modelled by superposing an unperturbed flow onto a vortex sheet. The velocity values are sought in the form of a double series of orthogonal functions. The unknown series coefficients are determined from a solution of a system of linear algebraic equations. V.P.

A80-29212 # Transverse bending of elastically rim-stiffened three-layer cantilever plates of variable layer thickness (Poperechnyi izgib konsol'no zakreplennykh trekhslonnykh plastin so sloiami peremennoi tolshchiny, podkreplennykh po konturu uprugimi diafragmami). V. N. Paimushin and S. V. Andreev. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 58-62. In Russian.

A80-29214 # Selection of the characteristic polynomial of a closed-loop transfer function by minimizing integral quadratic estimates (K vyboru kharakteristicheskogo polinoma peredatochnoi funktsii zamknutoi sistemy na baze minimizatsii integral'nykh kvadraticnykh otsenok). L. G. Romanenko. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 70-76. In Russian.

A80-29215 # Factorial interpolational method of analyzing the accuracy of nonlinear automatic control systems in the presence of random effects (K faktoromu interpolatsionnomu metodu analiza tochnosti nelineinykh sistem avtomaticheskogo upravleniia pri sluchainykh vozdeistviakh). A. V. Svilin. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 77-84. 7 refs. In Russian.

Cubic formulas are proposed for calculating the probabilistic characteristics of the output coordinates of nonlinear automatic control systems. The formulas provide an accuracy equal to that of other well-known interpolation formulas at a substantially lower number of interpolation points. Their good convergence is demonstrated by examples. V.P.

A80-29218 # A dynamic vibration generator for full-scale structures (Dinamicheskii vozбудitel' kolebanií naturnykh konstruktsii). V. A. Iaremenko. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 94-99. In Russian.

The proposed resonance technique of dynamic load generation in full-scale structures makes it possible to conduct tests at near-natural frequencies maintaining the fundamental waveform. The technique is implemented in an inertial vibration generator employing a rocking suspension. A mathematical model of a dynamic vibration generator is presented and the corresponding equations of motion are investigated. V.L.

A80-29221 # Solution of a problem of analytical design (K resheniiu odnoi zadachi analiticheskogo proektirovaniia). A. I. Bogomolov. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 104-106. In Russian.

Conventionally, the preliminary analytical designing of aircraft and other technological systems is limited to the selection of a version that is optimal from the viewpoint of a certain criterion. Since the design problem is a multicritical one, a more efficient approach is to select the optimal version on the basis of several criteria. In the present paper, a method is proposed for determining a group of alternative versions in the preliminary design stage. For illustration, the method is applied to the parametric synthesis of a multicriterial dynamic system. V.P.

A80-29222 # Experimental investigation of the flow past a wing of finite width (Eksperimental'noe issledovanie obtekanii klina konechnoi shiriny). V. A. Vinogradov, V. V. Duganov, N. N. Zakharov, and O. K. Ivanov. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 106-108. 5 refs. In Russian.

In the experiments described, the flow past supersonic air intake models with compression surfaces in the form of wedges of finite width was studied at a Mach number of 6.1 and Reynolds numbers calculated from the characteristic dimension ($h = 35$ mm) and the stagnation temperature (420 to 470 K). The wedge angle was 5, 10, and 15 degrees at a constant inlet section width to height ratio of 1.0. The tests revealed a substantial decrease in flow coefficient, owing to the three-dimensional nature of the flow over wedges of finite width. This effect should be taken into consideration in designing supersonic air intakes. V.P.

A80-29226 # A method of determining the degree of variation of a function, caused by a change in one of its arguments -

Contribution to the problem of factor analysis of the increment in the special-purpose efficiency of an aircraft (Metod opredeleniia doli izmeneniia funktsii za schet izmeneniia odnogo iz ee argumentov - K zadache faktornogo analiza prirosta tselevot otdachi samoleta). R. K. Sagaidak and E. V. Balyмова. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 118-121. In Russian.

A80-29227 # Selection of a rational structure diagram for a large-aspect-ratio wing (Vybor ratsional'noi konstruktivno-silovoi skhemy kryla bol'shogo udlineniia). A. P. Timofeev. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 121-123. In Russian.

The present paper deals with the problem of optimizing a wing structure by rational selection of the number and arrangement of stringers, ribs, and webs. It is proposed to design a structure diagram using the limiting carrying capacity as the criterion. The permissible stresses in the wing elements are determined by Kogan and Timofeev's (1978) algorithm for calculating the carrying capacity of a large-aspect-ratio wing. V.P.

A80-29228 # Optimized discretization of two-dimensional continuous contours (Optimizirovannaia diskretizatsiia ploskikh nepreryvnykh obvodov). V. Kh. Khasanov. *Aviatsionnaia Tekhnika*, no. 4, 1979, p. 124, 125. In Russian.

Situations are encountered in the practice where continuous information on a contour, given in analytical form, must be converted to discrete information. The present paper deals with the problem of discretizing a two-dimensional continuous contour under the condition that the deviation of the contour from the chord be always smaller than a prescribed value. A solution is obtained on the basis of an optimization method involving the minimization of a certain functional. V.P.

A80-29243 Models of radio refractive index over the Arabian Sea during ISMEX 1973. H. N. Srivastava and M. C. Pant (India Meteorological Department, New Delhi, India). (*National Physical Laboratory of India, Indian Space Research Organization, and Indian National Science Academy, Annual Radio and Space Sciences Symposium, 5th, New Delhi, India, Jan. 22-25, 1979.*) *Indian Journal of Radio and Space Physics*, vol. 8, Oct.-Dec. 1979, p. 259-262. 6 refs.

Based on the radio sonde observations over the Arabian Sea during monsoon experiment (ISMEX) 1973 under Indo-Soviet collaboration, models of radio refractive index have been studied along latitudes 11 and 16 deg N extending up to the coasts of Arabia. The study revealed that the exponential model is a fairly good representation except within the ducting layer wherein it decreases sharply with height. Its applicability is, however, rather poor over the eastern Arabian Sea. The duct thickness is of the order of 200 to 300 m near Aden coast extending about 200 km eastwards. The wavelengths trapped lie in the metric range. (Author)

A80-29449 * # Avionics and controls in review. R. K. Smyth (Milco International, Inc., Huntington Beach, Calif.). *Astronautics and Aeronautics*, vol. 18, Apr. 1980, p. 40-52. Contract No. NASw-2961.

The article surveys the changes which will occur in avionics and controls due to microprocessor technology. Attention is given to five broadly applicable technologies: (1) flight path management technology, (2) automatic control systems, (3) crew station technology, (4) integration and interfacing technology, and (5) fundamental technologies. Areas discussed include inertial navigation, guidance, weather avoidance, propulsion control systems, display technology, flight-system management, functional integration of avionics, and airborne information processing. M.E.P.

A80-29450 # CAD/CAM in packaging aerospace electronics. F. Gargione (RCA, Astro Electronics Div., Princeton, N.J.). *Astronautics and Aeronautics*, vol. 18, Apr. 1980, p. 56-59, 71.

It is noted that hard-wired, welded circuits hold an important place in aerospace systems because they allow short production runs to be prepared quickly. However, the electronic system designs are

very complicated and demanding to work on manually. The article describes a design process which saves time and effort without reducing the designer's freedom. It is shown that the CAD/CAM equipment produces all the drawings and extracts from the data needed to generate NC tapes for drilling and welding boards. In addition, it produces the artwork for etching the boards. Discussion covers the advance the system represents in cost effectiveness, versatility, and reliability. M.E.P.

A80-29469 Heat transfer to a plane wall from a heated, ventilated plane jet. G. F. Marsters (Queen's University, Kingston, Ontario, Canada), B. Howkins (Imperial Oil, Ltd., Don Mills, Ontario, Canada), and E. Kortschak (Du Pont of Canada, Ltd., Coteau-du-Lac, Quebec, Canada). *International Journal of Heat and Mass Transfer*, vol. 23, Mar. 1980, p. 301-309. 6 refs. National Research Council of Canada Grant No. A-4310.

Heat transfer data on a heated ventilated jet attaching to a plane wall are presented, and the resultant wall temperature distribution, due to the transfer of heat from the jet, is mapped in detail for two different offset gap values. Also considered are the temperature distribution in the primary and secondary flows and the wall static pressure distribution. The case where the secondary flow is blocked by a solid wall is examined, and wall static pressures are also presented. It is found that the effectiveness of a ventilated jet decreases as the gap increases. In addition, the secondary stream provides an additional mass of fluid which mixes with the primary stream, providing a more rapid decrease of the maximum temperature in the downstream direction. L.M.

A80-29477 # Recent developments in aerothermodynamic test techniques at the AEDC von Karman gas dynamics facility. D. W. Stallings, R. K. Matthews, and L. M. Jenke (ARO, Inc., Arnold Air Force Station, Tenn.). In: *ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 1-10. 10 refs.

The paper examines recent developments in aerothermodynamic test techniques at the von Karman gas dynamics facility. The test facilities consisting of three continuous-flow wind tunnels with model injection systems and heat transfer measurements using a technique which assumes a constant aerodynamic heat-transfer coefficient are discussed; dynamic heating measurements to map transition on an oscillating body and to identify boundary layer transition to record heat transfer distribution along the model surface are described. Finally, an infrared scanning system for thermal mapping and radiant heating techniques for representing surface heat flux distribution of internal regions of a guide bomb are considered. A.T.

A80-29481 # Calibration of a two probe synchronized sampling technique for measuring flows behind rotors. R. P. Shreeve, A. G. McGuire, and J. A. Hammer (U.S. Naval Postgraduate School, Monterey, Calif.). In: *ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 37-44. Navy-supported research.

A new method of measuring the velocity vector, point-by-point, behind the rotor of a single stage transonic compressor, using two simple Kulite probes and controlled (synchronized) digital sampling, is being developed. The technique provides a means of verifying LDV 2-component velocity measurements and in addition provides radial components of velocity and measurements of the pressure field. The technique requires computer control of digital data acquisition, and requires that the characteristics of two probes be established accurately by calibration. This paper describes the instrumentation scheme and reports the calibration and verification of the data reduction procedure in a steady free jet. (Author)

A80-29486 # ASTF Test Instrumentation System. M. W. Lawley, D. C. Bond, and J. R. Rickard (ARO, Inc., Arnold Air Force

Station, Tenn.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 86-96.

A data handling system has been designed to meet the requirements of data acquisition, handling, storage, and analysis for a new aircraft propulsion system test facility. The data system for the new facility, the Aeropropulsion Systems Test Facility (ASTF), is the Test Instrumentation System (TIS). The TIS utilizes a partitioned system architecture, consisting of data acquisition and conditioning hardware, multiple minicomputers, and a single large scientific computer. The TIS is designed to provide a capability to conduct both steady-state and transient engine testing and analysis in real time. The TIS design provides a reliable system which will also accommodate future modifications necessitated by changing requirements and those intended to take advantage of advances in state-of-the-art in data handling technology. (Author)

A80-29492 # A directionally sensitive hot-wire probe for detection of flow reversal in highly unsteady flows. L. W. Carr and W. J. McCroskey (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 154-162. 6 refs.

A three-element, directionally-sensitive hot-wire probe is described, which gives a definitive indication of both the direction and magnitude of the instantaneous velocity in highly unsteady, boundary-layer flows. Data are presented showing its performance on a dynamically stalling airfoil. A discussion of alternative approaches to flow-reversal detection is presented. The probe is recommended for use in any highly unsteady flow when information about instantaneous flow direction is required over a wide range of mean flow velocities. (Author)

A80-29494 * # Diagnosis of separated flow regions on wind-tunnel models using an infrared camera. A. Bandettini and D. J. Peake (NASA, Ames Research Center, Moffett Field, Calif.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 171-185. 8 refs.

A novel technique utilizing an infrared-sensitive imaging camera has been used to determine the location of three-dimensional (3-D) separated flow regions on an inclined 5 deg semiangle fiberglass cone. The results illustrate that there is a change in the contrast of the infrared (IR) signature on the cone surface corresponding with the location where the skin-friction lines merge toward lines of 3-D separation. This technique should offer a convenient means for locating separated flow regions on wind-tunnel models while obtaining simultaneous force, skin-friction, and pressure data. (Author)

A80-29495 * Measurement of dynamic direct and cross-coupling derivatives due to oscillatory roll. E. S. Hanff and K. B. Kapoor (National Aeronautical Establishment, Ottawa, Canada). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 186-193. 6 refs. Contract No. NASw-3079.

An oscillatory roll apparatus is described with which the complete set of moment and force derivatives due to an oscillation in roll can be obtained in a wind tunnel. A newly developed technique to reduce the dynamic data originating from the four-component balance used with the above apparatus is briefly presented. The technique is intended to account for the dynamic behavior of the model-balance subsystem in the presence of motions in the various degrees of freedom allowed by the balance webs. Finally, results obtained from both dynamic calibration as well as wind-tunnel tests are shown. (Author)

A80-29498 Instrumentation and techniques for parachute wind tunnel testing. R. H. Croll, P. C. Klimas, R. E. Tate, and D. F. Wolf (Sandia Laboratories, Albuquerque, N. Mex.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 206-218. 19 refs. Contract No. AT(29-1)-789.

Parachute testing techniques, tunnel support hardware, and special instrumentations are presented for static, dynamic and inflation testing on full and quarter-scale parachutes. The characteristics of six wind tunnel facilities are discussed, stressing such features as test section size, dynamic pressure, run time, responsiveness, and cost. Results from pressure surveys, suspension/reefing line tensions and dynamic motion/force correlation studies show the usefulness of wind tunnel testing for parachute development programs. It is concluded that the test results have had direct impact on the Space Shuttle Booster recovery system, the upgrading of existing weapon delivery systems, and as inputs to the data base of several system simulation and parachute design computer codes. L.M.

A80-29499 Instrumentation for a tactical aircraft air-to-ground full-mission simulation. B. C. King, Jr. and J. P. Ruse (Martin Marietta Aerospace, Orlando, Fla.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 219-225.

This paper describes instrumentation methods used in the Martin Marietta Aerospace Simulation and Test Laboratory (STL) in conjunction with a nighttime, tactical air-to-ground mission simulation. This experimental effort, supporting the USAF-funded Precision Attack Enhancement (PAE) feasibility demonstration flight test program, required wide-ranging data gathering capabilities to effectively measure combined pilot-equipment performance with various candidate avionics configurations. As background information, a brief review of the basic STL six degree-of-freedom visual simulation set-up is provided together with a summary of full-mission tasks performed by the pilot. Principal instrumentation hardware and software elements utilized in gathering and processing the digital, analog, video and audio test signals are described, and representative data samples are presented and discussed. Key test results derived from the data are then briefly reviewed. (Author)

A80-29500 # Design and verification of an automatic Mach number control system. R. L. Palko, G. T. Province, and R. L. Meyer (ARO, Inc., Arnold Air Force Station, Tenn.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 226-236.

A microprocessor-based automatic Mach number control system has been designed and installed in the 1-ft transonic Aerodynamic Wind Tunnel (1T) in the Propulsion Wind Tunnel Facility at the Arnold Engineering Development Center. A description of the tunnel Mach number control process and the development of the system are presented. The necessary control valve modifications, control system, control algorithms, and microprocessor software are included. Wind tunnel data obtained during the system's development and verification are also presented. (Author)

A80-29501 * # Computer/experiment integration for unsteady aerodynamic research. S. S. Davis (NASA, Ames Research Center, Moffett Field, Calif.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 237-250. 9 refs.

The use of a minicomputer for the acquisition and analysis of unsteady aerodynamic data is described. Some of the novel features of the system include: on-line digitization, a signal-averaging algo-

rihm, Fourier decomposition, graphical display, and on-line theoretical computations to compare with the ongoing experiment. The system's capabilities are described using some data from a recently completed oscillating airfoil experiment. (Author)

A80-29502 **A second generation instrumentation system for measuring cross coupling derivatives.** L. R. Foster and E. S. Hanft (National Aeronautical Establishment, Ottawa, Canada). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 251-256. 5 refs.

A second generation data acquisition and processing system for the measurement of dynamic cross and cross coupling derivatives is presented with consideration given to both hardware and software points of view. The system is fully digital and incorporates a minicomputer that extracts the necessary information by processing wind tunnel data in the time domain. The software has been reasonably optimized in relation to the computer capabilities, and a program has been completed to verify the performance of the system under controlled conditions intended to simulate those encountered in wind tunnel experiments. A preliminary evaluation shows that the system is capable of determining the pertinent aerodynamic quantities from wind tunnel data. L.M.

A80-29505 **Digital processing of unsteady periodic signals with application to the turbulence structure around oscillating airfoils.** G. De Grande, A. Haverbeke, and Ch. Hirsch (Brussel, Vrije Universiteit, Brussels, Belgium). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 273-283. 6 refs. Grant No. NATO-1264.

A microprocessor facility controlling the digital processing of unsteady signals, and of unsteady periodic signals in particular, is described. The facility is used in an experimental investigation on the turbulence structure around oscillating airfoils. Hot wires, mounted in the wake and in the boundary layers of an oscillating NACA 0012 profile, were used to analyze the flow field. General considerations about the digital processing of unsteady flows are given. Then the experimental set-up is described. This is followed by a summary of the rotating slanted hot wire technique. The complete data acquisition system is reviewed and details about the microprocessor facility are given. Experimental results are presented and discussed. (Author)

A80-29507 # **A three-dimensional Laser Doppler Velocimeter /LDV/ for use in wind tunnels.** W. J. Yanta (U.S. Navy, Naval Surface Weapons Center, Silver Spring, Md.). In: ICIASF '79; International Congress on Instrumentation in Aerospace Simulation Facilities, 8th, Monterey, Calif., September 24-26, 1979, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 294-301. 9 refs.

A three-component Laser Doppler Velocimeter (LDV) for use in large wind tunnels is described. The optical and electronic components and aerosol generators which are used in the system are described in detail. Typical results obtained with this 3-D LDV are also shown. (Author)

A80-29651 **Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers and Supplementary Papers.** Conference sponsored by the Royal Aeronautical Society and University of Bristol. Bristol, England, University of Bristol, 1979. Conference Papers, 190 p.; Supplementary Papers, 84 p.

Remotely piloted vehicles (RPVs), which are useful for military purposes in high-threat environments and for civilian purposes because of cost effectiveness, are surveyed. Various RPV systems and operations are discussed in terms of design and testing, such as airframes, control systems, engines, navigation, communications and recovery systems. RPVs ranging from harassment drones to mini-

RPVs are considered, as are payloads for surveillance, agricultural use and weapons delivery. J.P.B.

A80-29652 # **Operations of unmanned aircraft.** W. D. Simpson (British Aerospace, Dynamics Group, Stevenage, Herts., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 1.1-1.7.

Air, sea, and ground launched variants of unmanned aircraft for military uses, such as reconnaissance, target identification, electronic countermeasures, weapon delivery, and antisubmarine warfare, are discussed. Attention is given to jet powered and piston engined vehicles, and to recoverable and expendable types, including cruise missiles and harassment drones. Suitable modifications or redesign for air and sea carriers of unmanned aircraft are discussed, and it is proposed that special carrier systems, including ships, light fixed wing aircraft, and airships should be designed. J.P.B.

A80-29653 # **Prospects for advanced tactical RPV's.** F. Seidel (Dornier GmbH, Friedrichshafen, West Germany). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 2.1-2.8.

The concept, design, and operation of advanced tactical remotely piloted vehicles (AT-RPVs) which attack fixed or transient targets at known locations particularly in high threat missions, and could also perform tactical air reconnaissance and electronic warfare, are discussed. AT-RPVs are to fly at low altitude with high subsonic velocity, the entire mission including weapon delivery being executed in a preprogrammed mode. Navigation by an autonomous dead-reckoning system insensitive to enemy electronic countermeasures, an update system, and filter/calibration processing, is also considered, as are cost and operational effectiveness. J.P.B.

A80-29654 # **Unmanned aircraft systems research in the UK.** J. Benjamin (Royal Aircraft Establishment, Farnborough, Hants., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 5.1-5.3.

Objectives, testing, and research on cost-effective unmanned aircraft (UMA) in the UK are reviewed. The design characteristics of tested UMA are given, including mass, dimensions, speed, range, and payload capabilities (2-15 kg), and vehicle instrumentation to enable autonomous or remote pilot control as well as telemetry of the onboard systems is considered. Areas of research are also discussed, including navigation, communications, airframe and engine improvements, and propulsion requirements. J.P.B.

A80-29655 # **VFW-Fokker-concept for a ground-attack-RPV.** V. Schlenkrich (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 7.1-7.13.

System requirements for ground attack, remotely piloted vehicles (RPVs) for operation in the central European area are discussed; RPVs have advantages for high-threat environment use and in terms of cost effectiveness. The data link, guidance, target acquisition and weapon release aspects of RPVs are considered for three cases: stationary or quasi-stationary targets, self-radiating targets with restricted movements, and mobile point targets involving human decision making. In addition, details of the design, navigation system, target acquisition sensor system and armament for a particular recoverable RPV are presented. J.P.B.

A80-29656 # **A low budget experimental RPV system.** A. W. Sverby (Defence Materiel Administration, Stockholm, Sweden). In: Remotely piloted vehicles; International Conference, Bristol, En-

gland, September 3-5, 1979, Conference Papers.
Bristol, England, University of Bristol, 1979, p. 8.1-8.16.

An experimental remotely piloted vehicle system under consideration in Sweden is discussed, which uses a target drone and as much off-the-shelf avionics as possible. Attention is given to solid rocket booster launch, recovery via two stage parachute system, digital guidance and control, inertial navigation utilizing strapdown technology, and a terrain following system using a laser. Also considered are the engine, command and video links, the ground control station, and the testing program, including the loss factor.

J.P.B.

A80-29657 # Parachute recovery systems. I - Parachute materials, applications and design. II - The recovery system as an integral part of vehicle design. B. W. White and D. Northey (Irvin Great Britain, Ltd., Letchworth, Herts., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 9.1-9.15.

Parachute recovery systems are discussed in terms of materials such as silk, spun bonded nylon, polyolefin, dacron, and woven nylon, and designs including conical, ribbon, shaped, flat and cruciform parachutes, the ring slot, and the ring sail. Attention is given to parachute deployment and inflation, taking into account the payload, the terminal velocity, and whether the parachute is for personnel or weapon retardation. Integration of the parachute with the system is also discussed, and a comparison between a single parachute and a cluster is presented on the basis of performance, including system stability and the airspace needed to achieve terminal velocity.

J.P.B.

A80-29658 # RPV recovery systems. A. C. Roberts, J. D. Lye, and T. G. Wheeler (British Aerospace, Dynamics Group, Bristol, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 10.1-10.16.

Recovery methods applicable for remotely piloted vehicles weighing between 100 and 400 lb with approach speeds of from about 50 to 100 kts are reviewed, including conventional landing (with and without arresting systems), parachutes (gliding and non-gliding types), net recovery (fixed and traveling nets), and wire engagement systems. In addition, inclined landing ramps, retro-rockets and large pneumatic recovery cushions are considered. Attention is given to the necessary energy absorption devices, both the ground mounted systems such as drag chains and soft ground or gravel, and the airborne impact attenuation systems such as airbags, crushable structures, and parachute reel-in. It is concluded that the most economical methods are non-gliding parachutes and conventional landing, while net and arrester wire systems are effective but more expensive.

J.P.B.

A80-29659 # Aerofoils down to critical Reynolds numbers and the performance of remotely controlled gliders. T. J. Patrick (University College, London, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 12.1-12.6. 16 refs.

The remote piloting of small aircraft is discussed in terms of the decline of the lift/drag ratio with decreasing Reynolds numbers due to skin friction and separation. The critical behavior and supercritical improvement of profile drag coefficient are discussed, considering such wind tunnel results as the low-speed behavior of the Eppler (1965) 387 profile. It is found that there is a reduction of the lift/drag ratio available from aerofoils at low Re due to low-incidence separation, causing a severe loss of $C(L)_{max}$ with a large increase of form drag. In addition, the more intense shear of laminar boundary layers at relatively short distances from the aerofoil's leading edge means that skin friction drag coefficients are higher if Re is lower.

J.P.B.

A80-29660 # Mini-RPV research. R. Coleman, A. J. Robins, D. J. Frary, and R. Stephenson (British Aerospace, Dynamics Group, Bristol, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 13.1-13.12.

The identification of aerodynamic derivatives (ADs) of a mini-remotely piloted research vehicle is considered, for which the extended Kalman filter algorithm (Jazwinski, 1970) is used for the extraction of airframe ADs from flight trials data. A 3-D simulation has been employed, and results indicate that the ADs in the pitch and roll planes can be identified using rate sensor measurements only, and that the yaw derivatives can be determined, provided lateral acceleration is measured.

J.P.B.

A80-29661 Development, flight test and application of RPV control law concepts for microprocessor based computers. M. Woolley (Teledyne Ryan Aeronautical, San Diego, Calif.). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 14.1-14.18. 10 refs.

The control laws developed for use in a relatively small, slow digital computer, that is, the microprocessor flight control system, are described and subsequent flight testing is discussed. Analysis of the digital system and the techniques used are described; these include small perturbation z-transform analyses and extensive six-degree-of-freedom simulation modelling. Attention is also given to the application of the control law concepts to future vehicles such as the NASA highly maneuverable aircraft technology (HiMAT) vehicle, which was designed to investigate high-G maneuvering capability, and the Navy FIREBRAND, a multimission, multiuse supersonic aerial target.

J.P.B.

A80-29662 # Power units for mini RPV's. D. P. Short (Weslake Aeromarine Engines, Ltd., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 16.1-16.7.

Production engines suitable for mini-remotely piloted vehicles (RPVs), having minimum bulk and weight for a given power output are discussed, including engines designed for chain saws, snow-mobiles, and go-carts. Attention is given to the carburetor, exhaust and fuel systems, and the alternator. Typical specifications for such future mini-RPV engines include: rated output at 6500-8000 rpm, BMEP at rating 75-80 psi, specific fuel consumption at cruise condition better than 0.75 lb/bhp hr, and specific weight of a running engine, not including exhaust system, better than 1 lb/bhp.

J.P.B.

A80-29663 # The design and manufacture of a prototype cost-effective R.P.V. engine. P. B. Allen. In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 18.1.

A prototype lightweight (about 7 lb), high performance, economical 70 cc RPV engine useful for harassment drones is described. This engine features rear disk valve induction and Schnuerle porting, uses glow ignition to give more power by using methanol for fuel, and has an opposed twin cylinder layout with minimum cylinder stagger and an ultrashort stroke configuration; fuel consumption is 1.25 lb per HP per hour.

J.P.B.

A80-29666 # Antennas for RPV's. N. Williams, P. Wright, K. Keen (Electrical Research Association, RF Technology Centre, Leatherhead, England), and P. R. Foster (British Aerospace, Filton, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 24.1-24.5. 5 refs.

Various antennas used in mini-RPV experiments are reviewed, and the development of a microwave antenna system for a secure

data link is described. Considering antennas for an I band data link, coverage requirements for a vertically polarized antenna system are summarized, and attention is given to the short range antenna. It is concluded that several antennas are needed to obtain acceptable performance and that the wing tips offered the best sites since they introduced the least obscuration. J.P.B.

A80-29667 # Kalman-filter for terrain aided navigation. E. Skarman (Saab-Scania AB, Linköping, Sweden). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Conference Papers. Bristol, England, University of Bristol, 1979, p. 25.1-25.9.

The paper considers the application of Kalman filter theory to the design of a highly accurate terrain aided navigation (TAN) system with a low computational burden, which is regarded as a problem of statistical estimation. Recursive estimation is discussed, as well as (stochastic) terrain linearization and the principle of orthogonality. The advantage of applying Kalman theory is that TAN can be combined with very poor inertial navigation systems having appreciable dynamic errors. Experimental simulations, with and without the presence of wooded terrain, are described. J.P.B.

A80-29668 Use of a simulator in the development of a RPV system. N. J. Helbren (Royal Armament Research and Development Establishment, Fort Halstead, Kent, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 4.1-4.7.

The concept of an RPV system simulator is being employed currently for SUPERVISOR, a medium-range surveillance and target acquisition system being developed for the British Army. The system uses a remotely piloted helicopter which carries an imaging sensor and is capable of relaying in real time the observed scene on the ground below to a ground control station. Attention is given to the aims and design of the SUPERVISOR System simulator. Care must be exercised that the use of the simulator is appropriate to the outputs required; otherwise, not only is the system itself likely to suffer but the credibility of the simulator to the topics it was designed to examine will also be questioned. S.D.

A80-29669 # Mini-RPV technology development. D. T. Lowe (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 6.1-6.10. 9 refs.

The paper discusses the Mini-RPV Research and Development Program intended to develop RPV technology at low cost. The discussion covers the program background, aircraft design concepts, structural foam technology, avionics activities, vehicle recovery, and target strike investigations. Every attempt has been made to achieve acceptable performance at minimum cost. This program, begun several years ago, has resulted in the development of appropriate technology and has significantly helped in the positive display of total system capability. S.D.

A80-29670 # RPV aeronautical and support system Supporting Technology Programs. R. O. Stanton and G. N. Smith (U.S. Army, Applied Technology Laboratory, Fort Eustis, Va.). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 11.1-11.11. 12 refs. Army-supported research.

The paper discusses the six programs of the aeronautical and support systems area of the RPV Supporting Technology Program (STP). This program has three major areas: aeronautical and support systems; electrooptical systems; and data link and command systems. The six programs discussed concern propulsion, recovery systems, launch systems, fabrication techniques, servoactuators, and propeller

acoustics. It is suggested that the STP will continue to be a valuable source of technology for future RPV systems. S.D.

A80-29671 # Design and test of mini-RPV demonstrator engines. E. T. Johnson and J. Gomez (U.S. Army, Applied Technology Laboratory, Fort Eustis, Va.). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 15.1-15.7.

The design and testing of three 15-kW (nominal), two-cylinder, two-stroke demonstrator engines for use on mini-RPV aircraft are discussed. The objective is to develop the technological base for engines in the 15-kW class so that they would be available for RPVs as they enter engineering development. Specific goals of the mini-RPV demonstrator engine program are defined. Test results show that changes are required to improve durability, reliability, and maintainability. Test results for performance, altitude, noise, hot and cold starts, and electromagnetic interference are discussed. S.D.

A80-29672 # Advanced developments in turbo machinery for use in small RPV engines. R. W. Chevis (Noel Penny Turbines, Ltd., Coventry, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 17.1-17.10. 19 refs.

The paper focuses on outlining recent aerodynamic developments in turbomachinery applicable to small RPV turbojets. The term small is assumed to apply to engines having air mass flows less than about 8 lb/s. Attention is given to the impact of aerodynamic developments on engine performance. The discussion suggests strongly that the application of advanced small compressor and turbine technology can considerably improve performance levels in small RPV turbojets without increase in complexity. S.D.

A80-29673 Microprocessors in a RPV system. J. W. Eagle (Royal Armament Research and Development Establishment, Fort Halstead, Kent, England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 19.1-19.8. 5 refs.

The different roles played by RPVs in military systems are summarized, and the possible implementation of these roles with the aid of microprocessors is discussed. Some of the important design factors which must be considered are highlighted. The use of microprocessors in the application and testing of the RPV system is considered in general terms and their application in the context of a specific surveillance and target acquisition system is examined. Three clearly defined areas within an RPV system are considered: the air vehicle, the ground-based equipment, and the support services. Some of the problem areas are identified, and suggestions are made as to how these can be avoided. S.D.

A80-29674 # Communication to RPVs. S. E. Gibbs and M. R. B. Dunsmore (Royal Signals and Radar Establishment, Malvern, Worcs., England). In: Remotely piloted vehicles; International Conference, Bristol, England, September 3-5, 1979, Supplementary Papers. Bristol, England, University of Bristol, 1979, p. 23.1-23.10.

The various types of data links to RPVs are considered. The information to be transferred between the ground terminal and the RPV or between RPV and RPV depends largely on the type of mission. This imposes the largest constraint on the link design. Factors affecting RPV link data are discussed in terms of operational scenario, frequency allocation problems, signal or picture quality required to perform task, command and telemetry, integrated tracking, and electromagnetic interference and counters. Also discussed are special electronic components for RPVs. S.D.

A80-29688 # Design of perfect model following systems by geometric approach. T. Okada, M. Kihara, and S. Kobayashi (Defense

Academy, Yokosuka, Japan). (*Japan Society for Aeronautical and Space Sciences, Aircraft Symposium, 16th, Tokyo, Japan, Dec. 8, 1978.*) *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 22, Feb. 1980, p. 179-190. 5 refs.

The perfect model following (PMF) problem is investigated using the geometric approach in order to extend the PMF system to more general cases, such as arbitrary state variables and output matrices. Conditions for the existence of a solution are defined and a method is developed for finding a solution if one exists. It is shown that PMF systems can be designed even if the plant and the model are not represented in phase-variable canonical forms and the dimension of the plant state space is different from that of the model state space. It is also shown that this design technique can be successfully applied to aircraft control problems. V.L.

A80-29689 # An experiment of lift interference on 2-dimensional wings in a wind tunnel with perforated walls. H. Sawada (National Aerospace Laboratory, Chofu, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 22, Feb. 1980, p. 191-202. 10 refs.

An experiment on wall interference due to lift with two-dimensional wings was carried out in a transonic wind tunnel with perforated walls at high subsonic speeds. In this experiment, pressure distributions near the upper and the lower walls inside the test section were measured in addition to pressure distribution on an airfoil model. Various quantities involved in the lift interference with two-dimensional wings were assessed by a new method which requires only the measurement of pressure distributions on flow boundaries. Lift interference parameters for the present case were evaluated indirectly by this method. (Author)

A80-29773 Investigation can prevent aircraft accidents. G. B. Parker (Southern California, University, Los Angeles, Calif.). (*International Society of Air Safety Investigators, International Seminar, 10th, Montreal, Canada, Sept. 1979.*) *SAFE Journal*, vol. 10, Spring 1980, p. 8-13. 15 refs.

The paper discusses the investigation of aircraft accidents using the PSA 182/Cessna 172 mid-air collision as a case study example. Accident prevention is considered in terms of preventing occurrence and preventing recurrence, and the investigation process requirements including the pilot, material, and the 'act of God' factors are examined; it is suggested that the repeat accident is not an accident and that the accident has multiple causes. The history of the causes and the investigation formula for accidents are described, concluding that if the PSA accident is repeated it would be caused by the failure of the safety system to determine and establish the root causes and corrective action of previous mid-air collisions. A.T.

A80-29774 An inflatable troop seat. D. C. Reader (RAF, Farnborough, Hants., England). *SAFE Journal*, vol. 10, Spring 1980, p. 14-16.

The paper examines an inflatable troop seat of improved strength and crashworthiness for use in helicopters. A new type of seat has been developed which provides flexibility of seating whereby an aircraft can change from a troop to a cargo carrying role, and is very light in weight and high in strength. Bench seats have been made from inflated bags using rubberized neoprene and tested for suitability to carry all sizes of troops dressed in battle order, the vibration characteristics of seats, and their behavior under crash impact. The tests showed that the seats are suitable for use in aircraft, perform well under vibration conditions and crash impact, and are considerably stronger than many seats in service. A.T.

A80-29775 Rescue at sea of aircrew personnel. F. T. Thomasson (Stencel Aero Engineering Corp., Asheville, N.C.). *SAFE Journal*, vol. 10, Spring 1980, p. 27-30.

This paper documents the need for improvements in the techniques and equipment used to retrieve aircrew personnel from the hostile water environment. The documentation is by reiterating individual rescue scenarios rather than by the statistical approach. Narratives of ejections at sea which occurred in the 1975 through

1978 time frame were studied. Those ejections wherein the aircrew were not a candidate for rescue, such as those who ejected beyond the escape envelope or where the escape system malfunctioned were excluded from the study. One hundred and sixty three aircrew personnel were candidates for rescue. On hundred and forty four were rescued. Nineteen were classified as 'fatal' or lost at sea. Conclusions are made regarding the probable causes for the losses and recommendations are made for the application of technology to save aircrew personnel in future survival situations. (Author)

A80-29936 # Optimal wing profile in the flow of an ideal incompressible fluid (K voprosu ob optimal'nom profile kryla v potoke ideal'noi neszhimaemoi zhidkosti). V. I. Zubov. *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol. 20, Jan.-Feb. 1980, p. 241-245. 6 refs. In Russian.

The problem of choosing a profile with maximum lift among a series of profiles of prescribed length is examined. It is assumed that the chosen profile should have one sharp edge, which allows unambiguous definition of the circulation from the Joukowski condition. A variational solution, based on the numerical variation of Fourier series expansion coefficients, is obtained for the problem.

B.J.

A80-29942 Indoor and outdoor carbon monoxide measurements at an airport. P. Bellin and J. D. Spengler (Harvard University, Boston, Mass.). *Air Pollution Control Association, Journal*, vol. 30, Apr. 1980, p. 392-394.

Results of the monitoring of carbon monoxide levels in indoor and outdoor locations at an airport are reported. CO monitors were placed in baggage handling areas, near roadways, and indoors at Logan International Airport. Indoor concentrations are found to be significantly lower than outdoor and baggage handling area concentrations, with the outdoor concentrations log normally distributed at a mean of 9.8 ppm. At no time was a violation of the occupational standard of a 50 ppm 8-h average observed, nor was there a violation of the 35 ppm 1-h average. Results suggest that the 8-h standard of 9 ppm may be exceeded outdoors in the immediate vicinity of the airport; however, the lower indoor levels do not constitute a health threat to the general population or the working population. A.L.W.

A80-29950 * # Development of a metric half-span model for interference free testing. W. A. Corlett, D. S. Shaw, and P. F. Covell (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerodynamics Testing Conference, 11th, Colorado Springs, Colo., Mar. 18-20, 1980, Paper 80-0460*. 5 p.

A metric half-span model has been developed which allows measurement of aerodynamic forces and moments without support interference or model distortion. This is accomplished by combining the best features of the conventional sting/balance and half-span splitter plate supports. For example, forces and moments are measured on one-half of a symmetrical model which is mechanically supported by a sting on the nonmetric half. Tests were performed in the Langley Unitary Plan wind tunnel over a Mach range of 1.60 to 2.70 and an angle-of-attack range of 04 deg to 20 deg. Preliminary results on concept evaluation, and effect of fuselage modification to house a conventional balance and sting are presented. (Author)

A80-29988 Calculation of axisymmetrical flows in the flow section of turbomachines in solving the problem of optimisation of stages. A. V. Boiko and Iu. N. Govorushchenko (Khar'kovskii Politekhnicheskii Institut, Kharkov, Ukrainian SSR). (*Teplo-energetika*, vol. 26, Aug. 1979, p. 44-47.) *Thermal Engineering*, vol. 26, Aug. 1979, p. 477-480. 8 refs. Translation.

An algorithm for optimizing the axisymmetric flow in an axial-flow turbomachine stage is discussed. The steady axisymmetric flow of an ideal compressible fluid in an axial-flow turbine stage is described by the motion, continuity and process equations and the equations of state, mean stream surface and the orthogonality of the blade force to the stream surface, with the upstream gasdynamic

parameters and momentum moment distribution and the downstream boundary streamline inclination specified. The problem is solved numerically by iteratively solving the boundary value problems within the cross sections and the consecutive refinement of the shape of the meridional streamlines. The proposed method has been found to require a considerably smaller number of iterations than the streamline curvature method, and has shown stable convergence for stages with complex meridional bounding surfaces and different guide blade and moving blade twists. Results of calculations by the proposed algorithm are also found to be in agreement with experimental results for several axial-flow turbine stages. A.L.W.

A80-29990 * # Effects of thermally induced porosity on an as-HIP powder metallurgy superalloy. R. L. Dreshfield and R. V. Miner, Jr. (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Las Vegas, Nev., Feb. 24-28, 1980, Paper.* 18 p.

The effect of thermally induced porosity on the mechanical properties of an as-hot-isostatically pressed and heat-treated pressing made from low carbon Astroloy is examined. Tensile, stress-rupture, creep, and low cycle fatigue tests were performed and the results were compared with industrial acceptance criteria. It is shown that the porous pressing has a porosity gradient from the rim to the bore with the bore having 1-1/2% greater porosity. Mechanical properties of the test ring below acceptance level are tensile reduction in area at room temperature and 538 C and time for 0.1% creep at 704 C. It is also found that the strength, ductility, and rupture life of the rim are slightly inferior to those of the rim of the sound pressings, while those of the bore are generally below the acceptable level. At strain ranges typical of commercial aircraft engines, the low cycle fatigue life of the rim of the porous pressings is slightly lower than that of the sound pressings. L.M.

A80-29991 AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 398 p. \$25.

Various aspects of ATE are examined including design applications, control and support software, special purpose systems, standards, international systems, test generation techniques, automatic test system selection techniques, calibration, testability, and software verification and validation. Particular attention is given to commercial test program sets, built-in test/system integrated test, military systems, and automatic test program generation. B.J.

A80-29997 Test program set development process used for P3 Orion avionics support. R. W. Tobias and R. F. Heslin (AAI Corp., Baltimore, Md.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 72-77.

The test program set (TPS) is developed in a four-stage process controlled by the development engineer for maximum efficiency. Techniques that have evolved over the past decade such as multiple and simultaneous TPS assignments, standard TPS design guidelines, the use of multiple automatic test systems (ATS's) and units under test (UUT's) during the validation process, and a standard approach to interface design lead to TPS development at minimum cost. These processes have been used in development of shop replaceable assembly (SRA) and weapon replaceable assembly (WRA) TPS's for the AN/USM-449(V) ATS which is used at all Depots and Intermediate Level shops which support the P3 ORION aircraft. The AN/USM-449(V) is a state-of-the-art dual port general-purpose automatic test system having full ATLAS capability. (Author)

A80-29998 Cost saving approach to Automated Test Equipment for F-18L program. J. Colgan (Northrop Corp., Aircraft Div., Hawthorne, Calif.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn.,

September 19-21, 1979.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 78-80.

The front-end efforts required in ATE development to support a major system based on experience with the F-18L are discussed with emphasis on how the 'front-end' investment in support concepts can save costs throughout the life of a weapon system. Consideration is given to the mainframe acquisition process and test program set (TPS) development as two major cost elements in the ATE system acquisition. 'Front-end' tasks are defined for the TPS development along with design guidelines, including software, hardware, and documentation. It is shown that the process of mainframe acquisition with elements such as mature system versus fourth generation ATE and the development of a TPS acquisition plan with a set of TPS design guidelines can represent a 20% saving in the F-18L ATE program. L.M.

A80-30001 Built-in-test in MIL-STD-1553 systems. M. T. Ludvigson (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, Iowa). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 102-106.

The application of the MIL-STD-1553 data bus to future systems is discussed with regard to built-in-test that serves both the flight crew and the maintenance crew. Continuous monitoring is on line, and the system detects any failure to communicate on either bus in addition to microprocessor failures, and monitors power supplies in the computer control units and primary control unit (PCU), as well as PCU deflection circuits. The Army integrated avionics control system for helicopter cockpit management is cited as an example for which a small increase in hardware costs has provided about a two to one improvement in mean time to repair, and about a four to one improvement in maximum time to repair. J.P.B.

A80-30004 Cost-drivers affecting the development of F-16 depot ITA/hardware/ and test software. W. A. Greenhow (General Dynamics Corp., Fort Worth, Tex.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 136-140.

The system engineering approach taken by General Dynamics/F-16 SPO for the development of test software and associated Interface Test Adapters (ITA) for the F-16 depot support program is reviewed with specific emphasis on identification of the 'cost-drivers' which established or resulted in, (1) program/contractual requirements; (2) ATE selection; (3) test software and ITA review procedures; (4) ITA non-standard parts approval procedures and (5) the detailed development plans for both hardware and test software. The 'cost-drivers' are identified; trade-off alternatives analyzed; and the actions implemented to establish the most cost-effective program discussed. (Author)

A80-30005 # Air Force Automatic Test Equipment (ATE)/life cycle technical and logistics support considerations. J. B. Sides (USAF, San Antonio Air Logistics Center, Kelly AFB, Tex.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 141-146.

The Air Force Logistics Command is responsible for the technical and logistics support of ATE after production of a particular weapon system is complete. A significant part of the total ATE system life cycle cost is incurred during this period of the system's use. It is believed useful to inform ATE system suppliers of the AFLC management concepts and processes, and to describe some ATE support problems and the type solutions obtainable. This will aid ATE contractors in arriving at system design characteristics that can be supported most effectively in the AFLC 'post PMRT' era of system life cycle. (Author)

A80-30010 **Advanced electronic warfare test set - Realistic or futuristic.** D. O. Jacoby (U.S. Naval Air Systems Command, Washington, D.C.) and W. L. Ellis (ManTech Corp., Arlington, Va.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 179-181.

The paper describes the study/investigation phase of the advanced electronic warfare test set program which is directed toward the problems of increasing workload and decreasing number of qualified personnel in the electronic warfare avionics maintenance community. In particular, dual-port testing and the use of color graphic displays are considered. The dual-port approach is intended to maximize asset utilization and increase automatic test equipment (ATE) throughput more cost effectively than two single-port stations. Improved operator performance through the use of color coded displays is sought; direct application of color coding in ATE is seen in self-test and calibration, avionics end-to-end testing, and fault isolation.

J.P.B.

A80-30012 **ATE - A CRT display evaluation system.** O. G. Fuller (General Dynamics Corp., Fort Worth, Tex.) and M. Hauerbach (General Dynamics Corp., Electronics Div., San Diego, Calif.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 197-205. 5 refs.

An operational ATE test station is described which utilizes existing hardware technology and unique software to test and evaluate the two types of CRT displays, stroke and raster. This test station is the F-16 Avionics Intermediate Shop (AIS) Displays/Indicators Test Station. The test station, operating under program control and using the ATLAS high-level programming language, performs sufficient CRT evaluations to verify the display performance or to isolate its fault(s).

S.D.

A80-30014 **A cost effective approach to ATE.** G. A. Drown (Rockwell International Corp., Avionics and Missiles Group, Cedar Rapids, Iowa). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 229-232.

An approach designed to overcome the limitations of today's ATE systems and resulting in a 4 to 1 cost reduction for ATE usage is presented. The improvements include a simplified architecture due to the use of instruments in which the general purpose interface bus and the functions of the distribution panel are incorporated in the instrument. Distributed processing is used within the station by employing smart instruments, which incorporate local processing. The ATE concept also uses a functional assembly design that has a common form factor and common submodules, the design being suitable for severe environments. It is noted that this ATE concept is compatible with the second generation and third generation (synthesizing) ATE approaches.

L.M.

A80-30016 # **PATEC - An Air Force approach to ATE calibration.** J. C. Santo (USAF, Aerospace Guidance and Metrology Center, Newark Air Force Station, Ohio). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 242-246.

A general overview of Automatic Test Equipment (ATE) systems and their use in the Air Force is presented. ATE calibration is defined and various techniques which have been employed are discussed. The Portable Automatic Test Equipment Calibrator (PATEC) concept is defined and details of applying this concept are presented. These details include ATE system specifications, selection of the proper calibration point, determination of the 'core' instruments, analysis of the self test features and the assembly of a

complete PATEC system. A description of some successful PATEC applications and some current efforts is presented. (Author)

A80-30018 **Navy program for development of an Analog Test Program Generation system.** M. Modi (National Designers, Inc., Pennsauken, N.J.), J. Bauer, and R. Epstein (U.S. Naval Air Engineering Center, Lakehurst, N.J.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 250-253. 5 refs.

An attempt is made to discuss the Navy program development for an Analog Test Program Generation system. Attention is given to the three methods used to isolate faults, which include DC levels and waveforms, a functional approach, and a library approach. Various major algorithm development efforts are discussed, such as the NAEC algorithm for parametric and catastrophic fault isolation. The current and future efforts of algorithm developments are examined and it is concluded that all successful elements from these efforts will be merged and a large scale analog ATPG development effort will be pursued.

C.F.W.

A80-30028 # **F/A-18 Automatic Test Equipment.** T. J. Major (U.S. Naval Air Systems Command, Washington, D.C.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 317-319.

The development of the F/A-18 Automatic Test Equipment is discussed. Attention is given to areas in which cost reduction techniques and lessons learned from past ATE programs have been implemented. Areas covered include: the F/A-18A ILASS, the need for the ATE to be ship, shore, and USMC van compatible, systems monitoring, confidence testing, performance testing, and station maintenance and repair. Also covered are the Radar Test Station (RTS) and the benefits of the colorgraphic display, which include the possibility for operator corrective action, improved operator efficiency, reduced paper documentation, currency of documentation, and automatic test generation.

M.E.P.

A80-30029 # **F-16 avionics intermediate shop /AIS/ user involvement during development.** K. H. Ledford and T. J. Nickerson (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 330-333.

The formation, objectives and results of a technician/user team located on-site at the contractor's facility in order to evaluate an automated test equipments development program are discussed. The team was structured to cover the four F-16 A avionics intermediate shop test stations (computer-inertial, display-indicator, pneumatic-processor, and radio frequency). Specific accomplishments include: the generation of 19 reports on deficiencies which would normally have not been identified until well into the production delivery program; a detailed software analysis which provided the system program office software manager with the data to initiate corrective actions, and the identification of many instances where the line replaceable unit system test specification did not agree with the optimum repair level analysis recommendations.

J.P.B.

A80-30030 # **F-16 independent assessment - An Air Force viewpoint.** N. E. White (USAF, Systems Command, Wright-Patterson AFB, Ohio). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 342-344.

The paper deals with the benefits that have been derived to date from specific independent assessment efforts, and it defines those benefits that are expected to accrue as a result of having applied independent assessment techniques to the F-16 AIS and Depot

programs. The paper introduces the management approach applied on the F-16 program. It next describes the amount and type of recommendations that were obtained from the independent assessment team and the mechanism for getting such recommendations to the attention of the prime contractor. Statistics relating to the number of recommendations submitted and the number accepted by the prime contractor are presented in order to show positive acceptance by the prime contractor of the IA team's recommendations. Finally, the paper illustrates the benefits achieved as a result of having an IA contractor involved in the AIS and Depot test requirements and test program generation process. (Author)

A80-30032 **Test system requirements for 767 aircraft electrical components.** R. L. Maxwell and D. F. Miller (Boeing Aerospace Co., Electronics Support Div., Seattle, Wash.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 349-358.

The Automatic Test Equipment requirements for line replaceable units (LRU) on the 767 aircraft were studied to determine an integrated test system that would meet the requirements of the module manufacturer, flight line system integration and maintenance shops. The study included the following criteria: (1) functional test 767 Boeing-make LRU's, (2) test 767 Boeing-make cards, (3) dedicated test equipment, (4) use ATLAS test procedures, (5) self-contained stations LRU testing, (6) minimize manual steps, (7) display test results, (8) provide test records, (9) diagnostic capability, and (10) use common software. The phase of the study that is discussed is from the module production and flight line component verification areas. The development and maintenance areas of the study will be concluded later this year. The conclusion of the study was that a centralized ATE system would be used in the module production facility. The flight line component test shop would use ATE stations dedicated to families of LRU's. (Author)

A80-30033 **ATE system acquisition for E-3A sentry /AWACS/.** R. D. P. Duncan (USAF, Electronic Systems Div., Bedford, Mass.), J. H. Wilson (USAF, Warner Robins Air Logistics Center, Robins AFB, Ga.), and R. R. Schellenbach (Support System Associates, Inc., Burlington, Mass.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 365-369.

The paper describes the systems engineering and management decisions for the support of the organic depot maintenance operation of the E-3A Sentry Aircraft. In order to provide cost effective acquisition of ATE, a listing is given of the alternatives and considerations required to form an overall picture of the technical capability and total ownership cost of a particular ATE system. Special attention is given to ATE useful life requirements, efficiencies, and personnel skill level. The methodology employed in support of the E-3A mission avionics is considered. L.M.

A80-30034 # **Armament Programmable Test Set /APTS/.** J. Hobbs (U.S. Navy, Naval Avionics Center, Indianapolis, Ind.). In: AUTOTESTCON '79; Proceedings of the International Automatic Testing Conference, Minneapolis, Minn., September 19-21, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 370-374.

The paper outlines a basic test set design that is applicable to a variety of test set requirements in the aircraft armament area. Most of the test set circuitry will be mounted on throwaway Standard Electronic Modules (SEM). The use of SEM should result in higher reliability and a lower life cycle cost. The microcomputer section will be packaged in such a way that it can be easily replaced when technology changes make the selected microcomputer obsolete. The operation of the test set will be as automatic as practical in order to minimize actions and decisions by the operator. Test set calibration

requirements will be practically eliminated by using the built-in microcomputer and an internal reference standard to perform automatic calibration of the critical measurement circuitry. V.L.

A80-30282 # **Rotating stall and surge.** A. H. Stenning. *ASME, Transactions, Journal of Fluids Engineering*, vol. 102, Mar. 1980, p. 14-20. 14 refs.

Safe off-design operation of compressors is limited to the region in which the flow is stable. Flow instabilities can be of two types, rotating stall and surge. The first of these subjects the blading to high oscillating stresses while the second may also have a disastrous effect on the whole system of which the compressor is a component. In this paper, the properties of these two types of instability are discussed and some simple criteria for determining system stability are presented. (Author)

A80-30299 # **Reliability improvement on aircraft engine bearing by discriminant analysis.** F. Ohoka and R. Fujimoto. *Ishikawajima-Harima Engineering Review*, vol. 20, Jan. 1980, p. 29-34. 6 refs. In Japanese, with abstract in English.

The paper describes the successful elimination of an aircraft engine bearing skidding defect by the use of discriminant analysis and other multivariate procedures in the selection of bearing components. As the problem was thought to arise by the interaction of numerous engine characteristics, the techniques of principle component analysis and the outliers test for data stratification, variable selection by sum of squares prediction and discriminant analysis and bivariate control chart construction for the prediction of bearing skidding from assembly data were employed. A.L.W.

A80-30305 **Discriminant analysis of purchasers of general aviation aircraft avionics.** S. G. Vahovich (FAA, Energy Div., Washington, D.C.). *Transportation Research, Part A: General*, vol. 14A, no. 1, Feb. 1980, p. 25-31. 9 refs.

Using data from the Federal Aviation Administration's national sample of general aviation (GA) aircraft owners (1975), this study explores the factors that influence aircraft owners' equipment purchase decisions for eight different types of communication and navigation instrumentation. The discriminant function is developed for noncompany owners of GA aircraft and is applied to data for company owners to generate the classification results. The results for almost all types of avionics suggest that the discriminant function - based on owner's type of use of aircraft, the aircraft's age, type of aircraft, and intensity of use - effectively discriminates between the equipped and nonequipped groups. The classification results, tested against both a proportional chance and pure chance criteria, are for the most part statistically significant at the 0.01 level. Thus the discriminant functions effectively identifies individuals most apt to purchase a particular type of avionics. Hence, it could be used by the avionics manufacturing industry to establish market profiles and by the FAA in estimating the expected demand on their ground facility services and equipment. (Author)

A80-30325 # **Ensuring geometrical accuracy of riveted aircraft component contours (Obespechenie tochnosti obvodov klepanykh agregatov samoletov).** I. N. Voloshin. Moscow, Izdatel'stvo Mashinostroenie, 1979. 152 p. 27 refs. In Russian.

The book deals with assembly techniques and methods of obtaining geometrically precise contours of riveted aircraft structures of complex curvature. Some aspects of combining assembly methods with methods of obtaining precise connection links are examined on the basis of an analysis of the accuracy requirements placed on aircraft structure contours. V.P.

A80-30366 # **Aerodynamics and dynamics of aircraft flight (Aerodinamika i dinamika poleta letatel'nykh apparatov).** V. B. Baidakov and A. S. Klumov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 344 p. 28 refs. In Russian.

This textbook presents principles of aerodynamics and flight dynamics of aircraft. Emphasis is placed on analyzing the physical

nature and mechanisms of initiation and variation of external forces which act on aircraft, and on defining aircraft motion as a result of these forces. The basic principles of liquid and gas flow, elements of gas dynamics, and experimental methods are described; aerodynamic characteristics of aircraft including aerodynamics of bearing surfaces and frames as bodies of revolution and aerodynamic forces and moments acting on entire aircraft taking into account the interaction of its components and assemblies are considered. Finally, various types of aircraft power plants and their effect on flying characteristics are examined. A.T.

A80-30438 # The aircraft, the pilot, and flight safety (Samolet, letchik i bezopasnost' poleta). G. S. Kalachev. Moscow, Izdatel'stvo Mashinostroenie, 1979. 224 p. 26 refs. In Russian.

Various aspects of aircraft stability, controllability, and maneuverability are reviewed. Attention is given to pilot performance in cases when certain values of angle of attack, acceleration loading, and flight speed are exceeded. Some practical recommendations on flight safety associated with piloting, flight testing, and aerodynamic design are given. B.J.

A80-30442 # Dehydration of aircraft fuels and lubricants (Obezvozhivanie aviatsionnykh goruiche-smazochnykh materialov). K. V. Rybakov, E. N. Zhuldybin, and V. P. Kovalenko. Moscow, Izdatel'stvo Transport, 1979. 184 p. 89 refs. In Russian.

The book examines the causes and sources of water contamination of aircraft fuels and lubricants and the effect of water on motors for fuel, oil, and hydraulic aircraft and helicopter systems. The current purity requirements for aircraft fuels, oils, and special fluids are presented, and methods and equipment used for dehydration of aircraft fuels and lubricants are described. In addition, the effect of water contamination of fuels and lubricants on reliability and durability of aircraft and helicopters is discussed along with diaphragms and filter-separators used in dehydration. A.T.

A80-30504 # The effect of the law of control on the dynamics of the longitudinal motion of an aeroplane with a variable-geometry wing. Z. Dzygadło and C. Szendzielorz. *Journal of Technical Physics*, vol. 20, no. 3, 1979, p. 353-367. 8 refs.

An analysis of longitudinal motion dynamics of a variable-sweepback aircraft is performed for various combinations of linear and nonlinear control laws of system parameters. The Runge-Kutta-Gill (1958) method is applied for numerical integration of equations derived. Computations are performed for a number of cases in order to determine the effect of control functions on the character and values of flight parameter perturbations. V.T.

A80-30564 # The delta wing in oscillatory gusts. M. H. Patel (University College, London, England). *AIAA Journal*, vol. 18, May 1980, p. 481-486. 22 refs.

The paper is a contribution to an understanding of delta wing aerodynamics. It presents some experimental data for lift forces and pitching moments on sharp-edged delta wings of aspect ratios 1 and 2 both in steady flow and in oscillatory vertical gusts approaching the stationary wings with a variety of different wing incidences, frequency parameters, and gust intensities. The steady flow data are compared with some theories. Conclusions are drawn as to the nature and behavior of the leading edge vortices in unsteady flow. S.D.

A80-30567 * # Stability aspects of diverging subsonic flow. M. C. Cline (California, University, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.). *AIAA Journal*, vol. 18, May 1980, p. 534-539. 6 refs. Research sponsored by the U.S. Department of Energy and NASA.

The paper describes the computation of two-dimensional, subsonic, diverging internal flows and how they differ from the corresponding converging flows. Such diverging or decelerating flows occur in such obvious places as subsonic diffusers and inlets; however, such flows also occur in supersonic nozzles in the presence of a normal shock. The flow instability and its relation to the numerical method used, boundary conditions, and viscous effects are

assessed both analytically and numerically. The inviscid flow is shown to be physically unstable and a poor representation of the true viscous flow. S.D.

A80-30568 * # Noise radiation from the side edges of flaps. J. C. Hardin (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, Va.). *AIAA Journal*, vol. 18, May 1980, p. 549-552. 11 refs.

The recently observed phenomenon of high noise radiation from the side edges of flaps in flow is investigated by way of a simple two-dimensional model problem. The model is based upon a physical picture of boundary layer vorticity being swept around the edge by spanwise flow on the flap. The model problem is developed and solved and the resulting noise radiation calculated. Further, a mathematical condition for the vortex to be captured by the potential flow and swept around the edge is derived. The results show that the sound generation depends strongly upon the strength of the vorticity and distance from the edge and that it can be more intense than the more common trailing edge noise source in agreement with the experimental observations. (Author)

A80-30571 # Design of flat plate leading edges to avoid flow separation. M. R. Davis (New South Wales, University, Kensington, Australia). *AIAA Journal*, vol. 18, May 1980, p. 598-600. 9 refs. NSF-Navy-supported research.

Extremely sharp or extremely bluff leading edges on flat plate surfaces often lead to a local detachment of the laminar surface boundary layer. The paper determines for two simple leading-edge geometries which are easily specified, namely elliptical and double circular arc forms, what leading-edge shapes provide a fair margin as far as boundary-layer separation is concerned when the plate is at zero incidence. It is seen that the tendency for flow separation in the leading-edge region of a flat surface can be minimized using double arc contours with $r/t = 0.25$ (r = radius of nose arc on leading-edge profile, $2t$ = plate thickness) and $l/t = 4.6$ (l = distance between center of nose arc and commencement of parallel surface). When a greater margin for boundary-layer separation near the nose is required, an elliptical leading edge with a/t greater than 5.0 (a = semimajor axis of elliptic nose) should be used. S.D.

A80-30575 ATC flow management - Fuel is the spur and data links the key. D. Boyle and C. Bulloch. *Interavia*, vol. 35, Apr. 1980, p. 327-331.

The article looks at the problems and possibilities for an airline management system in USA and Europe, especially ATC flow management. The existing systems are analyzed and criticized stressing the fact of fuel cost growth. Improvements through an airline data-link system are proposed. The latter might be based on existing advanced systems, such as FAA's DABS (Discrete Address Beacon System) in the U.S. and ADSEL (ADDRESS SELECTIVE secondary surveillance radar system) in the UK whose capabilities could be extended to provide a digitized, essentially computer-controlled and transponder-actuated communications system. In situations requiring executive action by an airline pilot the resulting messages could be transmitted to specifically-identified aircraft, with little or no human intervention. O.L.

A80-30592 Experimental evaluation of the predicted behavior of squeeze-film-bearing-supported rigid rotors. S. Simandiri and E. J. Hahn (Rolls-Royce, Ltd., Advanced Research Laboratory, Derby, England). *Journal of Mechanical Engineering Science*, vol. 21, Dec. 1979, p. 439-451. 24 refs. Research supported by the Australian Research Grants Committee.

This paper describes the experimental investigations which were conducted to verify existing theoretical vibration-amplitude predictions for centrally-preloaded, squeeze-film-bearing-supported rigid rotors. Very good agreement was obtained with all aspects of these predictions, including the degree of pressurization needed to achieve full-film lubrication and the complicated bistable operation behavior. By developing the theoretical model for the more general case of a rigid rotor supported by unequal squeeze-film bearings at the ends, it

is shown how existing theoretical data, derived on the basis of a symmetric rotor with symmetric motion, are readily applicable to the case of a rotor supported by squeeze-film bearings at one end only. The experimental rig consisted of such a rotor, and, although the results are based on a given bearing have a length-to-diameter ratio of 0.167, and did not allow for any significant variation in the radial support stiffness, nor for variation in the bearing dimensions, and the rotor speed did not exceed 7500 rev/min, it is concluded that the theoretical data predictions are valid in general. Their validity is questionable, however, should conditions be such that turbulence and/or unaccounted-for cavitation effects become significant. Squeeze-film bearing behavior under such conditions warrants further investigation. (Author)

A80-30595 Model tests for the development of axial compressors (Modellversuche zur Entwicklung der Axialverdichter). J. Günther and O. A. von Schwerdtner (Kraftwerk Union AG, Mülheim, West Germany). *Brennstoff-Wärme-Kraft*, vol. 32, Mar. 1980, p. 87-93. In German.

Test facilities are presented for the development of axial compressors for stationary gas turbines, and flow distribution measurements of Plexiglass models are used to optimize entrance casings. Extensive measurements are carried out on a 4-stage model compressor test rig, operating in the high subsonic range. The effect of a radial entrance casing on the function of turbine blading is examined, and it is determined that the range of Reynolds numbers decreases with the number of test attempts. C.F.W.

A80-30679 Design of control laws to implement ACT benefits. J. G. Jones (Royal Aircraft Establishment, Control Div., Farnborough, England). (Royal Aeronautical Society, *Symposium on Design Aspects of Aircraft with Active Control Systems*, London, England, Feb. 15, 1979.) *Aeronautical Journal*, vol. 84, Jan. 1980, p. 13-21. 14 refs.

The paper is concerned with the development of a capability to implement successfully Active Control Technology (ACT) benefits by means of appropriate control laws. Subjects considered include the design of control laws for fast target acquisition and precise tracking, the design of ride-smoothing systems, control laws for maneuver limiting at high angles of attack, and flying qualities problems associated with aerodynamically-unstable aircraft. V.T.

A80-30680 Experimental study of flapping wing lift and propulsion. I. Fejtek (Toronto, University, Toronto, Canada) and J. Nehera (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada). *Royal Astronomical Society, Monthly Notices*, vol. 191, Apr. 1980, p. 28-33. 7 refs.

The instantaneous lift and propulsive forces generated by a rigid, sinusoidally flapping wing at Reynolds numbers ranging from 72,000 to 120,000 are experimentally studied. Consideration is given to flapping amplitude, frequency, plane angle, wing incidence, and windspeed. The experimental results are compared with the theories of Walker (1925) and Holst and Kuchemann (1942) both modified to correspond more closely to the experimental conditions. V.T.

A80-30771 Flight simulation fatigue crack propagation in 7010 and 7075 aluminium plate. R. J. H. Wanhill, W. G. J. 't Hart, and L. Schra (National Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). *International Journal of Fatigue*, vol. 1, Oct. 1979, p. 205-209. 14 refs.

The fatigue crack propagation resistances of 7010-T7651 and 7075-T7351 thick plate were compared for flight simulation (gust spectrum) loading conditions. The alloy 7075-T7351 was found to be slightly superior, and this superiority was not essentially due to its higher fracture toughness. The influence of specimen thickness on the crack propagation resistance was significant. Thinner specimens gave longer crack propagation lives, and, generally, lower crack propagation rates and longer delays in crack growth following severe flights. (Author)

A80-30787 Receivers for the Navstar global positioning system. P. K. Blair (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England). *IEE Proceedings, Part F - Communications, Radar and Signal Processing*, vol. 127, pt. F, no. 2, Apr. 1980, p. 163-167. 7 refs. Research supported by the Ministry of Defence (Procurement Executive).

The Navstar global positioning system is being actively developed by the USA and is likely to become operational for both civilian and military users in the mid-1980s. Accuracy of position in three dimensions of a few meters and velocity within 0.1 m/s is predicted. The user equipment, essentially a receiver and an antenna, will employ a considerable volume of signal-processing hardware and software. This paper aims to provide for the signal-processing community some basic understanding of the system outline and its operation as a navigation aid; a typical receiver outline is broken into a number of units whose operation is described with some emphasis on the signal-processing aspects. Areas in which improved signal-processing methods could contribute to improved performance, particularly in interference conditions, are examined. The potential of the antenna in improving user equipment performance by providing angular selectivity against interference is examined briefly. (Author)

A80-30800 Controlling air traffic with a touch sensitive screen. K.-P. Gäertner and K.-P. Holzhausen (Forschungsinstitut für Anthropotechnik, Werthhoven, West Germany). *Applied Ergonomics*, vol. 11, Mar. 1980, p. 17-22. 12 refs.

Computer-based ATC systems automate real-time processing of input data in such a way that ATC operators can get needed information in the desirable form. Input data include primary and secondary radar-based information such as position and altitude of all aircraft in the controlled airspace as well as flight plan and flight route data originating from the pilots. Current designs use decentralized controls and displays. The present paper describes a design approach using a touch-sensitive screen that permits operator inputs directly on a radar screen using the finger; the description is given in some detail, along with relevant results. Ergonomic advantages and design problems are discussed. S.D.

A80-30806 Acoustics-Aerodynamics Conference, 6th, Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 29-31, 1978, Proceedings (Colloque Acoustique-Aérodynamique, 6th, Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 29-31, 1978, Proceedings). *Revue d'Acoustique*, vol. 12, no. 48, 1979. 85 p. In French.

Papers are presented concerning the reduction of aircraft noise and the psychoacoustic effects necessitating the reduction. Specific topics include unsteady theories for the modeling of noise emission in a turbulent flow, the differences in the noise characteristics of the jet from a turbojet engine and model jets, tone noise sources upstream of a fan, ambient noise control in Spacelab, the measurement of acoustic impedance and noise from the exhaust flows of light aircraft. Attention is also given to the psychoacoustic effects of impulsive helicopter noise, the relation between aircraft noise and annoyance in regions around airports, the effects of aircraft noise on sleep and the monitoring of compliance with aircraft noise control procedures around airports. A.L.W.

A80-30807 The modeling of the noise emitted by a profile in a turbulent flow by means of unsteady aerodynamic theories (Modélisation du bruit émis par un profil placé dans un écoulement turbulent, à l'aide de théories aérodynamiques instationnaires). H. Arbey and M. Sunyach (Lyon, Ecole Centrale, Ecully, Rhône, France). (Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 10-12. 7 refs. In French. Research supported by the Direction Technique des Constructions Aéronautiques.

Consideration is given to the analysis of the noise emitted by a two-dimensional airfoil in turbulent flow using various unsteady formulations. The one-dimensional transfer functions of Karman and

Liepmann and the two-dimensional model of Filotas (1969), which allows a computation in terms of incident wave number, are employed to calculate the airfoil pressure distribution and the radiated noise and lift spectra, assuming the profile behaves as a point dipole and a simple relation between the longitudinal and transverse wave numbers of the incident turbulence. Anechoic chamber measurements of a NACA 0012 airfoil in turbulent flow are found to be in good agreement with the pressure distribution predicted by theory of Filotas in the leading edge region at relatively high frequencies (300-700 Hz) and with noise predictions at frequencies between 100 and 1500 Hz. A.L.W.

A80-30808 A comparative multidagnostic study of model and turbojet engine jets (Étude multidagnostic comparée d'un jet de maquette et de turboréacteur). G. Elias (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and C. Schmidt (SNECMA, Paris, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 13-18. 5 refs. In French.

The differences in the aerodynamic and acoustic properties of the outflow of an actual jet engine and a model jet are investigated. Jets emitted from a J-85 engine with a simple convergent nozzle and a scale model of the nozzle were measured by classical flow probes, infrared radiometry and two microphone configurations when the jets were in subcritical and supercritical regimes. Differences observed include the presence of a wake behind the turbine cone, residual rotation on the engine, different potential cone lengths and an increased turbulence level at the engine nozzle outlet, especially at low frequencies and multiples of the rotation frequencies. These differences are observed to disappear past the end of the potential cone, however are not capable of explaining completely the greater noise levels associated with the actual engine than with the model. A.L.W.

A80-30809 An analysis of acoustic tone sources upstream of a fan (Analyse des sources du bruit de raies en amont de soufflantes). S. Lewy, J. Lambourion (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and P. Raffy (SNECMA, Paris, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 19-25. 28 refs. In French.

The generation of discrete-frequency noise upstream of the fan of a double-flow turbojet engine is examined. Differences in the spectra, coherence properties and azimuthal wave number spectra between upstream noise generated in subsonic and transonic flow are illustrated for a CFM 56 turbojet engine fan model, and it is pointed out that in subsonic flow, noise can only be generated by the interaction of flow distortions with the rotor. The mechanisms responsible for the generation of noise by the interaction of the rotor with flow distortions are analyzed in detail, and means of more closely simulating tone noise generation during wind tunnel tests are suggested. A.L.W.

A80-30810 The nonlinear impedance of perforated walls in the case of two-pure-tone excitation (Impédance non linéaire des parois perforées dans le cas d'une excitation par deux sons purs). B. Jubelin and P. Sarlat (SNECMA, Paris, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 42-46. In French.

The acoustic impedance of a perforated wall, used as the resistive layer in an acoustic liner for turbojet engines, excited by two tones of discrete frequencies is investigated. Pure tones were excited simultaneously at an exciting frequency, at which acoustic impedance was determined, and at a perturbing frequency in a standing wave tube, and the real and imaginary components of acoustic impedance were determined as functions of the intensities of the exciting and perturbing waves. Results indicate that the perturbing frequency causes the acoustic resistance to increase with perturbing sound intensity, with a corresponding decrease in reactance. The experimental results are correlated with the acoustic velocity in the holes of the wall by means of an acoustic impedance model, and it is shown that the nonlinear dependence of material

response on wave amplitude can be accounted for in terms of the impedance resulting from single-tone excitation. A.L.W.

A80-30812 A study of light aircraft noise. I - Exhaust noise (Etude du bruit des avions légers. I - Bruits d'échappement). R. Cubaud (Société Bertin et Cie., Plaisir, Yvelines, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 55-59. In French.

The noise characteristics of an 180-hp four-cylinder light aircraft engine are investigated and used to define a noise suppressor allowing a 15-dBA noise reduction. The acoustic power radiated by the engine and its exhaust was determined at speeds of 2300 and 2700 rpm from a distance of 3 m, and a noise level of 67 dBA corresponding to an engine overflight 300 m above the ground is estimated. A detailed noise spectrum was then measured within the exhaust pipe, which connects the exhaust from the four cylinders two by two in a 3Y configuration, as a function of engine regime, and used to specify attenuation curve for the proposed noise suppressor. The design requirements are realized by a compound noise suppressor composed of Helmholtz resonators centered on frequencies of 180 and 270 Hz and a large-band device covering medium and high frequencies. Tests indicate that the noise suppressor allows engine exhaust noise to be reduced to the level of the background engine noise, with an acceptable engine counterpressure and a 2 dBA total ground noise reduction at altitude. A.L.W.

A80-30814 The nature of the annoyance and the noise-annoyance relation around airports (Nature de la gêne et relation bruit-gêne autour des aéroports). J. François (Institut Français d'Opinion Publique, Paris, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 70-78. In French. Research supported by the Direction Technique des Constructions Aéronautiques and Ministère de la Culture et de l'Environnement.

The nature of the physical and emotional effects of aircraft noise perceived by persons living near airports is discussed, and the quantitative relationship between aircraft noise and annoyance is investigated. It is shown that the two types of noise encountered around airports, violent, sudden noise and repeated noisy overflights, give rise to traumatic sensations, and tension and fatigue, respectively. A survey of 5000 people living near Orly airport, performed to determine the relation between noise as measured by the psophic index and annoyance as evaluated by the principle component factorial analysis of responses is reported. It is shown that correlation coefficient of up to 0.60 between the psophic index and the annoyance level was obtained, while the use of an improved version of the index, which takes into account air traffic variations, lead to improved correlation. Further studies around Roissy and Orly airports have also confirmed the correction to the psophic index which accounts for the greater annoyance provoked by night flights. A.L.W.

A80-30816 Aéroport de Paris and aircraft noise - Trajectory control and least nuisance procedures (Aéroport de Paris et le bruit des avions - Le contrôle des trajectoires et procédures de moindre nuisance). J. P. Roche (Aéroport de Paris, Direction du Trafic Aérien, Orly Aéroport, Val-de-Marne, France). (*Colloque Acoustique-Aérodynamique, 6th, Paris, France, May 29-31, 1978.*) *Revue d'Acoustique*, vol. 12, no. 48, 1979, p. 82-85. In French.

The measurement systems in use by Aéroport de Paris at the Orly and Roissy-Charles-de-Gaulle airports to determine aircraft compliance with trajectory and take-off procedures designed to minimize aircraft noise over populated areas are presented. The systems are composed of a microphone system for noise measurement, a secondary pursuit radar system for trajectory measurement and a centralized system allowing the identification of every flight by its flight plan. The system thus allows the association of the designation and flight plan of every flight with its trajectory and the noise resulting from it, by means of a central computer. A.L.W.

A80-30817 * # Cockpit Display of Traffic Information /CDTI/. J. F. Garren, Jr. (NASA, Langley Research Center, Hamp-

ton, Va.) and G. C. Moen (U.S. Army, Structures Laboratory, Hampton, Va.). *American Society for Information Science, Symposium, Pittsburgh, Pa., May 15-17, 1980, Paper.* 31 p. 8 refs.

As part of a joint NASA/FAA effort, CDTI flight tests were recently conducted with a research aircraft equipped with advanced cockpit displays. This paper briefly describes the scope of the joint program, summarizes the technical issues related to the application of CDTI, and presents flight test results. B.J.

A80-30859 # A velocity potential panel method for the prediction of unsteady airloads on oscillating wings and bodies. W. Geissler (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aeroelastik, Göttingen, West Germany). *Archiwum Mechaniki Stosowanej*, vol. 31, no. 5, 1979, p. 595-603. 7 refs.

A method is presented to calculate unsteady airloads on oscillating three-dimensional wings and bodies in subsonic flow. This method is based on the velocity potential using distributions of harmonically pulsating doublets in the case of wings, and harmonically pulsating sources and sinks in the case of bodies. On account of a panel type method, the oscillating surfaces are divided into small surface elements, panels, each with a constant yet unknown singularity distribution. The unknown singularity strengths are calculated using the solution of a large system of linear equations. The method is applied to a variety of geometrical configurations and flow conditions. The results are compared with other methods as well as with experimental results. (Author)

A80-30882 # Aerodynamic characteristics of a concave large-aspect-ratio trapezoidal profile in a monochromatic free-molecular rarefied-gas flow in the case of specular-reflection interactions (Aerodinamicheskie kharakteristiki vognutogo trapetsievidnogo profilja bol'shogo udlinenija v monokhromaticheskom svobodnomolekuliarnom potoke razrezhenno go gaza pri zerkal'noi skheme vzaimodejstviia). I. N. Kabluka and V. F. Kameko. *Kosmicheskie Issledovaniia na Ukraine*, no. 13, 1979, p. 25-29. In Russian.

A80-30952 Ames to begin V/STOL model tests. J. Mayfield. *Aviation Week and Space Technology*, vol. 112, Apr. 21, 1980, p. 65, 67, 68, 73, 75.

The testing of Grumman's Design 698 V/STOL aircraft planned for Spring 1980 at NASA's Ames Research center following a joint Grumman/Navy/NASA program is discussed. The current Design 698 configuration of about 20,000 lb. gross weight grew out of a design Grumman developed earlier for the Navy's Type A V/STOL aircraft program. The full-scale test model is 40.5 ft. long, its dihedral wing has a span of 36.7 ft., and it measures just over 13 ft. tall at its T-tail. It uses two TF34 turbofan engines generating 8845 lb. of thrust each. The aircraft, in a variety of mission configurations (jamming, targeting, missile launcher) has the ability to operate from a number of surface ships, giving the Navy both offensive and defensive capabilities. The Design 698 V/STOL technology has potential civil applications - particularly for ferrying offshore oil-rig crews. O.L.

A80-30976 * # Design of slotted transonic wind tunnels for supersonic flow development. M. A. Ramaswamy and E. S. Cornette (NASA, Langley Research Center, Hampton, Va.). *Supersonic Tunnel Association, Annual Meeting, Palo Alto, Calif., Mar. 26-28, 1980, Paper.* 28 p.

A simple analytical method to predict the supersonic flow development in a two-dimensional slotted transonic wind tunnel has been developed and validated. While doing that, an insight has been gained into the flow mechanism which causes overexpansion with some slot shapes. As a consequence of the success of the analysis method, a design method has been developed on similar lines, to obtain slot shapes for prescribed smooth supersonic flow development at a design Mach number. The performance of these slot shapes at off-design conditions have been studied to enable choice of slot shapes to be made, based on acceptable performance over the whole supersonic range of interest. (Author)

A80-31001 The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. Symposium sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, Inc., 1980. 154 p. \$25.

Papers are presented on wings, airfoils, wings for human-powered flight, the XB-35/YB-49 program, evolution of modern air transport wings, as well as on the evolution of the F-86, and observations on supersonic wing design. Other topics of interest include seven wings of the F-4, variable sweep wing design, and aerostatically tailored wing design. C.F.W.

A80-31002 # Wings. J. Chuprun, Jr. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 1-11. (AIAA 80-3031)

An attempt is made to convey some appreciation for and fundamental insight on how aircraft wings evolved into their geometric configurations. The main purposes of the paper are: (1) to show the wide variety of wing shapes that are used in aeronautical systems, (2) to highlight the powerful leverage that wings possess in the generation of lift, and (3) to provide insight on wing design considerations. C.F.W.

A80-31003 # Airfoils - Significance and early development. I. H. Abbott. In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 21-24. (AIAA 80-3033)

The paper describes the history and significance of airfoils as well as the design considerations for highlift airfoils. Attention is given to single-element airfoil development, emphasizing optimized velocity development, inverse airfoil solutions, and solutions for the maximum lift design problem. An extension of the single-element design method is presented, taking into consideration low-drag range and compressible flow. C.F.W.

A80-31004 # Wings for human-powered flight. P. B. S. Lissaman (AeroVironment, Inc., Pasadena, Calif.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 49-56. 5 refs. (AIAA 80-3035)

The various aspects of the aerodynamic characteristics of the Gossamer Condor aircraft are discussed, with emphasis on the design and dynamics of the wing. Attention is given to the first vehicle, its redesign, and the analytical design features of the wing and the propeller. Analytical features of aircraft stability and control are examined and it is noted that the Gossamer Albatross has the most significantly improved performance, due to a higher aspect ratio and better construction. C.F.W.

A80-31005 # Flying-wing airplanes - The XB-35/YB-49 program. W. R. Sears (Arizona, University, Tucson, Ariz.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 57-59. (AIAA 80-3036)

The paper presents a review of the design principles of the XB-35/YB-49 aircraft, some of their pertinent physical characteristics, as well as speculations on how one might improve these designs by employing state-of-the-art technology. Attention is given to control surface deflection, and to longitudinal-stability characteristics. C.F.W.

A80-31006 # Evolution of modern air transport wings. G. S. Schairer. In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980.

New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 61-65. (AIAA 80-3037)

The purpose of the paper is to describe the evolution of wing designs for large, load-carrying, long-range aircraft, particularly to Boeing built aircraft. Attention is given to the German pre-second World War aerodynamics, and to the high pressure-high bypass ratio. Photographs of various aircraft are presented including those of the B-47 and B-52. C.F.W.

A80-31007 # Evolution of transport wings from C-130, C-141, C-5 to C-XX. R. O. Lowrey (Lockheed-Georgia Co., Marietta, Ga.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 67-73. (AIAA 80-3038)

The purpose of the paper is to review some of the many diverse factors affecting wing design in the early developmental phase and to trace the evolutionary progress of wing design over a period of approximately 30 years, by examining the visual evidences of progress through a series of logistic aircraft designs. Attention is given to the primary technology disciplines contributing to wing design, which include aerodynamics, structures, and avionics/controls. The features that are dominated by takeoff and landing procedures are examined. C.F.W.

A80-31008 # Evolution of the F-86. M. M. Blair (Rockwell International Corp., El Segundo, Calif.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 75-89. (AIAA 80-3039)

The paper covers the evolution of the F-86 swept-back wing, that contributed to the outstanding success of the fighter during the Korean War. Various conceptual drawings of German wind tunnel data are presented together with photographs of several F-86 aircraft. Attention is given to sweep-aspect ratio wings, design requirements and performance parameter comparisons. C.F.W.

A80-31009 * # Some observations on supersonic wing design. R. T. Jones (NASA, Ames Research Center, Moffett Field, Calif.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 91-94. 10 refs. (AIAA 80-3040)

The paper presents a brief review on the development of supersonic wing design. Attention is given to linearized aerodynamic theory, emphasizing equations for drag and ratios of slopes and Mach lines. Diagrams that depict conditions for minimum drag as well as the effects of fore-and-aft dimension of wings and Mach numbers on areas of lateral entrainment are presented. C.F.W.

A80-31010 # Seven Wings the F-4 has flown. D. H. Bennett and W. A. Rousseau. In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 97-104. (AIAA 80-3042)

The paper presents a review of the design of the Seven Wings of the F-4. Characteristics of various aircraft type are presented, which include degree settings for leading edge flaps with and without boundary layer control. Photographs are presented that show wing spars, lower surface wing skin, and aircraft interceptor mission. Graphs are evaluated that chart altitude versus Mach numbers, and maximum usable force coefficients. C.F.W.

A80-31011 # Variable sweep wing design. R. W. Kress. In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 105-124. (AIAA 80-3043)

The purpose of the paper is to review the evolution of the variable sweep concept from its inception to applications on modern production aircraft. Emphasis is placed on the F-14, due to its

sophisticated application of variable sweep since the wing and its attendant flap/slat/glove vane system were 'worked' for the broadest spectrum of benefits. Diagrams of various tail and wing configurations are presented as well as of leading and trailing edge devices. C.F.W.

A80-31012 # The F-15 wing development program. L. G. Niedling (McDonnell Aircraft Co., St. Louis, Mo.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York American Institute of Aeronautics and Astronautics, Inc., 1980, p. 125-129. (AIAA 80-3044)

The McDonnell Aircraft Company (MCAIR) development of an aerodynamically efficient maneuvering wing for the F-15 is reviewed. The diverse performance requirements and the integrated system trade studies that were used to guide the wing development are described. The wing design trade study results which led to the selected configuration and the geometric and aerodynamic properties of the F-15 wing are presented. (Author)

A80-31013 # Evolution of the hybrid wing - YF-17/F-18 type. J. Patierno (Northrop Corp., Aircraft Div., Hawthorne, Calif.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 131-139. (AIAA 80-3045)

The hybrid wing concept was developed by Northrop in the late 1960's and applied to the YF-17 prototype development program in 1972. The wing concept is now entering production on the F-18. The evolution of the concept was motivated by a specific set of design objectives related to Northrop's fighter design philosophy. The significant benefits in lift, drag, and stability and control characteristics compared to a conventional planform have been verified in flight tests of the YF-17 Lightweight Fighter Prototype. (Author)

A80-31014 # Aeroelastically tailored wing design. L. E. Brown, Jr., M. A. Price, and P. B. Gingrich (Rockwell International Corp., Los Angeles, Calif.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 141-146. (AIAA 80-3046)

The paper describes the development of an aeroelastically tailored wing from the aspects of the aerodynamic requirements of wing twist distribution and the composite structural design to meet these requirements. Attention is given to preliminary and detail design methods that are developed for the supercritical airfoil and composite laminate layup designs, to meet strength and aeroelastic behavior requirements. It is concluded that structural design and fabrication aspects of the aeroelastically tailored wing that have been evaluated by static loading tests, demonstrated good correlation with predicted flexible characteristics. C.F.W.

A80-31015 # Forward swept wing design. N. J. Krone, Jr. (USAF, Washington, D.C.). In: The evolution of aircraft wing design; Proceedings of the Symposium, Dayton, Ohio, March 18, 19, 1980. New York, American Institute of Aeronautics and Astronautics, Inc., 1980, p. 147-149. (AIAA 80-3047)

The paper examines the growing problems such as aeroelastic divergence, that are evident in the design of forward swept wings. Aeroelastic divergence avoidance is examined as well as the goals outlined by the Defense Advanced Research Projects Agency (DARPA). Attention is given to flight demonstration and the six specific objectives that have been established through extensive interface with government and industry personnel. C.F.W.

A80-31018 * Application of a ground based minicomputer system for real time, closed loop control of remotely piloted aircraft models used in stall/spin research. R. J. Montoya and A. R. Jai (Research Triangle Institute, Research Triangle Park, N.C.). *Automatic Control Theory and Applications*, vol. 7, Sept. 1979, p. 49-54. 7 refs. NASA-supported research.

The paper describes a minicomputer-based, real-time closed loop remote control system at NASA Langley outdoor facility which is used to determine the stall/departure/spin characteristics of high-performance aircraft. The experiments are conducted with 15% dynamically scaled, unpowered models that are dropped from 3000 m and ground controlled. The effects of time delays and sampling rates on the stability of the control system and the selection of digital algorithms to meet frequency response and real time constraints are examined. Also described is the implementation of the modular software for the flexible programming of multi-axis control laws. L.M.

A80-31208 # Computer-aided designing of temperature fields for cooled gas-turbine blades (Proektirovanie temperaturnogo polia okhlazhdaemoi lopatki gazovoi turbiny s ispol'zovaniem elektronno-vychislitel'noi mashiny). L. M. Zysina-Molozhen and E. L. Mikheenkov. *Problemy Prochnosti*, Dec. 1979, p. 49-52. 5 refs. In Russian.

A computer-aided method is proposed for calculating optimal temperature fields for air-cooled blades. The program package is developed for running on a DOS computer. For illustration, the method is applied to the calculation of the optimal temperature field at a blade section. V.P.

A80-31217 # The investigation of transient loads in gas turbine engine blades using spectral analysis methods (Issledovanie peremennykh napriazhenii v lopatkakh GTD metodami spektral'nogo analiza). I. P. Kanunnikov and M. K. Sidorenko. *Problemy Prochnosti*, Dec. 1979, p. 96-100. In Russian.

The feasibility of applying spectral techniques to the analysis of transient loads in gas turbine engine blades is examined. It is shown that the spectrograms of blade stresses obtained with various filters provide frequency data unobtainable by oscillographic methods. The blade model used for spectral analysis, which takes into account low-intensity noise and is based on the theory of random processes, is presented, and it is noted that the model spectra agree well with actual spectra. The interpretation of a stress spectrum is discussed, with attention given to the evaluation of blade damping characteristics, amplitude-frequency characteristics in resonance zones, the intensity of the exciting harmonics, blade eigenfrequencies and the effectiveness of blade modifications. It is concluded that, despite the specialized equipment and amount of time required for the spectral analysis of gas turbine engine blade transient stresses, it represents a valuable source of additional information in tensometry. A.L.W.

A80-31246 Advanced fighter technology F-16. G. Warwick. *Flight International*, vol. 117, Apr. 5, 1980, p. 1084-1086.

The article describes the AFTI (advanced fighter technology integration) F-16. The modified aircraft will be equipped with canards and a digital flight control system, which will decouple aircraft attitude and flight path, thus giving the pilot freedom to maneuver the AFTI/F-16 in six, independent, degrees of freedom: translation - forwards and backwards, side to side and up and down; rotation - pitch, roll, and yaw. Discussion also covers a YF-16 modified as a fighter control-configured vehicle (CCV) which first demonstrated the tactical advantages of unorthodox flight maneuvers, such as fuselage pointing which can be used in air-to-air tracking. It is shown how the AFTI concept will make such maneuvers of practical value by means of an integrated flight- and fire-control system. M.E.P.

A80-31249 WELS - An international approach to range instrumentation support. W. P. Lustina (RCA, Missile and Surface Radar Div., Moorestown, N.J.). *RCA Engineer*, vol. 25, Feb.-Mar. 1980, p. 41-46.

It is noted that reliable, on-demand operation of precision tracking radars is a key element in supporting critical missions on today's test ranges. Such radars are located at various sites around the world which complicates the problem of keeping them operational. The paper describes an interagency approach to the problem,

the Worldwide Engineering and Logistics Support (WELS) Program. Attention is given to the scope and operation of the program, including the diversity of range user requirements and the engineering/technical assistance and logistics support needed.

M.E.P.

A80-31262 # An analytic solution for mode coupling in optical waveguide branches. W. K. Burns and A. F. Milton (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *IEEE Journal of Quantum Electronics*, vol. QE-16, Apr. 1980, p. 446-454. 18 refs.

Mode coupling between local normal modes in branching and separating optical waveguides is treated. An analytic solution for power transfer is provided for structures whose shape has a particular functional form. Analytic results are compared to numerical calculations for linear branches. Numerical examples for the design of shaped structures fabricated with Ti:LiNbO₃ channel waveguides are given. (Author)

A80-31388 Hypersonic flow of gas over a slender wing of variable shape. V. I. Bogatko, G. A. Kolton, and A. A. Grib. (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1979, p. 94-101.) *Fluid Dynamics*, vol. 14, no. 4, Jan. 1980, p. 548-554. 6 refs. Translation.

A study is made of the flow of a uniform homogeneous hypersonic ideal gas over the windward side of a slender wing whose surface profile depends on the time; the problem is solved by the thin shock layer method. The bow shock is assumed to be attached to the leading edge of the wing at at least one point. The corrections of the first approximation to the main 'Newtonian' flow are found. For wings of finite aspect ratio, when the bow shock is attached along the whole of the leading edge of the wing, computational formulas are obtained for determining the parameters of the gas in the shock layer. (Author)

A80-31593 # Evidence in aircraft accident investigation and its evaluation. S. K. Mukherjee (Indian Air Force, Medical Services, New Delhi, India). *Aviation Medicine*, vol. 23, Dec. 1979, p. 125-128.

The paper briefly outlines three of the numerous aircraft accidents which would have passed as 'Cause undetermined' but for the contribution of experts in the field of aviation medicine. There are three basic sources of evidence in an aircraft accident: (1) information from persons having knowledge of the accident; these persons are the aircrew, passengers, eyewitnesses and air traffic controllers; (2) wreckage, scene of the accident, and records and documents pertaining to the aircraft, aircrew, weather, and flight, as well as ATC records; and (3) persons who know the environment and the pilot. Attention is given to examination of wreckage and the scene of accident, examination of witnesses, and evaluation of evidence. The testimony should be evaluated in terms of realities of the situation. Examination of aircrew is the most sensitive part of the investigation and the investigators must be extremely tactful to elicit correct evidence. S.D.

A80-31780 Non-destructive examination of fibre composite structures by thermal field techniques. P. V. McLaughlin, E. V. McAssey (Villanova University, Villanova, Pa.), and R. C. Deitrich (U.S. Navy, Naval Air Engineering Center, Lakehurst, N.J.). *NDT International*, vol. 13, Apr. 1980, p. 56-62. 12 refs.

The nondestructive evaluation of advanced aerostructural materials has been approached using many techniques. Ultrasonics has many advantages; however, one disadvantage of the technique is the necessity for tedious scanning procedures in order to inspect large surface areas. It is this disadvantage which has prompted this research into thermographic infrared detection of flaws which could provide a more rapid method of inspecting large aerostructural surfaces such as graphite-reinforced epoxy. Rapid scanning of such areas with thermographic techniques will most certainly lead to some loss of quantitative information; however, if potential flaw sites can be identified in a rapid manner, then another technique such as ultrasonics, could be used at the potential flaw locations to confirm

flaw presence and quantify flaw extent. This procedure should significantly reduce inspection time when compared with ultrasonic scanning of the total surface. (Author)

A80-31796 # Application of certain optimal methods of propeller phase synchronization. J. Müller and L. Rouha. *Zprava VZLU*, no. Z-33, 1979. 20 p. 8 refs.

The paper examines a method which controls the mutual phase of the rotating propellers of a twin engine aircraft, by means of a master-slave system, in order to reduce propeller noise. The problem is investigated from the aspect of determining the optimal control method. Attention is given to the example of the time optimal control which is shown to be of very good quality, but too complicated for practical realization. Other governors discussed include a linear governor which is optimal with respect to the quadratic performance criterion and a discrete governor operating with a finite number of steps. It is concluded that a satisfactory degree of control was achieved in all cases. M.E.P.

A80-31809 Pressures inside a room subjected to simulated sonic booms. N. N. Wahba, I. I. Glass, and R. C. Tennyson (Toronto, University, Downsview, Ontario, Canada). *Journal of Sound and Vibration*, vol. 68, Jan. 22, 1980, p. 259-279. 19 refs. Research supported by the National Research Council of Canada and Ministry of Transport.

The pressure variations inside a room of plaster-wood construction subjected to sonic boom loadings were investigated both analytically and experimentally to study the problems of dynamic structural response. The N-wave pressure signatures were generated in the UTIAS (University of Toronto Institute for Aerospace Studies) Travelling Wave Horn-Type Sonic Boom Simulator. The room overpressures in some cases were found to be twice as great as that in the incident sonic boom. The analysis and experimental data can be useful in assessing structural damage caused by supersonic aircraft overflights. (Author)

A80-31810 Noise zoning around airports in the Netherlands. F. W. R. Evers (Ministry of Public Health and Environment, Noise Abatement Office, Netherlands). *Journal of Sound and Vibration*, vol. 68, Jan. 22, 1980, p. 281-294. 42 refs.

A80-31816 Radiation in a wall jet flow environment. R. Ramakrishnan (Joint Institute for Advancement of Flight Sciences, Hampton, Va.). *Journal of Sound and Vibration*, vol. 68, Feb. 8, 1980, p. 389-405. 20 refs.

An analytical study of sound propagation through a wall jet flow with compliant walls was made to evaluate the effects of flow convection and refraction due to nonuniform mean flow on sound radiation. The governing wave equation is derived from the conservation equations, and the mean flow field required for the analysis is obtained from a combination of experimental data and analytical solutions. The resulting convected wave equation is reduced to an ordinary differential equation and solved numerically in terms of modified modes in radial shells. The results show that the modal expansion procedure can be applied to investigate the problem of radiation in a wall jet flow environment, showing that the flow convection and shear refraction produced a significant effect on the sound directivity which showed a steep downstream valley. A.T.

A80-31817 Effect of damping on impact response of a two degrees of freedom system. M. S. Hundal (Vermont, University, Burlington, Vt.). *Journal of Sound and Vibration*, vol. 68, Feb. 8, 1980, p. 407-412.

The impact response of a system consisting of a main mass on which a critical element of much smaller mass is mounted, is analyzed. Equations of motion are nondimensionalized and a closed form solution obtained. System parameters are the two damping ratios and the frequency ratio. Maximum values of the nondimensional acceleration of the critical element and the product of its acceleration and displacement are computed. Results are presented in a form to permit optimum design of the system. (Author)

A80-32001 # Microwave landing system implementation. Volumes 1 & 2. Washington, D.C., Radio Technical Commission for Aeronautics, 1977. Vol. 1, 139 p.; vol. 2, 283 p. 93 refs. Price of volume one, \$16.; volume two, \$24. (DO-166)

The document responds to the terms of reference presented to RTCA Special Committee 125 by providing recommendations for a national microwave landing system (MLS) implementation policy. The recommendations included represent an amalgamation of differing views on how best to make the transition from VHF/UHF to a standard MLS. Three individual strategies (short, middle, and long term) are presented to match the differing objectives of each phase of the total program. Chapter material provides committee-approved material including user recommendations in response to the terms of reference. Appendices are the reports of informal working groups which were assigned responsibility to investigate and report on specific aspects of MLS implementation. V.T.

A80-32044 Experimental investigation of the strength of rotor materials with surface cracks. N. N. Zorev, G. S. Vasil'chenko, A. V. Amel'ianchik, and D. N. Klauch (Tsentral'nyi Nauchno-Issledovatel'skii Institut Tekhnologii i Mashinostroeniia, Moscow, USSR). (*Problemy Prochnosti*, Aug. 1979, p. 58-63.) *Strength of Materials*, vol. 11, no. 8, Apr. 1980, p. 866-872. 8 refs. Translation.

The paper deals with a general approach to the determination of crack resistance (fracture toughness) of brittle, semibrittle, and tough materials. The approach is based on the establishment of the mode of failure of the test specimen and on the use of criteria and methods of linear and nonlinear fracture mechanics. For cracked specimens tested in bending and asymmetric tension, curves representing the lower bound of rigid-plastic and elastoplastic fracture regions are obtained. V.P.

A80-32064 * # Hybrid composites that retain graphite fibers on burning. E. E. House (Boeing Aerospace Co., Seattle, Wash.). In: *Rising to the challenge of the '80s; Annual Conference and Exhibit, 35th, New Orleans, La., February 4-8, 1980, Preprints.* New York, Society of the Plastics Industry, Inc., 1980, p. 11-D 1 to 11-D 8. Contract No. NAS3-21383.

A laboratory scale program was conducted to determine fiber release tendencies of graphite reinforced/resinous matrix composites currently used or projected for use in civil aircraft. In the event of an aircraft crash and burn situation, there is concern that graphite fibers will be released from the composites once the resin matrix is thermally decomposed. Hybridizing concepts aimed at preventing fiber release on burning were postulated and their effectiveness evaluated under fire, impact, and air flow during an aircraft crash. (Author)

A80-32068 # Composite center fuselage - Phase I. L. J. Murrin and H. Erbacher (Grumman Aerospace Corp., Bethpage, N.Y.). In: *Rising to the challenge of the '80s; Annual Conference and Exhibit, 35th, New Orleans, La., February 4-8, 1980, Preprints.* New York, Society of the Plastics Industry, Inc., 1980, p. 12-B 1 to 12-B 5. 11 refs.

The paper discusses the design and development of an advanced composite center fuselage structure capable of satisfying the configuration and structural loading requirements of advanced aircraft systems. The test program described covered damage tolerance requirements, the effects of translaminar reinforcement (stitching), the effectiveness of crack arrest strips, the adequacy of post-buckling analysis techniques and the ability of the design to sustain cyclic loadings consistent with the airframe design life. A total of 150 coupons and 66 design elements were tested: dry and wet static tests were conducted at 180 degrees F; fatigue and residual static tests were also performed. The test program confirmed the analytical prediction techniques for diagonal tension skin rupture and for the structural behavior of the crack arrest strips. In addition, translaminar reinforcement is not required to prevent low energy impact damage delamination from growing. J.P.B.

A80-32077 # Real life aging properties of composites. G. Lubin and P. Donohue (Grumman Aerospace Corp., Bethpage, N.Y.). In: *Rising to the challenge of the '80s; Annual Conference and Exhibit, 35th, New Orleans, La., February 4-8, 1980, Preprints.* New York, Society of the Plastics Industry, Inc., 1980, p. 17-E 1 to 17-E 13. 5 refs.

The paper presents the results of aging tests performed on several composite aircraft structures made of fiberglass and graphite/epoxy, which were in service for up to 19 years, were extensively tested prior to use, and were exposed to a variety of extreme climatic conditions under actual flying loads. The tests indicated that when properly protected, fiberglass components do not show any appreciable structural degradation after 20 years of normal service including climatic and operational environment extremes. Tension, flexure and stiffness measurements show no appreciable drop after exposures of up to 13 years. It is concluded that an effective paint or coating system is required to protect composite parts against rain erosion, abrasion and effects of ultraviolet light; however, standard aircraft external paints offer very little protection against moisture penetration into the composite. J.P.B.

A80-32120 A simple Navstar receiver. J. P. Sudworth (Royal Aircraft Establishment, Radio and Navigation Dept., Farnborough, Hants., England). In: *International Specialist Seminar on Case Studies in Advanced Signal Processing, Peebles, Scotland, September 18-21, 1979, Proceedings.* London, Institution of Electrical Engineers; Piscataway, N.J., Peter Peregrinus, Ltd., 1979, p. 85-89.

The requirements, design, and performance of a Navstar receiver are described. A single-channel receiver uses conventional RF components, with both analog and computer-controlled digital tracking loops, with the complete receiver under the control of a fast general purpose minicomputer using a standard operating system. V.T.

A80-32150 # NAE Convair 580 aeromagnetism program. C. D. Hardwick (National Aeronautical Establishment, High Speed Aerodynamics Laboratory, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin, no. 4, 1979, p. 1-16.*

The paper considers the NAE Convair aeromagnetic program whose objective is the development of equipment aboard the Convair 580 aircraft to provide the first three-axis, total field, airborne gradiometer. This configuration will enhance anti-submarine warfare capabilities, allow an 'array sensing' approach which will supply information as to target's position with respect to aircraft track, and will allow measurement of total field gradient in the across-track direction with wider separation between flight lines. The mechanization of the three-axis gradiometer system is described, including the magnetic anomaly detection complementary filter, magnetic compensation, and magnetometer sensing, concluding that the information given here will be useful to operators considering the use of gradiometry. A.T.

A80-32175 # Pneumatic components of regulators (Pnevmaticheskie elementy reguliatorov). S. G. Agadzhanian, B. R. Barskii, and E. P. Dolgii. Moscow, Izdatel'stvo Mashinostroenie, 1979. 111 p. 28 refs. In Russian.

The book examines pneumatic components constructed for aircraft applications under complex conditions. The components are designed with a divider of the 'two nozzle-baffle' type. The construction of components for automation of systems for the conditioning of aircraft is described, along with the results of an analytical and experimental investigations. Design and construction of small size pneumatic elements are described, and their static and dynamic properties are given, including diaphragm and nozzle dimensions. A.T.

A80-32201 # The energy problem - Its effect on aircraft design. II - The effects of fuel cost. W. Tye. *Aircraft Engineering, vol. 52, Apr. 1980, p. 2-4.*

The paper examines the factors of the energy problem's effect on aircraft design beginning with a discussion of what decides cost and price. Attention is given to the effect of energy costs on the pattern of living and on air transport. Consideration is then given to fuel prices and aircraft operating costs. Finally, the effect of design advances on fuel use and DOC is studied. M.E.P.

A80-32202 # Flight recording in the UK. II - Equipment. T. Ford. *Aircraft Engineering, vol. 52, Apr. 1980, p. 5-8.*

Various flight recording units in use in the U.K. are described. Discussion covers improvements in aircraft design, advanced technology, protected recorders and QAR's, and military uses. M.E.P.

A80-32203 # Satellite navigation for helicopters. G. A. Gilbert (Glen A. Gilbert and Associates, Inc., Washington, D.C.). (*Nederlandse Vereniging voor Luchtvaarttechniek, European Rotorcraft and Powered Lift Aircraft Forum, 5th, Amsterdam, Netherlands, Sept. 4-7, 1979.*) *Aircraft Engineering, vol. 52, Apr. 1980, p. 8-13.* 12 refs.

A satellite-based navigation system called Navstar GPS (Global Positioning System) which is in the process of being implemented is described. It is reported that the system will have 24 satellites orbiting in three different orbits, with eight satellites in each. Attention is given to features of GPS which will be of particular benefit to helicopters, such as highly accurate airborne area navigation capability and the ability to function on a world-wide basis without the need for ground based navigation aids. M.E.P.

A80-32204 # Address Selective Surveillance Radar. M. C. Stevens (Cossor Electronics, Ltd., Harlow, Essex, England). *Aircraft Engineering, vol. 52, Apr. 1980, p. 14-18.*

The article describes an improved Secondary Surveillance Radar (SSR) system which will overcome many of the present defects in today's SSR. It is shown that the system, known as ADSEL (ADdress SElective), utilizes a number of new techniques including monopulse direction finding which gives a more accurate measurement of aircraft bearing. Further, it is noted that the system is compatible with SSR and DABS. M.E.P.

A80-32223 # Combined design of Q-fan superchargers and multiblade propellers (Prispevek ke komplexnimu navhu dmychadla typu Q-fan a mnoholistych vrtuli). R. Eichler. *Zpravodaj VZLU, no. 5, 1979, p. 215-238.* 27 refs. In Czech.

Problems arising in the design of Q-fan superchargers and multiblade propellers are discussed with particular reference to the highest permissible levels of perceived noise (about 95 PNdB) at a distance of 150 m perpendicular to the axes of the aircraft. Consideration is given to the interrelationship among acoustic, dynamic, aerodynamic, and strength problems and to the necessity of taking them into account in the initial phase of minimum-noise design. B.J.

A80-32224 # Determination of aircraft life factors according to NGLS-2 requirements (Soucinitele spolehlivosti pri prukazu unavove zivotnosti letounu podle predpisu NLGS-2). V. Nejedly. *Zpravodaj VZLU, no. 5, 1979, p. 239-248.* 16 refs. In Czech.

The NGLS-2 Soviet civil aircraft life requirements (1974 edition) are examined. The logical structure of life factors according to the requirements is discussed, and the application of these factors in aircraft design and testing stages is considered. Attention is given to a procedure of choosing the right values of life factors for mean fatigue life reduction as a function of the number of tested structures and the scatter of fatigue life values. B.J.

A80-32226 # Approximate method for calculating plane cascade flow at high subcritical Mach numbers (Vysetreni rovinneho obtekani lopatkovych mriži pri vysokých podkritických hodnotách machova čísla). K. Celikovský and M. Ruzicka. *Zpravodaj VZLU, no. 6, 1979, p. 275-287.* In Czech.

A numerical method is developed for calculating the aero-

dynamic characteristics of turbine and compressor blade cascades at high subcritical Mach numbers. The method is an extension of the method of Chung-Hua and Brown for solving direct and inverse problems of compressible flow past cascades of arbitrary profile.

B.J.

A80-32227 # Basic issues of reliability in aviation (Zakladni otázky reseni spolehlivosti letecke techniky). J. Schindler. *Zpravodaj VZLU*, no. 6, 1979, p. 289-297. 9 refs. In Czech.

A80-32228 # The influence of test equipment during resonance tests of light structures (Vliv zkusebniho zarizeni pri rezonancnich zkouškách lehkých konstrukcí). O. Cerny. *Zpravodaj VZLU*, no. 6, 1979, p. 299-308. In Czech.

Conditions of the mass and stiffness compensation of the effects of test equipment vibration in the testing of aircraft structures are examined. Various methods of experimental compensation are examined.

B.J.

A80-32408 Efficient sheet metal forming methods in the aircraft industry (Wirtschaftliche Blechumformungsmethoden im Flugzeugbau). E. Enroth and W. Mindrup (ASEA GmbH, Friedberg, West Germany). *Metall*, vol. 34, Apr. 1980, p. 314-318. 7 refs. In German.

The article examines the process of rubber pad forming, which is a type of sheet metal forming where a flexible rubber die replaces one or more rigid tool parts. Attention is given to three main methods employed: rubber pad pressing, fluid cell pressing, and deep draw pressing. Topics discussed include the steps in the production of a sheet metal part, classification of the form parts, forming pressure and temperature, and the effect of high stamping pressure on the production costs. Finally, consideration is given to development trends.

M.E.P.

A80-32417 Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, and Addendum. Conference sponsored by the Institute of Electrical and Electronics Engineers and American Institute of Aeronautics and Astronautics. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. Proceedings, 353 p.; Addendum, 42 p. \$35.

The Conference focused on advanced avionics systems, LSI applications to digital systems, digital avionics for general aviation, digital flight controls, crew station technology, software performance evaluation, and fault tolerant aircraft systems. Papers were presented on a VLSI microprocessor for spacecraft signal processing, a DABS data link avionics for general aviation, cosmic ray effects in spaceborne electronics, design considerations for automated maintenance of computerized avionics systems, the crew adaptive cockpit, software engineering system requirements, a navigation algorithm for single channel low-cost GPS receiver, and LSI-based resource controllers in TIES.

A.T.

A80-32418 Digital avionics - From research to production. B. C. Hainline (Boeing Commercial Airplane Co., Seattle, Wash.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 4-8.

The paper considers digital avionics for a commercial aircraft. The integrated flight management system utilizing digital computer systems and advanced avionics being designed for the Boeing 757 and 767 aircraft integrated automatic flight control, thrust management, navigation, guidance, performance management and sensor functions. Advanced electronic color displays enhance information presentation; digital avionics allows standardized equipment interfaces and greater integration among subsystems than would be possible with mixed generations of equipment.

A.T.

A80-32419 Self-organizing bus control. C. D. Wise (Westinghouse Defense and Electronic Systems Center, Baltimore, Md.) and R. A. Gibler (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 9, 11, 12.

The paper discusses the reduced need for memory and greater flexibility provided by the self-organizing bus control on avionics interface controls. This control was developed for the AN/ALQ-131 ECM pod, and more than 200 modular configurations can be assembled on the flight line without software changes. During a 1 to 2 second initialization, a 'live inventory' of modules and interfaces available for the mission is assembled; this inventory table is then used by a real time executive to structure all interface and timing for the system. It is concluded that this simple adaptive bus interface control has greatly enhanced the operational flexibility and growth potential of the equipment.

A.T.

A80-32420 Advanced avionic architectures for the 1980's - A software view. L. F. Morgan (Lockheed-California Co., Burbank, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 13-18. 9 refs.

The paper examines advanced avionics architectures including 'distributed', and 'hierarchical' with a centralized multiprocessor system at the apex. It was shown that the concept of distributed computers in avionics has been carried too far, and that the eventual impact of cheap-reliable digital hardware in avionics software will be the use of larger numbers of CP and memory elements in dedicated and shared hierarchical architectures. The all-digital character and requirements for future avionics architectures will lead to a fly-before-specify policy, using an early total-system-simulation approach systems development.

A.T.

A80-32421 The TI data flow architectures - The power of concurrency for avionics. M. Cornish (Texas Instruments, Inc., Austin, Tex.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 19-25.

The paper considers data flow system which complements traditional serial processing to provide concurrent information routinely available to the avionics designer. A data flow program is represented as a Pert Chart-like directed graph of instructions that shows their exact serial-parallel relationships rather than a traditional serial list of instructions; the data flow program is sequenced by data driven controllers that can find all parallel instructions in parallel rather than the usual program counter which follows the list serially. It is concluded that all execution overhead is overlapable, and the data flow processing power grows linearly with the number of processors.

A.T.

A80-32422 Applications of LSI to digital systems - An overview of expectations and reality. D. M. Giles (TRW, Inc., Redondo Beach, Calif.) and J. M. Nash (VERAC, Inc., San Diego, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8,

1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 26-31. 5 refs.

The paper considers applications of large scale integration (LSI) technology to digital systems. These applications include signal processing, control and display, while the Very Large Scale Integration (VLSI) with high speed processing will provide enhanced throughput capability and new opportunities will be provided by Very High Speed Integrated Circuits (VHSIC) and joint VLSI/VHSIC technology, the required set of hardware and software complexities will reduce the overall benefit. It is concluded that the future applications of future VLSI/VHSIC to Digital Avionics Systems are promising, but some limitations are indicated. A.T.

A80-32423 **Single chip custom LSI microcomputers for avionics applications.** J. W. Kantowski (Bendix Corp., Avionics Div., Fort Lauderdale, Fla.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 32-36.

The paper discusses a single chip custom LSI microcomputer with flexible architecture and a variable instruction set. This device was developed as an alternative to a full custom LSI and its associated long lead time, high development cost, and difficulties in incorporating changes. The microcomputer contains all the computer elements similar to MOSTEK 3870, it is much more efficient, the hardwired logic can be included on the chip, and its costs are cheaper than standard system implementations. Software development can take place on existing systems using macroinstructions and can be fully debugged in its application system using a simulator board. A.T.

A80-32424 **An LSI digital signal processor for airborne applications.** L. Schirm (TRW, Inc., Redondo Beach, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 37-41.

The paper considers an LSI digital processor for airborne applications. Signal processing history is described including basic radar, and typical radar and digital radar signal processors; the present programmable architectures characterized by each subunit performing a separate mathematical/hardware function such as ALU, multiplier and memory are discussed. The digital signal processing board designed to maintain sufficient usage standards of the multiplier/accumulator arithmetic unit as high as possible and to support a 6 MHz clock rate is considered. Finally, the basic processor address generators, the controller, and the system interface are examined. A.T.

A80-32425 **LSI radar signal processor.** T. S. Kiesman (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 42-45.

The paper considers the LSI radar signal processing applications and the system design. The airborne signal processing can be reduced in size, weight, and power, making airborne processing with low speed data links feasible in applications which usually required high speed data links with ground based processing. The system requirements for the LSI radar processor cover pulse compression, spectral analysis, and constant false alarm rate detection; the functions are modularized to provide stand-alone capability and included LSI chip developments and packaging concepts which enable the designer to take advantage of the size and weight reductions afforded by custom LSI chip feature. A.T.

A80-32427 * **A comparison of computer architectures for the NASA demonstration advanced avionics system.** C. L. Seacord, D. G. Bailey, and J. C. Larson (Honeywell, Inc., Avionics Div., Minneapolis, Minn.). In: Challenge of the '80s; Proceedings of the

Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 51-57. Contract No. NAS2-10021.

The paper compares computer architectures for the NASA demonstration advanced avionics system. Two computer architectures are described with an unusual approach to fault tolerance: a single spare processor can correct for faults in any of the distributed processors by taking on the role of a failed module. It was shown the system must be used from a functional point of view to properly apply redundancy and achieve fault tolerance and ultra reliability. Data are presented on complexity and mission failure probability which show that the revised version offers equivalent mission reliability at lower cost as measured by hardware and software complexity. A.T.

A80-32428 **An approach to DABS data link avionics for general aviation.** R. Jones (FAA, Washington, D.C.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 58-63.

The paper examines the discrete address beacon system (DABS) data link applications development program to evaluate its methods of using the digital link capability inherent in the signal structure of the DABS sensor to transfer air-ground aviation related messages. The program will define the groundside interfaces and information sources necessary, the means of formatting the information on the air-ground link and the required pilot or flight crew and controller interactions. The general aviation avionics must include a DABS transponder with Standard Message plus extended Length Message uplink capability, and SM link capability if the full variety of available services are desired. A.T.

A80-32429 **Scalar update navigation algorithm for a low-cost NAVSTAR GPS receiver.** G. A. Wong (Mitre Corp., McLean, Va.) and A. N. Joglekar (Institute for Defense Analyses, Arlington, Va.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 64-69. U.S. Department of Transportation Contract No. FAA79-WA-4184.

The paper investigates a scalar update navigation algorithm to reduce computational requirements in a low-cost, sequential, GPS receiver, and compares its performance to previously developed algorithms. The scalar update requires fewer computations than the iterative algorithm because at specified time intervals the scalar algorithm carries out a scalar update as compared to a matrix update done by the iterative algorithm. The computational levels of the scalar and batch algorithms are comparable; it is shown that the performance of the scalar algorithm is superior to that of the batch algorithm, but only slightly inferior compared to the iterative algorithm. A.T.

A80-32430 **DACS - A prototype general aviation digital avionics control system.** E. F. Hitt, B. L. Walters (Battelle Columbus Laboratories, Columbus, Ohio), and D. Eldredge (FAA, Systems Integration Branch, Atlantic City, N.J.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 76-80.

The capability to evaluate increasingly complex digital avionics techniques will be provided by a new digital cockpit simulation facility at FAA/NAFEC of which the DACS is a major component. The DACS will consist of a microcomputer, keyboard, digital information transfer system, and display. It will allow the pilot to reduce his workload through computer controlled avionics and information management. The DACS will accept pilot inputs through the keyboard, display appropriate message on its gas plasma display, and controls data transfer over the multiplexed data busses, and CRT

displays will be controlled through the DACS. Fault detection and correction will be handled through as dual redundant multiplex busses and computer checking of pilot entries. (Author)

A80-32434 Preliminary design of an integrated redundant digital flight control system for the maritime patrol aircraft. A. D. Stern (Boeing Aerospace Co., Seattle, Wash.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 101-116. 7 refs.

A preliminary design of an Integrated Redundant Digital Flight Control System for the U.S. Navy's Maritime Patrol Aircraft for use in the 1985-1990 time frame is presented. Three major tasks were included: (1) definition of functional requirements; (2) evaluation of candidate design options and life-cycle-cost factors; and (3) configuration selection and definition. A distinctive aspect of this study was to determine what portion of the tactical command officer's mission-oriented digital processing load could be integrated with the redundant flight control system processing. S.D.

A80-32435 The Discrete Address Beacon System data link. J. L. Leeper and J. C. Anderson (MIT, Lexington, Mass.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979.

New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 117-121. U.S. Department of Transportation Contract No. FA78WAI-895.

The Discrete Address Beacon System (DABS) is a surveillance and communication system for air traffic control. DABS is intended to serve as an evolutionary replacement for the existing Air Traffic Control Radar Beacon System. Various aspects of the DABS are discussed. The DABS data link provides the capability for two-way data communication between the ground and DABS data-link-equipped aircraft. The FAA is currently testing a set of initial applications which can be implemented in the same time-frame as the DABS sensor application. A digital avionics system has been developed for demonstrating and evaluating the initial services. S.D.

A80-32436 An overview of the Sperry flight management computer system for the Boeing 757/767 airplanes. D. Baker (Sperry Corp., Sperry Flight Systems, Phoenix, Ariz.) and A. Smith (Boeing Commercial Airplane Co., Seattle, Wash.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 122-128.

When the Boeing 757 and 767 airplanes enter into service in the early 1980s, they will use a flight management computer system (FMCS) to provide an unprecedented level of cockpit automation and operational efficiency. The paper defines the role of the FMCS in performance management, navigation, guidance and display processing. Attention is given to describing a unique aspect of the digital avionics used to implement this role. The most unique feature of the Sperry digital implementation is the utilization of a disk operating system to achieve the desired flexibility. With the larger storage capacity of the memory disk and the versatility provided by the real-time executive, the 757/767 FMCS is well prepared to accept a growing role in the years to come. S.D.

A80-32437 Computer data base for 767 avionics interface control. R. A. Shaw (Boeing Commercial Airplane Co., Seattle, Wash.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 129-136.

A new approach is described for producing tabular avionics interface tables. The approach relies on a computerized data base which provides a central source for all interface data. The tabular interface data for each line replaceable unit (LRU) specification is computerized. The computer sorts the data and prints them in a

standard format. The data are retained in the computer memory for use in creating overall system tables, checking interfaces between LRUs for consistency, and other applications. If there is an error in the data, it is corrected and a revised set of tables is printed. The key feature of this approach is that there is one source for the data. Implementation of the data base on a minicomputer system is discussed, along with the present state of the data base operation and the future development of the approach. S.D.

A80-32440 Design considerations for the automated maintenance of computerized avionics systems. L. D. Christie (Department of National Defence, Ottawa, Canada) and P. C. Tiffany (Lockheed-California Co., Burbank, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 150-155.

Automated maintenance is one of the possible options to increase test equipment capability. The paper deals with design considerations for automatic maintenance of computerized avionics systems. Automated maintenance uses computerized programming, and it increases system dependability by correctly identifying and diagnosing faults. It is shown that automatic maintenance can be either embedded or dedicated, and that it can utilize several levels of automation to meet the maintenance requirements of the system. This is exemplified in the system test program for the CP-140 aircraft. The benefits of automated maintenance are better realized with increased ability designed into the parts of the system to do self-test and/or respond to central computer test inquiries. Some other considerations in the design of an automated maintenance system are also considered. S.D.

A80-32441 The impact of digital avionics on equipment maintenance. W. T. O'Reilly (Westinghouse Electric Corp., Baltimore, Md.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 156-161.

The evolution of avionics maintenance is reviewed in order to fully appreciate the impact of digital circuitry on the maintenance of avionic equipment. The use of digital designs in the architecture of the basic equipment permits attaining extensive built-in test functions with a very small increase in the cost of the system. This in turn permits the use of new maintenance concepts which achieve lower logistic support costs, reduce the downtime for repair, and reduce the false removals and 'cannot duplicate' or 'retest OK' problems. The net effect is to reduce the logistic support costs, and to improve reliability by significantly reducing maintenance-induced faults and by increasing availability through reduced maintenance time and false failure reports. Fault isolation via built-in test has become a viable concept due to the impact of present-day digital technology. S.D.

A80-32442 Software for a correlation velocity sensor. R. M. Kimball (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 167-170.

The software required for a breadboard correlation velocity sensor is described. The software has been developed in an evolutionary manner over a number of years, while the sensor development has progressed from an elementary feasibility demonstration model to a full-range sensor that has been flight tested on both a Navy CH-53A helicopter and an Air Force C-141A cargo aircraft. The correlation velocity sensor system is described relative to general concept, antenna configuration, system implementation, and computer-controlled parameters (tracking parameters and configuration parameters). Particular attention is given to a discussion of software functions, configuration control software, and software evolution (Version I, major system modifications, and code conversion). S.D.

A80-32444 **Electronic flight instrument system for B767/757 aircraft.** A. J. Dandekar (Rockwell International Corp., Collins Air Transport Div., Cedar Rapids, Iowa) and G. L. Moore (Boeing Commercial Airplane Co., Seattle, Wash.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 180-186.

The new Boeing 767/757 aircraft will be equipped with a multicolor Electronic Flight Instrument System (EFIS). The EFIS represents significant technological advances over the traditional electromechanical flight instruments. The EFIS utilizes two multicolor cathode ray tubes (CRT) for each pilot to display information including that provided by conventional ADI and HSI electromechanical instruments. However, the ability to change and add information electronically makes the EFIS very flexible and allows the integration of map and weather radar data. The EFIS displays consist of the Electronic Attitude Director Indicator (EADI) and the Electronic Horizontal Situation Indicator (EHSI). The EADI and EHSI displays are driven by a programmable digital 'Symbol Generator' and the pilot can select the display presentation and mode from a Control Panel. This paper describes the capabilities of the EFIS and the advanced technology applied in the system implementation. (Author)

A80-32445 **Application of advanced digital techniques and displays to the L-1011 flight engineer's station.** W. R. Beckman (Lockheed-California Co., Burbank, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 197-203.

The paper presents crew station studies of advanced digital techniques which provide pictorial symbology and alpha numeric information in the L-1011 TriStar transport. The improvements in control and display functions provided to the flight crew with the advanced displays and microcomputers are discussed, along with the integration of the crew station's status and warning functions, propulsion displays, and the circuit breaker control operation. Finally, the maintainability, reliability, and fail operational capability for the L-1011 advanced flight engineer station are described.

A.T.

A80-32446 **The crew adaptive cockpit - Firefox, here we come.** J. Reising (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 204-207. 8 refs.

The paper examines the concept of the crew adaptive cockpit consisting of the aircrew, biocybernetic sensing loops, artificial intelligence software, and pictorial displays. This system would be adaptive to the changing conditions of the aircrew and the mission, and provide better interaction between the operator and the aircraft which would sense the aircrew thoughts and actions producing optimal aircrew/aircraft system efficiency. (Author)

A.T.

A80-32447 **Continuous-to-discrete transformations for control system simulation.** R. A. Weeks (Northrop Corp., Hawthorne, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 208-214. 11 refs.

Application of numerical integration for simulating digital control system filters is presented. Methods of transforming continuous Laplacian transfer functions into discrete recursion formulae are discussed, with continuous-to-discrete transformations presented as a state variable method and a direct programming z-transform method. The transformation method was demonstrated by mathematical modeling on analog and digital computers implemented in a man-in-the-loop real time simulation. This example of transforming

complex continuous airframe-coupled flight control system to digital mechanization showed its satisfactory performance and its compatibility with human pilots. (Author)

A.T.

A80-32448 * # **Total aircraft flight-control system - Balanced open- and closed-loop control with dynamic trim maps.** G. A. Smith and G. Meyer (NASA, Ames Research Center, Moffett Field, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 215-223. 5 refs.

The availability of the airborne digital computer has made possible a Total Aircraft Flight Control System (TAFCOS) that uses virtually the complete nonlinear propulsive and aerodynamic data for the aircraft to construct dynamic trim maps that represent an inversion of the aircraft model. The trim maps, in series with the aircraft, provide essentially a linear feed-forward path. Basically, open-loop trajectory control is employed with only a small perturbation feedback signal required to compensate for inaccuracy in the aircraft model and for external disturbances. Simulation results for application to an automatic carrier-landing system are presented. Flight-test results for a STOL aircraft operating automatically over a major portion of its flight regime are presented. The concept promises a more rapid and straightforward design from aerodynamic principles, particularly for highly nonlinear configurations, and requires substantially less digital computer capacity than conventional automatic flight-control system designs. (Author)

(Author)

A80-32449 **A description of a velocity-damped Schuler erected AHRS system.** M. S. Klemes and J. Blanco (Sperry Corp., Sperry Flight Systems, Phoenix, Ariz.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 232-239.

The paper describes the performance and design criteria for a strapdown attitude and heading reference system (AHRS) that uses a velocity-damped Schuler erection system. The design criteria are presented in terms of: classical complementary filtering, and optimal statistical evaluation was conducted to assure that the classical system performance was not compromised. The velocity-damped Schuler erection system in a strapdown AHRS was discussed, and the effect of fully implementing an optimal Kalman filter was compared with the use of a suboptimal nonlinear system; it was shown that nonlinear controls must be employed which are external to the optimal linear filter to accommodate the nonstatistical, infrequent disturbances. (Author)

A.T.

A80-32450 **Issues in avionics standardization.** R. K. Ricker (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 240-243.

The paper defines criteria for the selection of avionics standardization factors which take into account the forces which determine the productivity of standardization. These factors include technological maturity and architectural suitability; the maturity factor deals with a subsystem where the majority of elements are in a three-year cycle of 'order of magnitude' performance requirements, size reduction, or mechanization changes. In such cases standardization is not feasible; if the subsystem is architecturally interdependent with other subsystems with complex interfaces and a high degree of software, standardization is much more difficult than in a stand-alone subsystem with simple interfaces. (Author)

A.T.

A80-32451 **TIES - An integrated CNI system in hardware feasibility demonstration.** C. Palatucci, J. Bonanno, E. Ressler, L. Smith, and C. Nowicki (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort

Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 244-251. 7 refs.

The paper examines TIES, an integrated communication, navigation, and identification (CNI) system in a hardware feasibility demonstration. The TIES approach treats aircraft as a node of telecommunications network; TIES represents a systematic structuring of hardware and software to accomplish signal processing at the node. The control subsystem consisting of a central control element which provides high-level commands to remote controllers is discussed, along with the Frequency Division Multiplex Bus which provides a flexible mechanism for interconnection between the various frequency conversion units. Finally, the signal processors including narrowband and wideband signal conversion units are considered. A.T.

A80-32452 The U.S. Army Digital Avionics Technology program. G. G. Chandler, J. A. Dasaro, and L. J. Youngblood (U.S. Army, Avionics Research and Development Activity, Fort Monmouth, N.J.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 252-257.

A study is presented of the architectural design of the Cobra attack helicopter and the proposed Advanced Scout Helicopter. The Army Digital Avionics System program which will provide the core avionics and integrated controls and displays for the planned Systems Testbed for Avionics Research for UH-60 aircraft is also discussed. Finally, steps leading from the development to the production stage are examined, including the role of the government laboratory in engineering development, the relative merits of GFE and CFE avionics hardware, and experience gained in hardware and software standardization. A.T.

A80-32453 Airborne integrated communications system. C. R. Husbands (Mitre Corp., Bedford, Mass.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 258-261. Contract No. F19628-79-C-0001.

The paper examines the improved data handling capability of airborne command posts such as the E4 aircraft and a program to integrate new technologies into an improved airborne data network. The airborne integrated communication system study developed a concept which utilizes existing technology in cable distribution systems and microelectronics, new techniques in time-division multiplex architectures, a packet switched digitized voice, and fiber optic technology. These techniques were developed in a laboratory and integrated into a test bed which can examine these technologies in an integrated environment. A.T.

A80-32454 DRAS - A flexible data handling system for F-15 software performance evaluation. J. Kenney, Jr. (TRW Defense and Space Systems Group, Warner Robins, Ga.), C. Bierbaum, and D. Perkins (USAF, Warner Robins Air Logistics Center, Robins AFB, Ga.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 262-268. 5 refs.

The paper presents the Data Reduction and Analysis System (DRAS), a data handling system for F-15 software performance evaluation. The system can handle large amounts of avionics data in an orderly and timely manner, and it can approach a volume of 30 million data words for a representative one hour avionics flight test. The methodology used in a requirements set for the F-15 Avionics Integration Support Facilities (AISF) DRAS, and the flexibility and adaptability of DRAS to other avionic system operational flight programs to be supported in an AISF environment through a simple point-to-point comparison technique were described. A.T.

A80-32455 The anatomy of an avionics system develop-

ment and integration laboratory. J. A. Rey (Northrop Corp., Aircraft Div., Hawthorne, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 269-273. 5 refs.

The paper describes an efficient and technically effective facility which reduces testing time and provides early problem resolution during the development and testing process of avionic systems. Consideration is given to operational software data correlation, instrumentation and control of a dual redundant bus structure, and simulation fidelity. V.T.

A80-32456 Software engineering system requirements. L. C. Klos (General Dynamics Central Data Systems Center, Fort Worth, Tex.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 274-280. 12 refs.

The paper describes the desirable characteristics and the tools of such a software engineering system which can be used for the development and maintenance of embedded computer software. Functional characteristics are identified and the need for integration of the parts of the software is outlined. V.T.

A80-32457 * A navigation algorithm for single channel low-cost GPS receiver. H. Parsiani (Intermetrics, Inc., Pearland, Tex.), P. S. Noe, V. T. Rhyne, and J. H. Painter (Texas A & M University, College Station, Tex.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 281-288. Grant No. NSG-1374.

A sequential navigation algorithm for a navigator using the Global Positioning System satellites is developed and tested for both noise-free and noisy system models. Data from a six-hour flight from California to Hawaii (C5A aircraft) simulates a true user to test the accuracy of the user's position for a sequential navigation system. For error reduction in the user's position in the sequential navigation system (considering 100 m as a maximum average error tolerated by any low-cost GPS user) an analysis of error sources in the sequential system has led to the use of range-ephemeris rate to translate ranges to a common point in time and to use velocity aiding at the time of a satellite disappearance. To reduce the user's position and velocity errors in a noisy navigation system an 'alpha-beta' two-pole filter is implemented whose optimum alpha is obtained experimentally. A user's position error of 73 m at noise range error of 30.48 (1sigma) is achieved. (Author)

A80-32461 Advanced signal processing concepts for multi-function radio systems. C. R. Ward and R. A. Reilly (ITT, ITT Avionics Div., Nutley, N.J.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 307-313. 11 refs.

A new approach to radio signal processing is described which employs tapped delay lines as a means of implementing programmable transversal filters and correlators. Multifunction radio systems with more than one receiver are considered. The use of the transversal filters in multifunction radios is outlined. Transversal filter device technology is discussed. V.T.

A80-32462 Modular packaging for TIES. C. E. Grove (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979. New York, Institute of Electrical and Electronics Engineers, Inc., 1979, p. 314-318. Contract No. N62269-79-C-0007.

A package concept which facilitates the TIES (Tactical Information Exchange System) architecture is discussed in this modular packaging study. Guidelines and boundary conditions are defined, and include not only electronics partitioning but also airframe

interface. Comments and recommendations from several airframers are included. It is noted that the package concept developed within all these guidelines meets the overall system objectives with the minimum compromise. V.T.

A80-32467 **Air traffic control in a digital world.** S. B. Poritzky (FAA, Office of Systems Engineering Management, Washington, D.C.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 3 p.

It is noted that many of the Federal Aviation Administration's Engineering and Development programs could not be realistically considered without the use of digital avionics. The paper surveys new system developments for air traffic control to demonstrate the importance of data processing capability, reliability, and cost reductions possible through digital avionics. Topics covered include: Conflict alert, Discrete Address Beacon System (DABS), Automatic Traffic Advisory and Resolution Service (ATARS), Automated terminal service, and Collision avoidance system. M.E.P.

A80-32468 **Integrated system design - DAIS.** R. C. Mason (TRW Defense and Space Systems Group, Redondo Beach, Calif.) and M. J. Thullen (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 8 p.

The fundamental system characteristics and system features of the Digital Avionics Information System (DAIS) are described. Attention is given to how the system features were used in applying the DAIS architecture to a representative avionics application and mission, and were demonstrated in a hot bench environment. Discussion covers the basic attributes of the DAIS system including modularity, flexibility, ease of use, ease of modification, and portability. Finally, a specific example of how the application software was readily partitioned among the processors is described. M.E.P.

A80-32469 **Digital Flight Control System /DFCS/ multimode development.** G. J. Vetsch and D. B. Schaefer (McDonnell Aircraft Co., St. Louis, Mo.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 8 p.

It is noted that the flexibility in design and versatility in application achievable with digital technology facilitates the implementation of multimode control laws to meet specific mission requirements for advanced fighter aircraft. Attention is given to a McDonnell Aircraft (MCAIR) study, in which an advanced multimode flight control system was developed to enhance the operational effectiveness of high performance aircraft. It is shown that customized flight control modes were designed for specific mission segments to provide enhanced tactical effectiveness. Discussion also covers the incorporation of relaxed static stability and direct lift and side force control, as well as the inclusion of reconfiguration capabilities to offset battle damage. M.E.P.

A80-32470 **Advanced digital avionics for the DC-9 Super 80.** J. H. Armstrong and J. D. McDonnell (Douglas Aircraft Co., Long Beach, Calif.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 7 p.

This paper discusses from the aircraft manufacturer's point of view the avionics system architecture, its digital implementation, and some hardware details of most major system elements. New operational features are discussed including Category IIIa autoland, some new autopilot and autothrottle cruise modes, a head-up display system, and a 'hot on-board spare' flight guidance computer. Finally,

some of the advantages of the digital system over analog systems are noted. (Author)

A80-32471 **An Integrated Sensory Subsystem /ISS/ for advanced V/STOL aircraft.** C. R. Abrams (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.), R. Steele, and W. Weinstein (Grumman Aerospace Corp., Bethpage, N.Y.). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 8 p. 17 refs.

A conceptual design of an Integrated Sensory Subsystem (ISS) for Navy V/STOL Aircraft was prepared to satisfy the requirements of a Digital Flight Control System. As conceived, this subsystem will also provide reliable, redundant and survivable sensor information to other aircraft systems which include Air Inlet and Engine Control System, Display System, Navigation System and Weapon Delivery System. Utilizing V/STOL requirements and redundant digital computation system architectures (including dispersed microprocessors), configurations of gyros, accelerometers, air data components, inertial navigation systems and analytic redundancy algorithms were developed and evaluated in terms of system life cycle cost. The potential improvements in aircraft operational readiness was also examined. (Author)

A80-32472 **The Fault Tolerant Multiprocessor engineering model /A report/.** C. O. Schulz (Rockwell International Corp., Collins Government Avionics Div., Cedar Rapids, Iowa). In: Challenge of the '80s; Proceedings of the Third Digital Avionics Systems Conference, Fort Worth, Tex., November 6-8, 1979, Addendum. New York, Institute of Electrical and Electronics Engineers, Inc., 1979. 8 p. 5 refs.

It is noted that soon avionics systems will be expected to exhibit reliability presently required only of structural and mechanical control systems on aircraft. The Fault Tolerant Microprocessor (FTMP) which is designed to be the central computer of a homogeneous, wholly integrated avionics system is described, noting that it is being developed under funding of NASA's Energy Efficient Transport program. An overview is presented of the FTMP architecture concepts in order to describe the underlying principles. The engineering model design is described in detail and emphasis is given to areas where new concepts were developed during the EM design. M.E.P.

A80-32510 # **Military aerospace to 2000.** A. H. Flax (Institute for Defense Analyses, Washington, D.C.). *Aeronautics and Astronautics*, vol. 18, May 1980, p. 30-39. 8 refs.

The article presents observations and interpretations of military trends covering such topics as technology, strategic forces, tactical air forces, naval forces, and space. Emphasis is given to the tendency of established systems to persist and the leverage of cost in design and innovation. Discussion examines trends in aircraft and a shift in emphasis to the weapon rather than its carrier. M.E.P.

A80-32526 # **Conically cambered delta wings in supersonic flow. I - Basic solutions.** R. K. Bera (National Aeronautical Laboratory, Bangalore, India) and S. M. Ramachandra (Hindustan Aeronautics, Ltd., Bangalore, India). *Aeronautical Society of India, Journal*, vol. 29, Aug.-Nov. 1977 (Nov. 1979), p. 87-94. 21 refs.

The analysis of a conically cambered delta wing with subsonic leading edges in a supersonic stream is presented. The twist distribution chosen is a polynomial of even ordered terms in the conical coordinate for which a closed form series solution is obtained. It is found that the mean camber shapes are geometrically simple and appear to be promising in terms of low drag. To avoid flow separation at the leading edges at the design condition, the attachment line is prescribed which results in a leading edge droop for all basic shapes. (Author)

A80-32527 # **Reflex cambered delta wings with leading edge separation.** V. S. Holla (Indian Institute of Science, Bangalore, India)

and F. Joe. *Aeronautical Society of India, Journal*, vol. 29, Aug.-Nov. 1977 (Nov. 1979), p. 95-104. 10 refs.

A detailed analysis is made of the aerodynamic characteristics of a family of reflex curvature conically cambered delta wings with leading edge separation. The analysis is based on the extension of Smith's (1970) flow model for the plane wing to the case of nonplanar wings. It is found that the influence of spanwise camber shape on the vortex core location, vortex sheet shape, circulation strength, spanwise pressure distribution, and overall normal forces is very significant at lower incidences and decreases with increasing values of incidence. The present theory, due to the assumption of conical flow and slender wing theory assumptions, overestimates the nonlinear normal force and circulation strengths. A method is suggested to correct these values by using the results of Polhamus (1977) for nonlinear normal force. S.D.

A80-32528 # Effect of initial value on the behaviour of flow calculations for blade-to-blade flow through a turbomachine. R. B. Deshpande (University of Manchester Institute of Science and Technology, Manchester, England). *Aeronautical Society of India, Journal*, vol. 29, Aug.-Nov. 1977 (Nov. 1979), p. 129-131. 9 refs.

A80-32531 # Conically cambered delta wings in supersonic flow. II - Optimal solutions. R. K. Bera (National Aeronautical Laboratory, Bangalore, India) and S. M. Ramachandra (Hindustan Aeronautics, Ltd., Bangalore, India). *Aeronautical Society of India, Journal*, vol. 29, Aug.-Nov. 1977 (Nov. 1979), p. 145-148. 6 refs.

The simplicity of the results and favorable properties of a class of conically cambered delta wings with subsonic leading edges in a supersonic stream, studied in Part I, has suggested that one look into the possibility of obtaining useful minimum drag shapes when the basic solutions are linearly combined in a Lagrange multiplier formulation. To this end, the classical problem of minimum drag wings for a given total lift is solved by linearly combining the basic twist distributions in combinations of two, three and four using the Lagrange multiplier method. The optimal conical surfaces reported appear to be of practical use because of small surface waviness and a washout in incidence near the leading edge. The lift-to-drag ratios are close to the plane delta with suction and their off-design properties are expected to be better than those of Tsien (1955) and Holla (1967). The simplicity of the conical surfaces make them a viable candidate for any delta wing design for supersonic flight. S.D.

A80-32597 The evaluation of annoyance provoked by aircraft noise by means of opinion surveys (Evaluation de la gêne due au bruit des avions par les enquêtes d'opinion). J. Bremond (Centre d'Études et de Recherches Psychologiques Air, Saint-Cyr-l'École, Yvelines, France). *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare*, vol. 18, 4th Quarter, 1979, p. 269-274. 8 refs. In French.

A80-32598 Evaluation of annoyance due to Concorde noise in the vicinity of Washington-Dulles International Airport (Evaluation de la gêne due au bruit de Concorde autour de l'Aéroport International de Washington-Dulles). J. Bremond (Centre d'Études et de Recherches Psychologiques Air, Saint-Cyr-l'École, Yvelines, France). *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare*, vol. 18, 4th Quarter, 1979, p. 275-280. In French.

A80-32601 Annoyance caused by general aviation (La gêne causée par l'aviation légère). J. Bremond (Centre d'Études et de Recherches Psychologiques Air, Saint-Cyr-l'École, Yvelines, France). *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare*, vol. 18, 4th Quarter, 1979, p. 297-302. In French.

The level of annoyance brought about by the activities of general aviation in persons residing in the vicinities of four airports is investigated by means of an opinion survey. Participants were asked to respond to 11 questions relating to the effects of general aviation aircraft noise on their daily activities, and a scale of annoyance was derived. Results indicate the greater contribution of psychological

than sociological factors to the annoyance measured, with fear of airport expansion causing more annoyance at one airport than actual aircraft noise. At the other airports, annoyance is found to increase with exposure to aircraft noise in accordance with the psophic index of noise levels and traffic volume. A.L.W.

STAR ENTRIES

N80-20223*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
TECHNOLOGY REQUIREMENTS AND READINESS FOR VERY LARGE AIRCRAFT

D. William Conner and John C. Vaughan, III Mar. 1980 14 p refs
 (NASA-TM-81783) Avail: NTIS HC A02/MF A01 CSCL 01B

Common concerns of very large aircraft in the areas of economics, transportation system interfaces and operational problems were reviewed regarding their influence on vehicle configurations and technology. Fifty-four technology requirements were identified which are judged to be unique, or particularly critical, to very large aircraft. The requirements were about equally divided among the four general areas of aerodynamics, propulsion and acoustics, structures, and vehicle systems and operations. The state of technology readiness was judged to be poor to fair for slightly more than one-half of the requirements. In the classic disciplinary areas, the state of technology readiness appears to be more advanced than for vehicle systems and operations.

Author

N80-20224* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DETECTION OF THE TRANSITIONAL LAYER BETWEEN LAMINAR AND TURBULENT FLOW AREAS ON A WING SURFACE Patent

William R. Hood Issued 19 Feb. 1980 4 p Filed 27 Nov. 1978 Supersedes N79-16805 (17 - 08, p 0932)
 (NASA-Case-LAR-12261-1; US-Patent-4,188,823;
 US-Patent-AppI-SN-964009; US-Patent-Class-73-147;
 US-Patent-Class-73-205L) Avail: US Patent and Trademark Office CSCL 01A

A system is disclosed for detecting the laminar to turbulent boundary layer transition on a surface while simultaneously taking pressure measurements. The system uses an accelerometer for producing electrical signals proportional to the noise levels along the surface and a transducer for producing electrical signals proportional to pressure along the surface. The signals generated by the accelerometer and transducer are sent to a data reduction system for interpretation and storage.

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

N80-20225 Engineering Sciences Data Unit, London (England).
EXAMPLE OF PERFORMANCE ANALYSIS USING DATA OBTAINED CONCURRENTLY IN AIR-PATH, BODY AND EARTH AXES

1979 31 p
 (ESDU-79018; ISBN-0-85679-263-2) Copyright. For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC \$674.50

A detailed work example of the application of the equations of motion to the solution of problems in aircraft point-performance work involving the use of several axis systems is presented. The example is the determination of lift and drag for a supersonic-cruise aircraft using data from air-data systems, body-mounted accelerometers and an inertial platform system. A particular feature is the extent to which account is taken of quantities which individually might be regarded as negligible but whose collective effects in an attempted high-accuracy analysis can be significant.

ESDU

N80-20227*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A SPIN-RECOVERY PARACHUTE SYSTEM FOR LIGHT GENERAL-AVIATION AIRPLANES

Charles Bradshaw Apr. 1980 18 p refs Presented at the 14th Aerospace Mech. Symp., Hampton, Va. 1-2 May 1980 Submitted for publication
 (NASA-TM-80237; L-13585) Avail: NTIS HC A02/MF A01 CSCL 01A

A tail mounted spin recovery parachute system was designed and developed by the NASA Langley Research Center for use on light general aviation airplanes. The system was designed for use on typical airplane configurations, including low wing, single engine, and twin-engine design. A mechanically triggered pyrotechnic slug gun is used to forcibly deploy a pilot parachute which extracts a bag that deploys a ring slot spin recovery parachute. The total system weighs 8.2 kg (18 lb). System design factors included airplane wake effects on parachute deployment, prevention of premature parachute deployment, positive parachute jettison, compact size, low weight, system reliability, and pilot and ground crew safety. Extensive ground tests were conducted to qualify the system. The recovery parachute was used successfully in flight 17 times.

J.M.S.

N80-20228*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
TRANSONIC UNSTEADY AIRLOADS ON AN ENERGY EFFICIENT TRANSPORT WING WITH OSCILLATING CONTROL SURFACES

M. C. Sandford, R. H. Ricketts, F. W. Cazier, Jr., and H. J. Cunningham Feb. 1980 9 p
 (NASA-TM-81788) Avail: NTIS HC A02/MF A01 CSCL 01A

An aspect ratio 10.8 supercritical wing with oscillating control surfaces is described. The wing is instrumental with 252 static orifices and 164 in situ dynamic pressure transducers for studying the effects of control surface deflection on steady and unsteady pressures at transonic speeds. Results from initial wind tunnel tests conducted in the Langley Transonic Dynamics Tunnel are discussed. Unsteady pressure results are presented for two trailing edge control surfaces oscillating separately at the design Mach number of 0.78. Some experimental results are compared with analytical results obtained by using linear lifting surface theory.

Author

N80-20229*# National Aeronautics and Space Administration, Washington, D. C.

ON WINGS OF CIRCULAR DESIGN

Wilhelm Kinner Oct. 1979 7 p refs Transl. into ENGLISH from Z. Angew. Math. Mech. (East Germany), v. 16, no. 6, Dec. 1936 p 349-352 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-3199)

(NASA-TM-75505) Avail: NTIS HC A02/MF A01 CSCL 01A

Prandtl's method of sources and sinks for air foils is used to investigate the aerodynamics of circular wings in constant flow. Lift distribution, total lift, and pitching moment are investigated as well as the influence of changes in the angle of attack.

Author

N80-20230*# Remtech, Inc., Huntsville, Ala.

WAKE FLOWFIELDS FOR JOVIAN PROBE Final Report

Carl D. Engel and Leroy M. Hair Hampton, Va. NASA Langley Research Center Mar. 1980 62 p refs
 (Contract NAS1-15819)

(NASA-CR-159235) Avail: NTIS HC A04/MF A01 CSCL 01A

The wake flow field developed by the Galileo probe as it enters the Jovian atmosphere was modeled. The wake produced by the probe is highly energetic, yielding both convective and radiative heat inputs to the base of the probe. A component mathematical model for the inviscid near and far wake, the viscous near and far wake, and near wake recirculation zone was developed. Equilibrium thermodynamics were used for both the ablation and atmospheric species. Flow fields for three entry conditions were calculated. The near viscous wake was found to exhibit a variable axial pressure distribution with the neck

pressure approximately three times the base pressure. Peak wake flow field temperatures were found to be in proportion to forebody post shock temperatures. J.M.S.

N80-20231*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

OPERATIONAL IMPLICATIONS OF SOME NACA/NASA ROTARY WING INDUCED VELOCITY STUDIES

Harry H. Heyson Feb. 1980 53 p refs Presented at 3d Midwest Helicopter Safety Seminar, Joliet, Ill., 26-27 Feb., 1980; sponsored by FAA and Ill. Dept. of Transportation. (NASA-TM-80232) Avail: NTIS HC A04/MF A01 CSCL 01A

Wind tunnel measurements show that the wake of a rotor, except at near-hovering speeds, is not like that of a propeller. The wake is more like that of a wing except that, because of the slow speeds, the wake velocities may be much greater. The helicopter can produce a wake hazard to following light aircraft that is disproportionately great compared to an equivalent fixed-wing aircraft. This hazard should be recognized by both pilots and airport controllers when operating in congested areas. Even simple momentum theory shows that, in autorotation and partial-power descent, the required power is a complex function of both airspeed and descent angle. The nonlinear characteristic, together with an almost total lack of usable instrumentation at low airspeeds, has led to numerous power-settling accidents. The same theory shows that there is a minimum forward speed at which a rotor can autorotate. Neglect of, or inadequate appraisal of this minimum speed has also led to numerous accidents. Ground effect and the problems it creates is discussed. R.E.S.

N80-20232*# Kentron International, Inc., Hampton, Va.

AERODYNAMIC DESIGN AND ANALYSIS OF THE AST-204, AST-205, AND AST-206 BLENDED WING-FUSE LARGE SUPERSONIC TRANSPORT CONFIGURATION CONCEPTS

Glen L. Martin and Kenneth B. Walkley Mar. 1980 49 p refs (Contract NAS1-16000)

(NASA-CR-159223) Avail: NTIS HC A03/MF A01 CSCL 01A

The aerodynamic design and analysis of three blended wing-fuselage supersonic cruise configurations providing four, five, and six abreast seating was conducted using a previously designed supersonic cruise configuration as the baseline. The five abreast configuration was optimized for wave drag at a Mach number of 2.7. The four and six abreast configurations were also optimized at Mach 2.7, but with the added constraint that the majority of their structure be common with the five abreast configuration. Analysis of the three configurations indicated an improvement of 6.0, 7.5, and 7.7 percent in cruise lift-to-drag ratio over the baseline configuration for the four, five, and six abreast configurations, respectively. R.E.S.

N80-20234# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio, Aeromechanics Div.

INVESTIGATION OF NUMERICAL TECHNIQUES FOR PREDICTING AERODYNAMIC HEATING TO FLIGHT VEHICLES Final Report, May 1975 - Sep. 1977

Arthur B. Lewis, Jr. and Neil J. Sliski May 1979 120 p refs (AF Proj. 2404)

(AD-A078121; AFFDL-TR-79-3001) Avail: NTIS HC A06/MF A01 CSCL 20/4

The development of complex lifting configurations and high speed maneuvering vehicles has emphasized the need for numerical techniques to predict aerodynamic heating rates as a function of the vehicle trajectory. These numerical programs are not expected to eliminate the requirements for wind tunnel and flight testing, but will be an aid to more efficient use of experimentation time and improve confidence that all potential problem areas on the vehicle have been examined. Three programs, the Hypersonic Arbitrary Body Program, the MINIVER Program, and a third program were examined to determine their usefulness for vehicles with non-circular cross sections and large flat areas as exemplified by lifting reentry vehicles. The MINIVER code was found to be unsuitable for this; the Hypersonic Arbitrary Body Program was applicable to these shapes, but because of program limitations was used for only limited calculations. The

last program also had limitations in the areas of geometry description and surface pressure calculations. Efforts were made to remove these limitations and several shapes were investigated. The ultimate goal of this effort was to extend the capabilities of one or more of the heating codes; while no effort was made to improve MINIVER or the Hypersonic Arbitrary Body Program, significant improvements were made in the last program and inviscid flow field program. GRA

N80-20235# ARO, Inc., Arnold Air Force Station, Tenn.

AERODYNAMIC CHARACTERISTICS AND STORE LOADS OF THE 1/24-SCALE F-111 AIRCRAFT MODEL WITH SEVERAL EXTERNAL STORE LOADINGS Final Report, 18-23 Jun. 1979

C. F. Anderson AEDC Aug. 1979 48 p

(AD-A078677; AEDC-TSR-79-P48) Avail: NTIS

HC A03/MF A01 CSCL 20/4

The 1/24-scale F-111 aircraft model was tested to obtain simultaneous measurements of the aircraft and store aerodynamic loads and to evaluate the effects of the TAWDS pod on aircraft stability and control. Static stability and store loads data were obtained at 5 wing sweep angles for Mach numbers from 0.4 to 1.2. Data were also obtained for stabilizer deflections of + or - 10 deg and with the speed brake deflected 50 deg for some configurations. The angle of attack range was from -2 to 24 deg and the angle of sideslip range was from -10 to 10 deg. GRA

N80-20236# Neilsen Engineering and Research, Inc., Mountain View, Calif.

THE DEVELOPMENT OF RAPID PREDICTIVE METHODS FOR THREE-DIMENSIONAL TRANSONIC FLOW FIELDS ABOUT FIGHTER BOMBER AIRCRAFT, PART 1 Final Report, 1 Jan. 1975 - 30 Sep. 1979

Anthony J. Crisalli, Stephen S. Stahara, Jack N. Nielsen, and John R. Spreiter Jul. 1979 314 p refs

(Contract F44620-75-C-0047; AF Proj. 2307)

(AD-A078683; NEAR-TR-198; AFOSR-79-1281TR) Avail:

NTIS HC A14/MF A01 CSCL 20/4

This report presents an overall account of the progress made on an essential component of the transonic store trajectory problem: the prediction of transonic flow fields about wing-body/pylon combinations representative of modern fighter-bomber aircraft. The emphasis here is on the development of predictive techniques which are sufficiently economical from the standpoint of computer cost to enable an aircraft designer to employ the techniques over a wide range of Mach number, angle of attack, and geometric parameters. The report presents several candidate transonic predictive methods and evaluates them by comparing their predictions of various flow field quantities with experimental data. The experimental data are taken from a parallel wind-tunnel test phase of the project, designed specifically for evaluating the predictive methods. The experimental data have been documented and archived in several test reports. The extensive comparisons of the theoretical predictions from the various predictive methods with the data comprise the major portion of this report. GRA

N80-20237# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, School of Engineering.

GROUND PLANE EFFECTS ON A CONTOURED SURFACE AT LOW SUBSONIC VELOCITIES M.S. Thesis

J. A. Krawtz Dec. 1979 115 p refs

(AD-A079877; AFIT/GA/AA/80M-3) Avail: NTIS

HC A06/MF A01 CSCL 20/4

The wing-in-ground effect phenomenon was examined by investigating the flow between a flat ground plate and a contoured upper plate. Velocity and turbulence intensity measurements were taken at various points in the flow with a Laser Doppler Velocimeter. Mach numbers studied were Mach 0.15 and Mach 0.2 at the exit plane of a 1 cm by 10 cm two-dimensional nozzle. Measurements were taken across the width of the jet, 5, 10, and 15 cm downstream with plate separations of 1, 2, and 5 cm and vertically without the ground plate. In addition measurements were taken near the top plate with conventional pressure measuring techniques and the results compared. The

proximity of the ground plate had the effect of spreading the flow outward across the 10 cm width of the jet by 20%. The laser velocimeter showed the turbulence intensity to be constant across the potential core of the jet. Turbulence intensity increased beyond 10% in the boundary layers of the jet and in the plate boundary layer. The pressure measurement data correlated well with the laser velocimeter results. GRA

N80-20239# Wright State Univ., Dayton, Ohio. Dept. of Engineering.
AN APPROXIMATE ANALYSIS OF WING UNSTEADY AERODYNAMICS Final Report, 1 Sep. 1976 - 31 Jan. 1978

W. R. Wells May 1979 44 p refs
 (Contract F33615-76-C-3145; AF Proj. 2307)
 (AD-A079322; AFFDL-TR-79-3046) Avail: NTIS
 HC A03/MF A01 CSCL 20/4

A brief review of the unsteady aerodynamics in lifting surface theory is reported. For utility in design application, simplified but accurate analytical expressions were developed for generalized unsteady aerodynamics of wings of finite aspect ratio and sweep. This includes a means of calculating the unsteady lift load on the wing and tail surface of arbitrary shape and angle of attack variation. In addition, a formulation to include the indicial aerodynamics in the longitudinal equations of motion of the aircraft was performed. Sample numerical solutions to the longitudinal equations for a step input in elevator deflection are presented for the Navion aircraft. From these calculations, a noted difference in angle of attack and pitch rate response can be seen for the cases of unsteady and quasi-steady aerodynamics. The apparent increase in damping effects in the aircraft response due to the unsteady aerodynamics indicate that various design constraints might be relaxed somewhat if the unsteady aerodynamics is modeled properly. GRA

N80-20241# ARO, Inc., Arnold Air Force Station, Tenn.
REAL-GAS EFFECTS ON THE AERODYNAMICS OF BLUNT CONES AS MEASURED IN A HYPERVELOCITY RANGE Final Report, Jul. 1975 - Oct. 1978

C. J. Welsh, W. R. Lawrence, and R. M. Watt AEDC Oct. 1979 29 p refs
 (AD-A075526; AEDC-TR-79-33) Avail: NTIS
 HC A03/MF A01 CSCL 20/4

A 1,000-ft hypervelocity range was used in a free-flight investigation of real-gas effects on the aerodynamics of blunted 10-deg semiangle cones. The tests were made using nitrogen and air test environments at a nominal velocity of 16,000 fps and at Reynolds number levels (based on model length and free-stream conditions) of about 400,000 and 2,000,000. Measurements indicate appreciable real-gas effects in the center-of-pressure and moment data. A discussion is also included of a new data reduction procedure devised to reduce nonlinear static stability data from small amplitude nonlinear motion histories. GRA

N80-20242# SRI International Corp., Menlo Park, Calif. Aviation Systems Lab.

AIRBORNE AIDS FOR COPING WITH LOW-LEVEL WIND SHEAR. ALL-WEATHER LANDING SYSTEMS, ENGINEERING SERVICES SUPPORT PROJECT, TASK 2 Final Report, Jun. 1975 - Jul. 1979

W. H. Foy Jul. 1979 103 p refs
 (Contract DOT-FA75WA-3650; SRI Proj. 4364)
 (AD-A080589; FAA-RD-79-117) Avail: NTIS
 HC A06/MF A01 CSCL 01/2

The development and testing of airborne displays, instrumentation, and procedures for aiding an airline jet transport pilot to cope with wind shear on approach and landing and on takeoff were studied. The task involved analysis of wind shear effects, development of wind models including shear and turbulence, specification of displays and instrument models, and conduct of six large scale piloted flight simulation exercises. A set of candidate standard wind shear models was developed. The beneficial effects of training in a moving base simulator were noted. Tests on the pilot aiding systems were conducted on both wide bodied (DC-10) and nonwide bodied (B-727) aircraft. The aiding systems tested included approach management

techniques, go around decision aids, techniques for assisting the pilot during the go around maneuver, and head up displays. The operational and technical role of head up displays during flight operations with wind shear is emphasized. A.W.H.

N80-20243# SRI International Corp., Menlo Park, Calif.
DEVELOPMENT OF WIND SHEAR MODELS AND DETERMINATION OF WIND SHEAR HAZARDS Interim Report, Apr. - Nov. 1977

D. W. Ellis and M. G. Keenan Jan. 1978 96 p refs
 (Contract DOT-FA75WA-3650; SRI Proj. 4364)
 (AD-A080588; FAA-RD-79-119) Avail: NTIS
 HC A05/MF A01 CSCL 01/2

Mathematically modeled and measured wind data represented as a function of both aircraft altitude and distance were flown with a fast-time computer model piloted by an idealized controller. The wind models and the runway position relative to each wind field were systematically varied to produce a number of different wind profiles. Relative comparisons of wind profile severity were made, based on aeronautical system performance in the computer. Potentially hazardous wind profiles were identified, and their relative severity designated as low, moderate, or high for purposes of piloted simulator tests. The piloted simulation results were used to verify the severity ratings. Effects of wind shear on aircraft are illustrated using simplified examples and then correlated with wind profile characteristics. Wind profile design techniques and implementation methods are discussed, and a set of candidate standard wind profiles is recommended. The results of the wind shear hazard determination indicate that the severity of a wind shear encounter is dependent on the position and alignment of the approach path with respect to the wind field and on the timing of the encounter, and that both wind shear in the vertical wind component and wind shear in the longitudinal wind component can produce a hazardous condition. High severity wind shear is also found to be hazardous on takeoff. J.M.S.

N80-20244# Atmospheric Science Associates, Bedford, Mass.
AIRFLOW EFFECTS ON RIMING MEASUREMENTS BY A WING TIP-MOUNTED ICE DETECTOR ON THE MC130E RESEARCH AIRPLANE Final Report, 1 Mar. - 31 Aug. 1979

Hillyer G. Norment 24 Aug. 1979 42 p refs
 (Contract F19628-79-M-0006; AF Proj. 6670)
 (AD-A077019; AFGL-TR-79-0194) Avail: NTIS
 HC A03/MF A01

Sampling efficiencies for water drops in the diameter range 10 to 7000 microns are calculated theoretically at four proposed mounting sites for an icing indicator instrument on the wing tip of the AFGL MC130E airplane. Significant flux distortion of droplets in the diameter range 10 to 100 microns is indicated at all four sites. Sensitivity to angle-of-attack of the airplane also is found, and a nose-up angle-of-attack of at least 4 deg is recommended. Additional separation of the sensor probe from the wing tip surface of as little as one-half inch is indicated to substantially ameliorate the sampling problems. To obtain the sampling efficiencies, trajectories were calculated with use of a three-dimensional flow code that ignores effects of lift vorticity. Exploratory calculations with a similar code that includes lift indicate that the results obtained with the non-lifting flow are optimistic. GRA

N80-20245# Army Command and General Staff Coll., Fort Leavenworth, Kansas.

F-4 PHANTOM AIRCREW SURVIVAL EQUIPMENT EVALUATION M.S. Thesis Final Report

William Edgar Lindsay 8 Jun. 1979 120 p refs
 (AD-A076330) Avail: NTIS HC A06/MF A01 CSCL 06/7

The F-4 Phantom aircraft is equipped with an ejection seat which has space provided in a seat kit for the carriage of aircrew survival equipment. This study evaluated the utilization of this space and the equipment available for inclusion in this kit. The space is not being filled with appropriate equipment in many instances because the required density of the packed kit is too great, requiring local units to pack lead shot instead of survival equipment. The survival equipment available to the aircrew in the seat kit is generally of good quality and sound theoretical

design. However, there are many areas in which the equipment has not been redesigned to use current technology and thus provide more and better equipment in a smaller space. Additionally, the average survival kit lacks the cold weather survival protective equipment required to sustain the downed aircrew member. This study contains specific recommendations for equipment redesign and selection for the F-4 survival seat pack. GRA

N80-20246# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
DEVELOPMENT OF A BIRD/AIRCRAFT STRIKE HAZARD ASSESSMENT METHODOLOGY M.S. Thesis

Jeffrey M. Jorgensen and Kent G. Smith Sep. 1979 80 p refs
(AD-A075584; AFIT-LSSR-10-79B) Avail: NTIS HC A05/MF A01 CSCL 13/12

This thesis effort was an attempt to identify a managerial tool that could be used to make decisions when comparing alternative methods of reducing bird/aircraft strike hazards. The general theory was that there should be certain identifiable factors present on a base that affect the probability of a bird/aircraft strike. A relationship was developed by using information from several bases which related to their environment and aircraft operating procedures. Using multiple linear regression, a model was developed to explain how the base's strike rate is affected by these factors. The effort resulted in several conclusions and recommendations that could be used in further research efforts in this area of utmost importance to the Air Force. GRA

N80-20247# National Weather Service, Silver Spring, Md. Techniques, Development Lab.

NOWCAST AND SHORT-RANGE (0-2 HOUR) FORECASTS OF THUNDERSTORMS AND SEVERE CONVECTIVE WEATHER FOR USE IN AIR TRAFFIC CONTROL Final Report, Apr. 1978 - Nov. 1979

Mikhail A. Alaka, Robert C. Elvander, and Robert E. Saffle Nov. 1979 41 p refs
(Contract DOT-FA78WAI-886; FAA Proj. 152-461-01)
(AD-A080426; FAA-RD-79-98) Avail: NTIS HC A03/MF A01 CSCL 17/7

The development of improved automated techniques for monitoring and forecasting thunderstorms and severe local convective weather at and around air terminals is discussed. The products being developed are intended primarily for air traffic controllers. Weather radars with automatic signal digitizing capability are evaluated. The radar data processor (RADAP) which includes a minicomputer, color graphic and alphanumeric display devices, and communication ports is highlighted in the evaluation. The project D/RADEX (digitized radar experiment) is described. The D/RADEX network offers an interim means to develop and evaluate radar data processing techniques that are aimed for RADAP implementation. A.W.H.

N80-20248# SRI International Corp., Menlo Park, Calif.
INERTIALLY AUGMENTED APPROACH COUPLERS Final Report, Jun. 1975 - Jun. 1979

D. A. Tiedeman, F. B. Benson, L. V. Miller, R. J. Rudig, T. J. Schuldt, C. P. Shih, and E. D. Skelley Jun. 1979 131 p refs
(Contract DOT-FA75WA-3650; SRI Proj. 4364)
(AD-A080488; FAA-RD-79-118) Avail: NTIS HC A07/MF A01 CSCL 01/2

The results of a series of engineering design studies and tests of methods for acceleration augmentation of airplane control systems for approach and landing are presented. Emphasis is on the use of body-mounted accelerometers, which are reasonably inexpensive. Control laws were developed for several aircraft (CV-880, DC-10, B-727) and tested by simulation with both automatic and human pilots and include automatic landing systems, flight director with full ILS, and flight director for nonprecision approach. The modified flight director (MFD) control algorithms (pitch, roll, and thrust) were also tested in large-scale piloted flight simulations. Approach and landing performance on Category 1 and 2 ILS beams comparable to that with current systems on Category 3 beams was achieved along with improved performance over current systems in coping with low level wind

shear. Performance comparable to that attainable with an expensive full inertial navigation system was demonstrated.

J.M.S.

N80-20249# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.
IMPROVED SUN-SENSING GUIDANCE SYSTEM FOR HIGH-ALTITUDE AIRCRAFT Patent Application

Robert D. Reed, inventor (to NASA) Filed 12 Mar. 1980 17 p
(NASA-Case-FRC-11052-1; US-Patent-Appl-SN-129783) Avail: NTIS HC A02/MF A01 CSCL 17G

A Sun sensing guidance system for high altitude aircraft is described. The system is characterized by a disk shaped body mounted for rotation aboard the aircraft in exposed relation to solar radiation and has a plurality of mutually isolated chambers. The photosensors are arranged in facing relation with the chamber openings for receiving incident solar radiation and responsively providing a voltage output. The photosensors are connected in a paired relation through a bridge circuit for providing heading error signals in response to detected imbalances in intensities of solar radiation incident on the photosensors of either pair of photosensors until a nulled relationship is achieved for the disk to the source of radiation. NASA

N80-20252# Electronics Engineering Group (1842nd), Scott AFB, Ill. TRACALS/Electronics Systems Branch.

COMPUTER MODELING OF TERRAIN EFFECTS ON INSTRUMENT LANDING SYSTEM (ILS) GLIDE SLOPE SYSTEMS

James A. Baggett 15 Nov. 1979 30 p refs
(AD-A078228; Rept-1842-EEG/EEITN-TR-80-2) Avail: NTIS HC A03/MF A01 CSCL 17/7

This report describes the two major components of an instrument landing system (ILS); the localizer, which provides horizontal guidance, and the glide slope, which provides vertical guidance. GRA

N80-20254# Army Communications-Electronics Combat Developments Agency, Fort Huachuca, Ariz.

STANDARD ENGINEERING INSTALLATION PACKAGE AN/TSQ-117, AIRCRAFT CONTROL CENTRAL Final Report

31 Oct. 1979 73 p
(AD-A079776; USACEIA-SEIP-027) Avail: NTIS HC A04/MF A01 CSCL 17/7

This standard engineering installation package assists project officers, logisticians, engineers, and technicians to program, procure, engineer, and install the AN/TSQ-117. The document provides a system description with prerequisites that are essential for effective implementation of the AN/TSQ-117. The document also provides the necessary drawings, bill of materials, and quality assurance. GRA

N80-20255# Systems Research Labs., Inc., Dayton, Ohio.
AIRBORNE ELECTRONIC TERRAIN MAP SYSTEM: A LITERATURE REVIEW

Gilbert G. Kuperman (AMRL) and Anthony J. DeFrances Wright-Patterson AFB, Ohio AMRL Oct. 1979 59 p refs
(Contract F33615-79-C-0503; AF Proj. 7184; AF Proj. 2003)
(AD-A079402; AMRL-TR-79-92) Avail: NTIS HC A04/MF A01 CSCL 17/7

Currently, the United States Air Force is placing significant emphasis on low-altitude high-speed profiles for tactical aircraft survivability. In order to execute these terrain avoidance profiles, pilots require an efficient and credible source of terrain relief information for both accurate and safe navigation and to alleviate the high workload associated with the primary pilotage function. This report highlights many of the limitations of current airborne sources of cartographic information and describes a viable alternative--the Airborne Electronic Terrain Map System (AETMS). The AETMS consists of an in-the-cockpit, computer-generated, wide-area terrain map display, capable of providing forward-looking perspective and/or planimetric information. Because of the large integrated data base, real-time information source for many mission segments is provided. The system is totally

self-contained and passive, which precludes the possibility of jamming and reduces detection probability. GRA

N80-20258# Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.

OPTIMAL FLOW CONTROL OF AIR TRAFFIC Final Report
William J. Dunlay, Jr. and W. Bruce Allen Aug. 1979 155 p refs

(Contract DOT-OS-70065)
(PB80-105976; DOT-DPA-RSPA-50-79/15) Avail: NTIS HC A08/MF A01 CSCL 17G

Flow control procedures for air traffic initiated during periods of unusually high demand or low capacity are discussed. Aspects of flow control which are addressed include forecasting of demand and capacity, forecasting of congestion, and assignment of delays and landing and departure priorities. In particular, the demand capacity-buffer relationship is explored, with emphasis on improvement of forecasts and evaluation of their accuracy. It is shown that buffer size, which represents the excess number of aircraft in the airspace due to delays, can be estimated recursively and then forecasted on the basis of arrival forecasts and the number of landings recorded. Regression analysis is used to describe and predict flow rates of arrivals and departures. GRA

N80-20260*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THE ROLE OF TECHNOLOGY AS AIR TRANSPORTATION FACES THE FUEL SITUATION

Cornelius Driver Mar. 1980 15 p Presented at Upper Midwest Council, Minneapolis, 1 Nov. 1979
(NASA-TM-81793) Avail: NTIS HC A02/MF A01 CSCL 01C

Perspectives on the air transportation fuel situation are discussed including intercity air traffic, airline fuel consumption, fuel price effects on ticket price, and projected traffic and fuel usage between now and the year 2000. Actions taken by the airlines to reduce consumption are reviewed, as well as efforts currently underway to improve fuel consumption. Longer range technology payoffs resulting from NASA research programs are reviewed and results from studies on the use of alternate fuels are discussed. A.W.H.

N80-20261*# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.

A SINGULAR PERTURBATION ANALYSIS OF MINIMUM TIME LONG RANGE INTERCEPT Final Report

Anthony J. Calise Jan. 1980 50 p refs
(Grant NsG-1496)

(NASA-CR-162895) Avail: NTIS HC A03/MF A01 CSCL 01C

The application of singular perturbation theory for deriving algorithms suitable for on board real time computation of optimal aircraft trajectory control was investigated. Minimum time intercept in three dimensions was selected as a pilot problem formulation, and data for an early version F-4 aircraft was used to represent aircraft aerodynamic and propulsion characteristics. Results include the derivation of nonlinear, near optimal feedback control laws that are readily implementable in an aircraft flight computer, performance results for a variety of initial conditions (including optimal intercept at short ranges), and a point mass three dimensional simulation suitable for representing fighter aircraft under closed loop optimal control. J.M.S.

N80-20262# Bell Helicopter Co., Fort Worth, Tex.
ROTORCRAFT FLIGHT SIMULATION, COMPUTER PROGRAM C81. VOLUME 3: PROGRAMMER'S MANUAL Final Report, Nov. 1976 - Aug. 1977

P. Y. Hsieh Oct. 1979 91 p
(Contract DAAJ02-77-C-0003; DA Proj. 1L2-62209-AH-76)
(AD-A077345; BHT-699-099-062-Vol-3; USARTL-TR-77-54C)
Avail: NTIS HC A05/MF A01 CSCL 01/3

This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron. This current version of the digital computer program is referred to as AGAJ77.

The accompanying program for calculating fully coupled rotor blade mode shapes is called DNAM05, and the rotor wake program is called AR9102. The first volume, the Engineer's Manual, presents an overview of the computer program capabilities plus discussions for the background and development of the principal mathematical models in the program. The models discussed include all those currently in the program. Volume 2, the User's Manual, contains the detailed information necessary for setting up an input data deck and interpreting the computed data. Volume 3, the Programmer's Manual, includes a catalog of subroutines and a discussion of programming considerations. The source tapes and related software for the computer programs documented in this report are unpublished data on file at the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia.

GRA

N80-20263# Northrop Corp., Hawthorne, Calif. Aircraft Group.

ADVANCED FIREFLY ASSESSMENT GENERALIZED MECHANIZATION REQUIREMENTS REPORT Interim Report, 25 Oct. 1978 - Feb. 1979

S. J. Asseo Wright-Patterson AFB, Ohio AFAL Jun. 1979 112 p refs

(Contract F33615-78-C-1503; AF Proj. 7629)
(AD-A079752; AFAL-TR-79-1092) Avail: NTIS HC A06/MF A01 CSCL 19/5

The requirements for the design of the Generalized Mechanization of the FIREFLY concept of Integrated Fire and Flight Control to be implemented in a digital simulation has been completed. This generalized mechanization consists of a set of equations, algorithms, and control laws capable of being programmed into an airborne digital computer which can be specialized to perform successfully in a variety of tactical aircraft with differing avionics sensors, fire control algorithms, control laws, flight control systems, and weapon delivery modes. The document first addresses the scope of the requirements analysis followed by a description of the analysis done in deriving the requirements of the generalized mechanization. Finally, the requirements are summarized in a section discussing them explicitly in relation to their place in the overall fire control system. A discussion of the work done on the FIREFLY 2 familiarization and initial analysis of two of the potential advanced concepts for evaluation is contained in the appendices. GRA

N80-20264# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.

EVALUATION OF PACKAGING FOR THE CN-1325/ASN-108 AHRS DISPLACEMENT GYRO, F-15 AIRCRAFT Final Report

Frank C. Jarvis Sep. 1979 17 p
(AD-A078707; PTPT-79-15) Avail: NTIS HC A02/MF A01 CSCL 13/4

The packaging evaluation of the CN-1325/ASN-108 AHRS Displacement Gyro (F-15) revealed that the pack is not adequate to provide the 15 G shock protection level required for this item. The field tests confirmed the laboratory results which produced a maximum impact force of 21 Gs. A prototype pack with corner pad cushion inserts was evaluated and found to be suitable as an interim or a permanent replacement for packaging this item. GRA

N80-20265# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION, AH-1G WITH THE AIRBORNE TARGET ACQUISITION FIRE CONTROL SYSTEM AND THE HELLFIRE MODULAR MISSILE SYSTEM INSTALLED Final Report, Jun. 1978 - Jan. 1979

Patrick J. Moe and Raymond B. Smith Jul. 1979 43 p refs
(AD-A078340; USAAEFA-78-02) Avail: NTIS HC A03/MF A01 CSCL 19/5

The AH-1G helicopter with the HELLFIRE modular Missile System (HMMS) and the Airborne Target Acquisition Fire Control System (ATAFCS) is being used as a surrogate trainer for the YAH-64 helicopter. The United States Army Aviation Engineering

Flight Activity was tasked to provide quantitative and qualitative data on the handling qualities of the helicopter, obtain limited level flight performance data, and obtain limited handling qualities of the helicopter with only the ATAFCS installed. The test helicopter was a production AH-1G helicopter (212 tail rotor) modified with an ATAFCS mockup and carrying eight HELLFIRE missiles. Six productive flight test hours were flown in six flights. No shortcomings or deficiencies attributable to HMMS and ATAFCS installation were found. The AH-1G helicopter, with HMMS and ATAFCS installed, exhibits an additional equivalent flat plate area of 4.0 sq ft compared to the standard AH-1Q helicopter. The handling qualities of the helicopter with only the ATAFCS installed are essentially the same as the production AH-1G helicopter. GRA

N80-20266# Hughes Aircraft Co., Los Angeles, Calif. Display Systems Lab.

DEVELOPMENT OF A COLOR ALPHANUMERIC LIQUID CRYSTAL DISPLAY Final Report, 1 Oct. 1977 - 20 May 1979

J. E. Gunther Warminster, Pa. NADC Dec. 1979 39 p refs (Contract N62269-77-C-0477) (AD-A079289; HAC-E0122; HAC-P90440; NADC-77212-30) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report encompasses efforts directed toward the development of a multicolor liquid crystal display suitable for aircraft command and control applications. The approach taken was to combine a striped, color-selective filter with previously developed matrix liquid crystal display technology. Two 1.75 x 1.75 inch displays and one set of LSI drive circuits were constructed. The displays provided 100 elements per inch horizontal resolution and 33 elements per inch vertical resolution, with each vertical element consisting of a red-green-blue triad. While the optical performance of the displays was limited, sufficient information was gained to ensure adequate viewability in subsequent designs. GRA

N80-20267# Arinc Research Corp., Annapolis, Md. **MECHANIZATION ARCHITECTURE FOR ENHANCEMENT OF AVIONICS PLANNING DATA BASE Final Report**

S. Cotton and R. Gilbertson Sep. 1979 170 p (Contract F33657-79-C-0567) (AD-A075572; Rept-1750-01-1-2024) Avail: NTIS HC A08/MF A01 CSCL 05/2

This report presents the design of an enhancement to the mechanized version of the Avionics Planning Baseline (APB). For each Air Force aircraft, the APB records the force structure (for a 15-year period), the avionics suite, all present and planned modifications to the avionics suite, all class 4 and class 5 of those modifications, and all ROC/SON/GOR statements dealing with avionics requirements. GRA

N80-20268# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A STUDY OF TWO AVIONICS LIFE CYCLE COST MODELS AND THEIR APPLICABILITY IN THE COMMUNICATIONS-ELECTRONICS-METEOROLOGICAL ENVIRONMENT M.S. Thesis

Nicholas J. Drobot and Martin H. Johnson Sep. 1979 159 p refs (AD-A076981; AFIT/GSM/SM/79S-5) Avail: NTIS HC A08/MF A01 CSCL 14/1

This study determines the applicability of Life Cycle Cost (LCC)/Logistic Support Cost (LSC) models in the CEM environment. The scope of this study addresses two of the models identified (LSC, PRICE) with respect to three Air Force TACAN systems. A methodology is developed to evaluate each model based on the five desirable model characteristics: availability of input data, validity, sensitivity, completeness, and documentation. The results presented are also framed within the above model characteristics. The most important model characteristic, validity, is accessed by comparison with an AFCS cost study of NAVAIDS equipment. Based on the methodology, the results indicate that both models are applicable in the present and future CEM environment. GRA

N80-20269# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN OPERATING AND SUPPORT COST MODEL FOR AVIONICS AUTOMATIC TEST EQUIPMENT M.S. Thesis
Joel A. Guerra, Andrew J. Lesko, and Jose G. Pereira Sep. 1979 181 p refs (AD-A075586; AFIT-LSSR-21-79B) Avail: NTIS HC A09/MF A01 CSCL 14/1

One of the fastest growing elements of weapon system support equipment which relates directly to Operating and Support (O and S) costs is Automatic Test Equipment (ATE). The importance of ATE has expanded to such a degree that it requires additional management attention. The importance is exemplified by the \$600 million projected development and acquisition costs of ATE for the F-16. This amount of cost qualifies the F-16 ATE for major program status. This thesis documents the development of a model to estimate and measure O and S costs for Avionics ATE. The model will be an important addition to the tools used in ATE Life Cycle Costing (LCC) techniques. It is envisioned primarily as an evaluation tool to be used in ATE source selection, but may also be useful in various design trade-off studies. GRA

N80-20270# National Aviation Facilities Experimental Center, Atlantic City, N. J.

EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT-AIRCRAFT TELEDYNE CONTINENTAL MOTORS (TCM) GTSIO-520-K PISTON ENGINE Final Report

Eric E. Becker Dec. 1979 94 p refs (FAA Proj. 201-521-100) (AD-A080433; FAA-NA-79-40) HC A05/MF A01 CSCL 21/7

General aviation piston engine exhaust emission tests were conducted to determine and establish total exhaust emission characteristics for a GTSIO-520-K engine. The engine is described along with the fuel flow system and the air cooling system. The test set up, procedures, and facilities are described and the computation procedures are presented. The results are summarized for the exhaust emissions, the maximum cylinder head temperatures, and the critical landing and takeoff cycle. A.W.H.

N80-20271# Teledyne Continental Motors, Muskegon, Mich. **A 150 AND 300 kW LIGHTWEIGHT DIESEL AIRCRAFT ENGINE DESIGN STUDY Final Report**

Alex P. Brouwers Apr. 1980 149 p refs (Contract NAS3-20830) (NASA-CR-3260; Rept-756) Avail: NTIS HC A07/MF A01 CSCL 21A

The diesel engine was reinvestigated as an aircraft powerplant through design study conducted to arrive at engine configurations and applicable advanced technologies. Two engines are discussed, a 300 kW six-cylinder engine for twin engine general aviation aircraft and a 150 kW four-cylinder engine for single engine aircraft. Descriptions of each engine include concept drawings, a performance analysis, stress and weight data, and a cost study. This information was used to develop two airplane concepts, a six-place twin and a four-place single engine aircraft. The aircraft study consists of installation drawings, computer generated performance data, aircraft operating costs, and drawings of the resulting airplanes. The performance data show a vast improvement over current gasoline-powered aircraft. R.E.S.

N80-20272*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECT OF WATER INJECTION AND OFF SCHEDULING OF VARIABLE INLET GUIDE VANES, GAS GENERATOR SPEED AND POWER TURBINE NOZZLE ANGLE ON THE PERFORMANCE OF AN AUTOMOTIVE GAS TURBINE ENGINE

Edward L. Warren Mar. 1980 35 p (Contract EC-77-A-31-1040) (NASA-TM-81415; E-333; DOE/NASA/1040-80/10) Avail: NTIS HC A03/MF A01 CSCL 21E

The Chrysler/ERDA baseline automotive gas turbine engine was used to experimentally determine the power augmentation and emissions reductions achieved by the effect of variable

compressor and power engine geometry, water injection downstream of the compressor, and increases in gas generator speed. Results were dependent on the mode of variable geometry utilization. Over 20 percent increase in power was accompanied by over 5 percent reduction in SFC. A fuel economy improvement of at least 6 percent was estimated for a vehicle with a 75 kW (100 hp) engine which could be augmented to 89 kW (120 hp) relative to an 89 Kw (120 hp) unaugmented engine. Author

N80-20273*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.

ALTERNATIVES FOR JET ENGINE CONTROL Semiannual Status Report, 1 Sep. 1979 - 29 Feb. 1980

Michael K. Sain 1980 93 p refs

(Grant NsG-3048)

(NASA-CR-162911) Avail: NTIS HC A05/MF A01 CSCL 21E

Nonlinear modeling researches involving the use of tensor analysis are presented. Progress was achieved by extending the studies to a controlled equation and by considering more complex situations. Included in the report are calculations illustrating the modeling methodology for cases in which variables take values in real spaces of dimension up to three, and in which the degree of tensor term retention is as high as three. R.E.S.

N80-20274*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

JT9D-7A (SP) JET ENGINE PERFORMANCE DETERIORATION TRENDS

G. Paul Richter, W. J. Olsson, and N. B. Andersen 1980 24 p ref Presented at the Intern. Aircraft Maintenance Eng. Exhibition and Conf., Dallas, 8-10 Apr. 1980; sponsored by Hamilton Burr Publishing Co. Prepared in cooperation with Pratt and Whitney Aircraft Group, East Hartford, Conn. and Pan American World Airways, Inc., Jamaica, N.Y.

(NASA-TM-81459; E-388) Avail: NTIS HC A02/MF A01 CSCL 21E

The levels, trends, and causes of engine performance deterioration were investigated. A series of installed engine calibrations (both on-the-ground and in-flight) were performed on two new Pan American World Airways 747 SP aircraft. The performance data gathered covered from before the first flight through approximately 1000 flight cycles and 6900 flight hours. To accomplish the calibrations a special instrumentation system for ground testing of installed engines over a broad power range was used along with performing concurrent in-flight engine calibrations under revenue service conditions. Results of the analysis of the data, which provide a better understanding of short and long term performance deterioration of both engines and modules are presented. J.M.S.

N80-20275*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

OPTIMUM SUBSONIC, HIGH-ANGLE-OF-ATTACK NACELLES

Roger W. Luidens, Norbert O. Stockman, and James H. Diedrich [1979] 20 p refs Prepared for the 12th Congr. of the Intern. Council of the Aeron. Sci., Munich, 13-17 Oct. 1980 and the 1980 Aerospace Congr. and Exposition, Los Angeles, 13-16 Oct. 1980; sponsored by the Soc. of Automotive Engr.

(NASA-TM-81491; E-406) Avail: NTIS HC A02/MF A01 CSCL 21E

The optimum design of nacelles that operate over a wide range of aerodynamic conditions and their inlets is described. For low speed operation the optimum internal surface velocity distributions and skin friction distributions are described for three categories of inlets: those with BLC, and those with blow in door slots and retractable slats. At cruise speed the effect of factors that reduce the nacelle external surface area and the local skin friction is illustrated. These factors are cruise Mach number, inlet throat size, fan-face Mach number, and nacelle contour. The interrelation of these cruise speed factors with the design requirements for good low speed performance is discussed. J.M.S.

N80-20276# Naval Ship Research and Development Center, Bethesda, Md.

FEASIBILITY STUDY OF AN ISOLATED REVERSE-TURBINE SYSTEM FOR GAS TURBINE ENGINES

Thomas L. Bowen Dec. 1979 133 p refs

(SF43432301)

(AD-A077898; DTNSRDC-79/033)

Avail: NTIS

HC A07/MF A01 CSCL 21/5

Aircraft gas turbine engines, as now configured for ship propulsion, are unidirectional in output rotation and, therefore, require the added complexity of a reversing transmission or a reversible-pitch propeller. This study explores the feasibility of a novel reverse-turbine concept which is configured to adapt to existing free-power turbine engines without additional clutches or separate drive trains. This device, termed the 'isolated reverse turbine', is sized for meeting that most demanding maneuver for a fixed-pitch propeller-driven frigate or destroyer, namely, the crash reversal maneuver. The reverse-turbine concept would replace the function of the reversing gear or the reversible-pitch propeller; it could also complement electrically actuated reverse transmissions by eliminating the need for braking resistors and switches. Because of the potentially wide applicability of this reverse-turbine concept, it is recommended that additionally substantiating data be obtained to demonstrate the practicality of required hardware components. Full-scale development is not recommended at this time because the status of the above-mentioned alternatives has not been fully evaluated. GRA

N80-20277# Iowa State Univ. of Science and Technology, Ames, Engineering Research Inst.

AERODYNAMICS OF ADVANCED AXIAL-FLOW TURBOMACHINERY Annual Report, 1 Oct. 1978 - 30 Sep. 1979

G. K. Serovy, Patrick Kavanaugh, Theodore H. Okiishi, and Elmer C. Hansen Nov. 1979 52 p refs

(Contract F49620-79-C-0002; AF Proj. 2307)

(AD-A079617; ISU-ERI-AMES-80060; TCRL-14;

AFOSR-79-1325TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

A multi-task research program on aerodynamic problems in advanced axial-flow turbomachine configurations is being carried on at Iowa State University. The elements of this program are intended to contribute directly to the improvement of compressor, fan, and turbine design methods. Experimental efforts in intrapassage flow pattern measurement, unsteady blade row interaction, and control of secondary flow are included, along with computational work on inviscid-viscous interaction blade passage flow techniques. This first Annual Report summarizes progress to date and indicates the direction of each task for the immediate future. GRA

N80-20278# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio, School of Engineering.

VELOCITY PROFILES IN A LONG INLET DUCT EMPLOYING A PHOTON CORRELATING LASER VELOCIMETER WITHOUT SEEDING M.S. Thesis

H. J. V. Rogers Dec. 1979 172 p refs

(AD-A079878; AFIT/GAE/AA/79D-16)

Avail: NTIS

HC A08/MF A01 CSCL 14/3

This thesis involves a practical application of the Malvern Laser Velocimeter System (LV). In this work, the LV was used to measure mean velocity profiles across the inside diameter of a duct which supplies air to the compressor of a jet engine. The engine, which is a General Electric J-85 turbo-jet engine is located in the Propulsion Laboratories of Wright-Patterson Air Force Base in Ohio. In addition to the mean velocity profiles, the LV was used to measure turbulence intensity profiles across the inside diameter of the duct at each of the three test points. To analyze the quality of the LV data as obtained, alternate mean velocity profiles and turbulence intensity profiles were obtained with the aid of a Hot Wire Anemometer System and a Pitot-Static Tube. During each of the traverses, or tests, with the LV System, the Hot Wire System and the Pitot-Static Tube, the engine was held at a fixed RPM, being 50% or 70% of maximum engine RPM. Good correlation was achieved between each of the three systems in respect to the mean velocity profiles obtained at each of the three test positions while the turbulence intensity profiles matched well in the regions of the

flow where turbulence levels of 2% to 30% were encountered.
GRA

N80-20279# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EXPERIMENTAL STUDY OF STATIC THRUST AUGMENTATION USING A 2-D VARIABLE EJECTOR M.S. Thesis
Eli Kedem Dec. 1979 97 p refs
(AD-A079857; AFIT/GAE/AA/79D-7) Avail: NTIS
HC A05/MF A01 CSCL 21/8

A short rectangular throat ejector was constructed and tested to determine the effects of a number of variables on thrust augmentation and mass augmentation. The variables included those associated with geometry (e.g., diffuser length/throat length, diffuser area ratio, diffuser sidewall angle, nozzle angles and positions) and those due to differences in primary mass flow rate distributions among the nozzles. There were two kinds of thrust augmentation that were calculated; the free thrust augmenting ratio and the isentropic thrust augmenting ratio. The free thrust augmenting ratio is the ratio of the ejector's measured thrust to the sum of the nozzles' measured thrust, if each of them were discharged separately to ambient pressure. The isentropic thrust augmenting ratio is the ratio of the ejector's measured thrust to the calculated thrust of the nozzles if discharged isentropically to the ambient pressure. A free thrust augmenting ratio as high as 1.63 and an isentropic thrust augmenting ratio of up to 1.29 were obtained. Mass augmentation which is the ratio of secondary flow to primary flow was in the range of 3.5 to 5. Some conclusions concerning design aspects were drawn also. They include the necessity of 3-D shrouding for the ejector's inlet and exit and the prevention of blowing high velocity air (primary and BLC flow) tangential to the ejector walls.
GRA

N80-20280*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
WING/STORE FLUTTER WITH NONLINEAR PYLON STIFFNESS

Robert N. Desmarais and Wilmer H. Reed, III Apr. 1980 8 p refs Presented at the AIAA/ASME/ASCE/AHS 21st Structures, Struct. Dyn. and Mater. Conf., Seattle, 12-14 May 1980 (NASA-TM-81789) Avail: NTIS HC A02/MF A01 CSCL 01C

Recent wind tunnel tests and analytical studies show that a store mounted on a pylon with soft pitch stiffness provides substantial increase in flutter speed of fighter aircraft and reduces dependency of flutter on mass and inertia of the store. This concept, termed the decoupler pylon, utilizes a low frequency control system to maintain pitch alignment of the store during maneuvers and changing flight conditions. Under rapidly changing transient loads, however, the alignment control system may allow the store to momentarily bottom against a relatively stiff backup structure in which case the pylon stiffness acts as a hardening nonlinear spring. Such structural nonlinearities are known to affect not only the flutter speed but also the basic behavior of the instability. The influence of pylon stiffness nonlinearities or the flutter characteristics of wing mounted external stores is examined.
J.M.S.

N80-20281# Perceptronics, Inc., Woodland Hills, Calif.
ADAPTIVE ESTIMATION OF INFORMATION VALUES IN CONTINUOUS DECISION MAKING AND CONTROL OF ADVANCED AIRCRAFT Final Report

Randall Steeb, Yee-Yeen Chu, Cynthia Clark, Yo Ram Alperovitch, and Amos Freedy Jun. 1979 127 p refs
(Contract F44620-76-C-0094; AF Proj. 2313)
(AD-A077917; PATR-1037-79-6; AFOSR-79-1266TR) Avail: NTIS HC A07/MF A01 CSCL 05/10

This report describes research and development centered on evaluation of information needs in advanced operations. The selection of information for display is a recurrent, subjective decision involving many factors--aircraft state, environmental conditions, operator capabilities, and acquisition costs, among others. An adaptive computer model has been developed which incorporates these factors into a multi-attribute decision model. The program is designed to capture the operator's information

seeking policy using a training algorithm based on pattern recognition techniques. The individual policy is then used for information system evaluation and for automated information management. Experimental tests of the adaptive modeling and information management approaches were made using a task simulation resembling multiple intercept operations in advanced aircraft. Individual subjects (8 in study) navigated a simulated aircraft through a hazardous, changing environment. The report includes an example application of the information management program to F-14 threat intercept operations and a set of system application guidelines.
GRA

N80-20282# Dayton Univ. Research Inst., Ohio.
DEVELOPMENT OF STABILITY METHODS FOR APPLICATIONS TO NONLINEAR AEROELASTIC OPTIMIZATION Final Report, Jan. 1978 - Jun. 1979

R. F. Taylor Jul. 1979 189 p refs
(Grant AF-AFOSR-3487-78; AF Proj. 2307)
(AD-A077851; UDR-TR-79-64; AFFDL-TR-79-3114) Avail: NTIS HC A09/MF A01 CSCL 20/4

An approximate procedure is developed which determines efficiently and accurately the amplitude-dependent stability of nonlinear systems. This new procedure, which is referred to as the 'method of imposed disturbances', is shown to be especially applicable to studies of the sensitivity of nonlinear aeroelastic systems to changes in design variables. Emphasis is placed on airfoil and panel flutter instabilities in aerodynamically nonlinear flow. To develop the theory, modified forms of the van der Pol oscillator equation and of the Lewis servomechanism equation are studied. Based on the principle of conservation of energy in a limit cycle, approximate closed-form expressions are developed which relate the loading and the limit amplitude to system design variables. Results are compared to solutions obtained by numerical integration.
GRA

N80-20283# ARO, Inc., Arnold Air Force Station, Tenn.
AIRCRAFT MOTION SENSITIVITY TO DYNAMIC STABILITY DERIVATIVES Final Report, 1 Oct. 1977 - 30 Sep. 1978

T. F. Langham AEDC, Jan. 1980 142 p refs
(AF Proj. 921E)
(AD-A079421; AEDC-TR-79-11) Avail: NTIS
HC A07/MF A01 CSCL 20/4

A six degree-of-freedom, nonlinear dynamic derivative sensitivity study has been conducted on a fighter/bomber and an attack-type aircraft. The dynamic derivatives investigated in the study were C sub lq, C sub mq, C sub mp, C sub mr, C sub l beta, and C sub n beta. For the cross-coupling derivatives, C sub lq was shown to have the most significant effect on the level and 3-g turning flight motion, followed by C sub nq and C sub mp with the derivative C sub mr showing little to negligible effect in the same regime. For the acceleration derivatives, C sub l beta was shown to have a significant influence on the aircraft motion. The C sub n beta derivative had little effect on the simulated motion. The analysis also documents the configuration dependency of the cross-coupling derivatives and investigates the effects of nonlinear variations in the derivatives on the aircraft motion.
GRA

N80-20284# Transportation Systems Center, Cambridge, Mass.
AIRPORT GROUND ACCESS Final Report

M. Gorstein, L. Frenkel, and R. Marek (FAA, Washington, D.C.)
Washington FAA Oct. 1978 371 p refs
(AD-A068974; FAA-EM-79-4) Avail: NTIS HC A16/MF A01 CSCL 01/5

Ground access to airports is studied in terms of constraints on airport capacity and air travel. Case studies of sixteen commercial airports of various sizes and locales were prepared. Specific topics discussed include: the access capacity of representative airports; whether access needs at these airports are adequately considered in the planning process; potential solutions to noted access problems; and identification of projects for consideration by local public bodies and planning authorities which may improve airport access in selected cases. A 1978 update of the ground access to airports study prepared by the Federal Highway Administration (FHWA) is included.
J.M.S.

N80-20287# Environmental Engineering Consultants, Inc., Gainesville, Fla.

AEROSOL FILTER LOADING DATA FOR A SIMULATED JET ENGINE TEST CELL AEROSOL Final Report, Jan. - Jul. 1979

Dale A. Lundgren Tyndall AFB, Fla. Air Force Engineering and Services Center Aug. 1979 44 p
(Contract F08637-79-M-0784; AF Proj. 1900)
(AD-A078779; ESL-TR-79-28) Avail: NTIS HC A03/MF A01 CSCL 21/5

The Air Force routinely tests turbine engines in fixed test cells, some of which have been cited by state pollution control officials for violations of opacity regulations. A previous theoretical study, CEEDO-TR-78-53, predicted that relatively low efficiency and low cost techniques could bring jet engine test cells into compliance with air pollution regulations. The system proposed included a water cooling spray and a mist eliminator followed by a medium efficiency, high velocity, throw-away type glass filter media. The most serious limitation of velocity filtration is the aerosol mass loading and the potential for rapid pressure drop build up across the filter. Since filter loading characteristics could not be theoretically predicted, the objective of this follow-on work was to experimentally test and report the filter loading characteristics of glass fiber filters for possible application to jet engine test cell exhaust plume opacity control. Two types of glass fiber media were tested: (1) two different medium efficiency pre-filter media; and (2) two different high efficiency final filter media. GRA

N80-20288# National Technical Information Service, Springfield, Va.

AIRFIELD PAVEMENT EVALUATION, VOLUME 4. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report

Guy E. Habercom, Jr. Jul. 1979 199 p Supersedes NTIS/PS-78/0685; NTIS/PS-77/0662; NTIS/PS-76/0581
(NTIS/PS-79/0754/6; NTIS/PS-78/0685; NTIS/PS-77/0662; NTIS/PS-76/0581) Avail: NTIS HC \$28.00/MF \$28.00 CSCL 01E

Durability, wear resistance, skid resistance, and surface qualities of airfield pavement structures are analyzed and evaluated. This updated bibliography contains 187 abstracts, 3 of which are new entries to the previous edition. GRA

N80-20317*# Bionetics Corp., Hampton, Va.
THE VULNERABILITY OF COMMERCIAL AIRCRAFT AVIONICS TO CARBON FIBERS

Jerome A. Meyers and Seymour Salmirs Hampton, Va. NASA Langley Res. Center Apr. 1980 50 p refs
(Contract NAS1-15238)
(NASA-CR-159213) Avail: NTIS HC A03/MF A01 CSCL 11D

Avionics components commonly used in commercial aircraft were tested for vulnerability to failure when operated in an environment with a high density of graphite fibers. The components were subjected to a series of exposures to graphite fibers of different lengths. Lengths used for the tests were (in order) 1 mm, 3 mm, and 10 mm. The test procedure included subjecting the equipment to characteristic noise and shock environments. Most of the equipment was invulnerable or did not fail until extremely high average exposures were reached. The single exception was an air traffic control transponder produced in the early 1960's. It had the largest case open area through which fibers could enter and it had no coated boards. K.L.

N80-20340*# Massachusetts Inst. of Tech., Cambridge. Sloan Automotive Lab.

COMBUSTION AND OPERATING CHARACTERISTICS OF SPARK-IGNITION ENGINES Final Report, Jan. 1979 - Jan. 1980

John B. Heywood, James C. Keck, Gian Paolo Beretta, and Paula A. Watts 28 Mar. 1980 13 p refs
(Grant NsG-3245)
(NASA-CR-162896) Avail: NTIS HC A02/MF A01 CSCL 21B

The spark-ignition engine turbulent flame propagation cycle was investigated. Then, using a spark-ignition engine cycle simulation and combustion model, the impact of turbocharging

and heat transfer variations or engine power, efficiency, and NO sub x emissions was examined. R.E.S.

N80-20341# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.

THE STRUCTURE OF EDDIES IN TURBULENT FLAMES, VOLUME 1

Norman A. Chigier and Andrew J. Yule Mar. 1979 104 p refs Prepared in cooperation with Sheffield Univ., England
(Contract N00014-75-C-1143; Proj. SQUID)
(AD-A078625; SQUID-US-1-PU-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 21/2

High frequency response measurement techniques are used with data processing and conditional sampling to measure large eddy structure and coherence in the transitional flow region of turbulent diffusion flames. Comparisons are made between nonburning and burning flow conditions; these show physical similarity for cold and burning flows in the transitional region. Flow visualization shows quasi-laminar interface layers which are distorted, stretched and convoluted by vortex interactions. High-speed Schlieren color movies show axisymmetric wave and vortex ring formation. Velocity, temperature and ionization density measurements show that the transitional flow and the potential core of the jet are much longer in the flame than in the nonburning jet. A marked difference is found between the initial fundamental instability frequencies of the shear layers; the most amplified frequency predicted by stability theory for cold inviscid flow is found in the cold jet but not the flame. Increase in viscosity due to heat release causes delay and damping of the processes of vortex formation and coalescence; dilatation and buoyancy forces also contribute to differences between the flame and cold jet. Large eddies are shown to play an important role in the transitional region of turbulent jet flames. GRA

N80-20398*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

COMPOSITE WALL CONCEPT FOR HIGH TEMPERATURE TURBINE SHROUDS: SURVEY OF LOW MODULUS STRAIN ISOLATOR MATERIALS

Robert C. Bill, Gordon P. Allen, and Donald W. Wisander Mar. 1980 27 p refs Presented at the 25th Ann. Intern. Gas Turbine Conf., New Orleans, 9-13 Mar. 1980; sponsored by ASME Prepared in cooperation with Army Aviation Research and Development Command, Cleveland
(NASA-TM-81443; AVRADCOM-TR-80-C-7; E-363) Avail: NTIS HC A03/MF A01 CSCL 11A

Plasma sprayed yttria stabilized zirconium oxide turbine seal specimens, incorporating various low modulus porous metal strain isolator pads between the zirconium oxide and a dense metal substrate, were subjected to cyclic thermal shock testing. Specimens that had a low modulus pad composed of sintered FeNiCrAlY fibermetal survived 1000 thermal shock cycles without spalling of the ceramic. A figure of merit for the low modulus pad materials taking into consideration the elastic modulus, thermal conductivity, strength, and oxidation resistance of the pad was proposed, and showed reasonable agreement with the thermal shock results. A potential surface distress problem on the zirconium oxide, associated with nonuniform temperature distribution and rapid stress relaxation was identified. One approach to solving the surface distress problem through application of laser surface fusion of the zirconium oxide layer showed some promise, but improvements in the laser surface fusion process are necessary to prevent process associated damage to the ceramic. K.L.

N80-20399# ARO, Inc., Arnold Air Force Station, Tenn.
THERMAL RESPONSE AND REUSABILITY TESTS OF ADVANCED FLEXIBLE REUSABLE SURFACE INSULATION (RSI) AND CERAMIC TILE RSI SAMPLES AT SURFACE TEMPERATURES TO 1200 DEGREES F Final Report
E. C. Knox AEDC, Arnold AFS, Tenn. May 1979 46 p refs
(AD-A077887; AEDC-TSR-79-V29) Avail: NTIS HC A03/MF A01 CSCL 20/13

The surface analysis of anodes and cathodes from phosphoric acid electrolytes by ion scattering spectrometry (ISS) and secondary ion spectrometry (SIMS) shows that contamination

can occur under a variety of conditions. Contamination can occur both during and after anodization and either with or without the electrodes connected. These results point up the dynamic and ever changing character of the anodization process and suggests reasons for poor reproducibility of oxide chemistry and morphology. GRA

N80-20405# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

EVALUATION OF FUEL CHARACTER EFFECTS ON THE F101 ENGINE COMBUSTION SYSTEM Final Report, 1 Aug. 1977 - 30 Sep. 1978

O. C. Gleason, T. L. Oller, M. W. Shayeson, and D. W. Bahr Jun. 1979 200 p refs
(Contract F33615-77-C-2043; AF Proj. 3048)
(AD-A077860; R79AEG405; AFAPL-TR-79-2018; CEEDO-TR-79-07) 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 General Electric F101 augmented turbofan engine main combustion system are presented. Combustor rig tests conducted at engine idle, takeoff, cruise, dash, cold day ground start and altitude relight operating conditions with 13 different fuels are described. Fuel nozzle fouling tests conducted with the same fuels are also described. The test fuels covered a range of hydrogen contents (12.0 to 14.5%), aromatic type (monocyclic and bicyclic), initial boiling point (285 to 393 K), final boiling point (552 to 679 K) and viscosity (0.83 to 3.25 millimeters²/s at 300 K). At high power conditions, fuel hydrogen content was found to have a very significant effect on liner temperature, smoke, and NO_x levels. While smoke levels decreased with increasing hydrogen content, the levels were very low with all the fuels. At idle conditions, CO and HC levels correlated with fuel atomization/volatility parameters, but showed no relationship to hydrogen content. Cold day ground start and altitude relight also correlated with fuel atomization/volatility parameters, but showed no dependence on hydrogen content. Combustor liner life analyses yielded relative life predictions of 1.00, 0.72, 0.52, and 0.47 for fuel hydrogen contents of 14.5, 14.0, 13.0, and 12.0 percent, respectively. At the present state of turbine stator development, no fuel effect on life is predicted. Extended cyclic fuel nozzle valve gumming tests revealed significant effects of fuel type and temperature on nozzle life. The results correlated with laboratory thermal stability ratings of the fuels based on tube deposits alone. GRA

N80-20407# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYN-FUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Jan. - Mar. 1979

R. F. Sullivan Apr. 1979 41 p
(Contract EX-76-C-01-2315)
(FE-2315-37) Avail: NTIS HC A03/MF A01

Pilot plant tests on the hydrotreating of SRC-2 process product indicate that this coal-derived feed is suitable for refining using advanced commercial petroleum processing technology. Nitrogen in the whole SRC-2 process product can be reduced to a concentration of less than 0.5 ppm in a single catalytic stage. Sulfur and oxygen can also be reduced to low levels; and at high severity, most of the aromatic compounds are converted to naphthenes. As the processing severity is decreased, product nitrogen increases and the product becomes more aromatic. In the latter case, further hydrotreating of the naphtha is required before it can be fed to the second stage of a catalytic reformer. Depending on the severity employed, the jet boiling range product must be further hydrogenated for specification jet fuel. Experiments were made to determine appropriate conditions for these processing steps. DOE

N80-20410# Department of Energy, Bartlesville, Okla. Energy Technology Center.

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Technical Summary Report, 1 Oct. 1978 - 30 Sep. 1979

William D. Good, Donald W. Scott, Norris K. Smith, Susan Lee-Bechtold, and Ann G. Osborn 1979 19 p refs
(AFOSR ISSA 79-0007; AF Proj. 2308)

(AD-A080072; AFOSR-80-0076TR) Avail: NTIS
HC A02/MF A01 CSCL 21/4

Measurements were completed of the enthalpy of combustion of the ramjet fuel RJ-6. Measurements of the enthalpy of combustion of hexacyclic exo,exo-dihydrodinorbornadiene, hexacyclic endo,endo-dihydrodinorbornadiene and exo-tetrahydrodicyclopentadiene are in progress. Vapor pressure measurements were made on exo-tetrahydrodicyclopentadiene. Synthesis and purification of alkylindans and alkylnaphthalenes with high steric interactions continue at Oklahoma State University. GRA

N80-20424# Southwest Research Inst., San Antonio, Tex. Mobile Energy Div.

STABILITY SURVEY OF HYDROCARBON FUELS Final Report

J. N. Bowden Oct. 1979 35 p refs
(Contract EW-78-C-03-1778)
(BETC-1778-4) Avail: NTIS HC A03/MF A01

The storage stability characteristics of No. 2 diesel fuels, JP-4 turbine fuels, and unleaded and leaded gasolines were evaluated. The 43.3 C storage stability test, which included gum determinations after periods of 4, 8, 16, and 32 weeks, was conducted on all samples. The thermal stability of the JP-4 fuels was also measured. Results indicate that the JP-4 fuels are the most stable, followed by the unleaded gasolines, leaded gasolines, and the diesel fuels. None of the jet fuels showed any degree of deterioration during the 32 weeks of storage, while at least one of each type of gasolines and four diesel fuels appeared to have some measure of instability. DOE

N80-20432 Ottawa Univ. (Ontario).
THE PRESSUREMETER: APPLICATION OF PAVEMENT DESIGN Ph.D. Thesis

Jean-Louis Charles Briaud 1979 467 p
Avail: Univ. Microfilms Order No. 8005516

Special pressuremeter, termed the Briaud pressuremeter, has been designed and built specifically for use in pavement engineering; also, a standard test procedure has been established. Both the special pressuremeter and test procedure are proposed as a basis for the traffic load design of flexible airport pavements. The pressuremeter probe is short and monocellular, and the test measures a cyclic modulus. The short probe allows tests to be performed every 0.3 m from the pavement or ground surface down to a depth of 1.8 m. The Briaud pressuremeter is portable and relatively inexpensive, the test is of short duration, and the results give a direct assessment of the condition of the pavement with depth. Dissert. Abstr.

N80-20459# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.

A STANDARDIZATION EVALUATION POTENTIAL STUDY OF THE COMMON MULTI-MODE RADAR PROGRAM Final Report, Jan. - Sep. 1979

J. Gregory Jolda and Janine L. Thomas Nov. 1979 193 p refs
(AF Proj. 2003)
(AD-A079678; AFAL-TR-79-1195) Avail: NTIS
HC A09/MF A01 CSCL 17/9

The cost impact of standardization as applied to Air Force avionic systems is discussed in this report. Several life-cycle cost estimates were made on the ASD Common Multi-Mode Radar program using the Standardization Evaluation Program (STEP) model. Costs for development, operation, and support of a common (standard) radar system are compared with like costs estimated for using individually developed radar systems across applicable aircraft. The STEP model is described, the Common Multi-Mode Radar program is discussed, and the STEP model application to this radar program is documented. STEP estimates project life-cycle costs of unique radar systems to be twice those of a common radar system. Results are discussed in terms of STEP runs and ASD costing estimates, and STEP model use is described. GRA

N80-20488# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
APPARATUS FOR DAMPING OPERATOR INDUCED

OSCILLATIONS OF A CONTROLLED SYSTEM Patent Application

John W. Edwards and John W. Smith, inventors (to NASA)
 Filed 29 Feb. 1980 24 p
 (NASA-Case-FRC-11041-1; US-Patent-Appl-SN-126064) Avail:
 NTIS HC A02/MF A01 CSCL 09C

The invention relates to an adaptive filter for suppressing operator induced oscillations of a control system such as a pilot controlled aircraft or spacecraft. The novelty of the invention is in the filter arrangements which effectively estimate frequency and amplitude to produce a signal that will provide damping without rate limiting. NASA

N80-20513 Virginia Univ., Charlottesville.
DYNAMICS OF FLEXIBLE ROTORS PARTIALLY FILLED WITH A VISCOUS INCOMPRESSIBLE FLUID Ph.D. Thesis
 Scott Lynn Hendricks 1979 125 p
 Avail: Univ. Microfilms Order No. 8004603

A linear theory is developed to study the motion of a hollow circular cylinder rotating with constant angular velocity and partially filled with a viscous incompressible fluid. A two-dimensional theory which ignores axial motion in the fluid is discussed. This theory exhibits all of the essential features of liquid-rotor coupling and is used to analyze a simple rotor configuration, and explore the ramifications of the analysis. The full three dimensional theory is then developed and used to analyze more complicated rotors. The results of the analysis predict that over a range of operating speeds, the rotor-fluid system is unstable. The extent of this unstable region is determined by the system parameters. The interplay between the viscosity of the fluid and damping on the rotor is especially important in determining stability boundaries. Dissert. Abstr.

N80-20587 Virginia Univ., Charlottesville.
ROTOR MODEL PARAMETERS ESTIMATION AND ROTOR BALANCING STUDIES WITH QUADRATIC PROGRAMMING Ph.D. Thesis

Emerson Keith Woomer 1979 133 p
 Avail: Univ. Microfilms Order No. 8004602

The parameter estimation problem is formulated as an optimization process in which unknown constants in the system model are adjusted to give the best agreement between the measured response of the rotor to an applied unbalance and the predicted response from the model. A computer code based on Lemke's algorithm for quadratic programming is used to demonstrate the reliable, efficient computation of rotor balance weights when upper bounds are placed on the weight magnitudes. Heuristic criteria for estimating best choices of balance weight locations are evaluated by comparing the predictions based on the criteria to optimal locations determined by exhaustive search or estimated by random sampling. The influence of the distribution of intrinsic shaft unbalance on optimal balance weight locations and on the magnitudes of normalized curves of shaft deflections and phases is also studied. Dissert. Abstr.

N80-20594# Grumman Aerospace Corp., Bethpage, N.Y.
HYDRAULIC DIAGNOSTIC MONITORING SYSTEM
 31 May 1979 267 p
 (Contract N62269-78-C-0041)
 (AD-A077552; NADC-TR-76389-30) Avail: NTIS
 HC A11/MF A01 CSCL 13/7

The purpose of the Hydraulic Diagnostic Monitoring System (HYCOS) is to warn of impending failure of hydraulic system components by onboard sensors continuously monitoring failure-indicating parameters. The monitoring system consists of three basic types of sensors: analog, discrete, and fiber-optic. These sensors feed information to a self-contained, centrally located display panel through interface circuits that are easily accessible to ground maintenance personnel. The panel has circuit and system test capability which detects malfunctions of the display indicators, electronic equipment, and sensor circuits. Task 1 encompassed the design, development and procurement of hardware, sensors and microprocessors for two diagnostic monitoring systems. Task 2 installed one system on the F-14 a Hydraulic Simulator for system component-reliability demonstrations. The task also covered simulated component failures and diagnostic system reaction. GRA

N80-20619*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

ON THE NONLINEAR DEFORMATION GEOMETRY OF EULER-BERNOULLI BEAMS

Dewey H. Hodges, Robert A. Ormiston, and David A. Peters
 Apr. 1980 57 p refs
 (NASA-TP-1566; A-7985; AVRADCOM-TR-80-A-1) Avail:
 NTIS HC A04/MF A01 CSCL 20K

Nonlinear expressions are developed to relate the orientation of the deformed beam cross section, torsion, local components of bending curvature, angular velocity, and virtual rotation to deformation variables. The deformed beam kinematic quantities are proven to be equivalent to those derived from various rotation sequences by identifying appropriate changes of variable based on fundamental uniqueness properties of the deformed beam geometry. The torsion variable used is shown to be mathematically analogous to an axial deflection variable commonly used in the literature. Rigorous applicability of Hamilton's principle to systems described by a class of quasi-coordinates that includes these variables is formally established. K.L.

N80-20625# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE PREDICTION OF MASS LOADED NATURAL FREQUENCIES AND FORCED RESPONSE OF COMPLEX, RIB-STIFFENED STRUCTURES M.S. Thesis

L. B. Glensek Dec. 1979 149 p refs
 (AD-A079856; AFIT/GAE/AA/79D-5) Avail: NTIS
 HC A07/MF A01 CSCL 20/4

An experimental investigation was conducted to determine the validity of an algorithm developed by Whaley (Ref 14) to approximate the natural frequencies of a complex structure under arbitrary mass loading conditions, when only the unloaded natural frequency and mode shape data is known. The chosen test specimen was a curved, rib-stiffened panel from a C-141 Starlifter, aircraft. The panel was suspended from the ceiling by bungee cords and tested in an unloaded configuration and nine separate mass loaded configurations. Then using only unloaded data the generalized mass and generalized stiffness for each mass loaded configuration were computed, and the natural frequencies for each configuration were computationally predicted using the aforementioned algorithm. The theoretical and experimental results were then compared to determine the amount of error incurred in the approximation technique. The theory of how to ultimately determine the overall forced response of the specimen was discussed and an error model was developed to enable an examination of the reliability of the algorithm in predicting forced response. Recommendations concerning future test procedures, areas requiring further study, and the use of the algorithm were made. GRA

N80-20673# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

AIRPORT OBSTACLE MAPS [FLUGPLATZ HINDERNISKARTEN]

Heinz Bannach *In its* Rept. on Cartography and Geodesy. Ser. 1: Original Rept. No. 73 1974 p 237-240 In GERMAN

Avail: NTIS HC A11/MF A01

The application of photogrammetry to the study of the effects of obstacles on a aircraft takeoff and landing is considered with emphasis on safety. Observation clearance limits required by the International Civil Aviation Organization are discussed along with regulations in force in Germany. A technique utilizing a high precision stereocomparator to determine the heights of various man-made and natural objects is described. The way in which the measurements are made and interpreted is presented as a function of the real conditions prevailing. A practical example is given. Author (ESA)

N80-20821*# National Aeronautics and Space Administration, Washington, D. C.

OVERVIEW OF NASA BATTERY TECHNOLOGY PROGRAM

Robert W. Riebling *In* NASA. Goddard Space Flight Center The 1979 Goddard Space Flight Center Battery Workshop Apr.

1980 p 5-11

Avail: NTIS HC A22/MF A01 CSCL 10C

Highlights of NASA's technology program in batteries for space applications are presented. Program elements include: (1) advanced ambient temperature alkaline secondaries, which are primarily nickel-cadmium cells in batteries; (2) a toroidal nickel cadmium secondaries with multi-kilowatt-hour storage capacity primarily for lower orbital applications; (3) ambient temperature lithium batteries, both primary and secondaries, primarily silver hydrogen and high-capacity nickel hydrogen.

R.E.S.

N80-20987# Minority Services, Inc., Washington, D.C.
INFERRED CLIMATOLOGY FOR U.S. AIRPORTS Final Report

Roy E. Wyett Nov. 1979 141 p ref

(Contract DOT-FA78WAI-881)

(AD-A080487; FAA-RD-79-110; FAA Proj. 152-462) Avail: NTIS HC A07/MF A01 CSCL 01/5

Based on climatological data from airports where weather observations are taken, a climatological value is derived for most U.S. airports. This value represents the percentage of time over a period of a year that one could expect to encounter ceilings less than or equal to 1,500 feet and/or visibilities less than or equal to 3 miles.

R.C.T.

N80-21100*# Columbia Univ., New York. Psychophysics Lab.

DEVELOPMENT AND EVALUATION OF A GENERAL AVIATION REAL WORLD NOISE SIMULATOR Final Report

Eugene Galanter and Richard Popper Mar. 1980 21 p refs (Grant NsG-1541)

(NASA-CR-159237) Avail: NTIS HC A02/MF A01 CSCL 20A

An acoustic playback system is described which realistically simulates the sounds experienced by the pilot of a general aviation aircraft during engine idle, take-off, climb, cruise, descent, and landing. The physical parameters of the signal as they appear in the simulator environment are compared to analogous parameters derived from signals recorded during actual flight operations. The acoustic parameters of the simulated and real signals during cruise conditions are within plus or minus two dB in third octave bands from 0.04 to 4 kHz. The overall A-weighted levels of the signals are within one dB of signals generated in the actual aircraft during equivalent maneuvers. Psychoacoustic evaluations of the simulator signal are compared with similar measurements based on transcriptions of actual aircraft signals. The subjective judgments made by human observers support the conclusion that the simulated sound closely approximates transcribed sounds of real aircraft.

K.L.

N80-21219# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF AERODYNAMIC DISTURBANCE TEST PROCEDURES. VOLUME 2: TECHNICAL REPORT Final Report, 30 Sep. 1977 - 30 May 1979

Richard H. Klein and Jeffrey R. Hogue Aug. 1979 188 p refs

(Contract DOT-HS-7-01716)

(PB80-118383; DOT-HS-805-079; TR-1117-1-2) Avail: NTIS HC A09/MF A01 CSCL 13F

The crosswind responses of twenty different vehicles were surveyed. Three test procedures were used in three different crosswind disturbance configurations. These were steering fixed, steering free, and driver control of land position. The crosswind configurations were straight pulse, doublet pulse, and a shaped profile. Results showed that passenger cars, station wagons, trucks, and most vans have virtually no crosswind sensitivity problems, whereas the VW Microbus, the pickup/camper (in winds higher than 35 mph), cars pulling trailers, and mopeds do have potential problems. The collected test procedures, performance measures, crosswind configurations, and definitions of the relationship between subjective driver ratings and the objective measures.

GRA

N80-21242# RAND Corp., Santa Monica, Calif.
THE REDUNDANCY OF SCHEDULED AND UNSCHEDULED

MAINTENANCE Interim Report

I. K. Cohen, T. S. Donaldson, and T. M. Rodriguez Sep. 1979 42 p refs

(Contract F49620-77-C-0023)

(AD-A076962; RAND/N-1258-AF) Avail: NTIS HC A03/MF A01 CSCL 01/3

This note concerns the extent to which aircraft scheduled and unscheduled maintenance are redundant. It investigates the extent to which Periodic Inspection items on the F-4 aircraft are made visible at the flight line during unscheduled aircraft maintenance. The study focuses on inspection tasks behind aircraft doors, and assumes that once a door is removed for maintenance activity, the inspection item is visible. Visibility or accessibility for condition monitoring is defined as the frequency of door removals. The total number of removals for each aircraft door was counted, and a probability model was used to estimate the probability that a door would be opened within a given inspection interval. The results of this study indicate that most of the F-4 Periodic Inspection tasks are accessible for condition monitoring on the flight line during unscheduled aircraft maintenance. The note discusses the implications of these results for inspection policy.

GRA

N80-21243# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

THE USE OF COMPUTERS AS A DESIGN TOOL

Jan. 1980 445 p refs Partly in ENGLISH and FRENCH Flight Mech. Panel Symp. held at Neubiberg, West Germany, 3-6 Sep. 1979

(AGARD-CP-280; ISBN-92-835-0256-6) Avail: NTIS HC A19/MF A01

The positive and negative aspects of computerized aircraft design are considered including the cost and technical effectiveness, the benefits, and the difficulties and limitations of the whole process. Topics covered include: specifications and assessment of requirements; computer aided design and computer graphics; computational aerodynamics and design; structural analysis and design; and propulsion and system design.

N80-21244# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany). Wehrtechnische Systeme.

THE USE OF COMPUTER AIDED DESIGN METHODS IN AIRBORNE SYSTEMS EVALUATION

P. Ebeling and E. Pfisterer In AGARD The Use of Computers as a Design Tool Jan. 1980 11 p refs

Avail: NTIS HC A19/MF A01

The application of computer aided design methods for pre-design and evaluation purposes of airborne systems, especially in early phases, is considered. Two methods are presented. The first is the aircraft design computer program APFEL which is described in detail. The second application is the missile design program PROFET. Typical applications including some results are given.

J.M.S.

N80-21245# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

CRITERIA FOR TECHNOLOGY

R. L. Haas In AGARD The Use of Computers as a Design Tool Jan. 1980 12 p refs

Avail: NTIS HC A19/MF A01

A perspective on the use of computers in an approach to technology program planning is given. A rationale for cost benefit assessment of technology to form the foundations for the technology of systems is presented. An approach is defined which builds on techniques associated with computer aided design capability and is analogous in form to process control. A description of the basic process applied to a tactical fighter problem is discussed.

J.M.S.

N80-21246*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

AN ACCEPTABLE ROLE FOR COMPUTERS IN THE AIRCRAFT DESIGN PROCESS

Thomas J. Gregory and Leonard Roberts In AGARD The Use

of Computers as a Design Tool Jan. 1980 7 p refs

Avail: NTIS HC A19/MF A01 CSCL 09B

Some of the reasons why the computerization trend is not wholly accepted are explored for two typical cases: computer use in the technical specialties and computer use in aircraft synthesis. The factors that limit acceptance are traced in part, to the large resources needed to understand the details of computer programs, the inability to include measured data as input to many of the theoretical programs, and the presentation of final results without supporting intermediate answers. Other factors are due solely to technical issues such as limited detail in aircraft synthesis and major simplifying assumptions in the technical specialties. These factors and others can be influenced by the technical specialist and aircraft designer. Some of these factors may become less significant as the computerization process evolves, but some issues, such as understanding large integrated systems, may remain issues in the future. Suggestions for improved acceptance include publishing computer programs so that they may be reviewed, edited, and read. Other mechanisms include extensive modularization of programs and ways to include measured information as part of the input to theoretical approaches. J.M.S.

N80-21247# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE USE OF COMPUTER BASED OPTIMIZATION METHODS IN AIRCRAFT STUDIES

Brian Edwards /n AGARD The Use of Computers as a Design Tool Jan. 1980 27 p refs

Avail: NTIS HC A19/MF A01

Multivariate optimization (MVO) computer programs used in the field of aircraft design are considered. The constitution of such programs, which embody an optimization method as well as a mathematical model of aircraft design and operation comprised of aircraft design synthesis and performance analysis methods, is discussed in general terms. Techniques for using MVO programs are emphasized in an effort to show how the optimization method can be used to explore the model and cultivate an insight into its characteristics. A discussion of some possible applications for MVO programs is included. J.M.S.

N80-21248# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

SOME FUNDAMENTAL ASPECTS OF TRANSPORT AIRCRAFT CONCEPTUAL DESIGN OPTIMIZATION

E. Torenbeek /n AGARD The Use of Computers as a Design Tool Jan. 1980 22 p refs

Avail: NTIS HC A19/MF A01

Various design merit functions and program structures are discussed and program elements common to most design exercises are analyzed. Criteria are presented for optimum cruise conditions for aircraft with or without Mach number dependent drag polars and arbitrary propulsion systems. The constrained and unconstrained optima for design cruise speed and altitude, engine thrust, wing loading, and aspect ratio are presented in the form of generalized analytical expressions. They are based on closed-form equations for the payload weight fraction. A powerplant merit function is proposed, which can be used for assessing propulsion systems in the project study phase in isolation from the aircraft design. The method gives clear insight into the design problem structure and is adaptable to arbitrary ground rules and different data bases. The tradeoff between mission requirements, technological factors, and (optimum) design characteristics is evident from the criteria presented. J.M.S.

N80-21251# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

COMPUTER GRAPHICS, RELATED DESIGN AND MANUFACTURE PROCESS AT DORNIER

J. Nagel, L. Thieme, and A. Harter /n AGARD The Use of Computers as a Design Tool Jan. 1980 9 p

Avail: NTIS HC A19/MF A01

A computer systems program which concerns the definition

and machining of the general outer contour surfaces of an aircraft is described. R.E.S.

N80-21252# British Aerospace Aircraft Group, Warton (England). **COMPUTER GRAPHICS AND RELATED DESIGN PROCESSES IN THE UK**

R. I. Hacking and B. Reuben /n AGARD The Use of Computers as a Design Tool Jan. 1980 13 p

Avail: NTIS HC A19/MF A01

The use of computer graphics in British aerospace engineering and its integration with manufacturing is described. R.E.S.

N80-21256# Societe Nationale Industrielle Aerospatiale, Marignane (France.)

USING THE COMPUTER TO PRODUCE ELECTRIC SCHEMAS [LIASSE ELECTRIQUE ASSISTEE PAR ORDINATEUR]

Jean-Pierre Pauzat /n AGARD The Use of Computers as a Design Tool Jan. 1980 6 p In FRENCH

Avail: NTIS HC A19/MF A01

In nine years of operation, an aircraft of the Airbus type generates 16,500 plans which include 7,000 schemas, 5,000 equipment lists, and 4,500 tables. The information processed in these plans is estimated at about 80,000 definitions for cables and their branchings, 20,000 equipment definitions, 3,000 modifications definitions, and 40 validation standards required by clients. The electric cable information management system used to assist in the definition, design, and diffusion of electric schemas is described. This system also take into account the requirements of exterior services which use the schemas for preparation, production, and control or for use after purchase of the aircraft. The system for the computerized design of electric cables is used to design electric schemas on an interactive basis, and adds to the information network all the data which supply the cable management information system. The design and application of both systems are discussed. Transl. by A.R.H.

N80-21257*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

USE OF ADVANCED COMPUTERS FOR AERODYNAMIC FLOW SIMULATION

F. R. Bailey and W. F. Ballhaus /n AGARD The Use of Computers as a Design Tool Jan. 1980 12 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.

Avail: NTIS HC A19/MF A01 CSCL 01A

The current and projected use of advanced computers for large-scale aerodynamic flow simulation applied to engineering design and research is discussed. The design use of mature codes run on conventional, serial computers is compared with the fluid research use of new codes run on parallel and vector computers. The role of flow simulations in design is illustrated by the application of a three dimensional, inviscid, transonic code to the Sabreliner 60 wing redesign. Research computations that include a more complete description of the fluid physics by use of Reynolds averaged Navier-Stokes and large-eddy simulation formulations are also presented. Results of studies for a numerical aerodynamic simulation facility are used to project the feasibility of design applications employing these more advanced three dimensional viscous flow simulations. M.G.

N80-21258# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

THE USE OF THE COMPUTER IN THE DESIGN OF AERODYNAMIC CONFIGURATIONS [UTILISATION DE L'ORDINATEUR POUR LE DESSIN DE CONFIGURATIONS AERODYNAMIQUES]

Pierre Perrier /n AGARD The Use of Computers as a Design Tool Jan. 1980 17 p In FRENCH

Avail: NTIS HC A19/MF A01

The computer is of considerable assistance in both the optimization and evaluation of aerodynamic configurations with, however, very different degrees of efficiency, and very different

methods of use. The operations used are not equivalent to those used for the analysis and synthesis usually alluded to in the development of an aircraft project. The general principles and the terminology used systematically in the design and definition of prototypes are presented along with the different levels of computation associated with each. Two relatively simple, concrete examples related to civil and military aircraft, are used to show the aid provided by computers in aerodynamic design. Developments which can be predicted for years to come are indicated, taking into account improved possibilities of computation.

Transl. by A.R.H.

N80-21259# Aeritalia S.p.A., Torino (Italy).
WING DESIGN PROCESS BY INVERSE POTENTIAL FLOW COMPUTER PROGRAMS

Luciano Fornasier /in AGARD The Use of Computers as a Design Tool Jan. 1980 14 p refs

Avail: NTIS HC A19/MF A01

The approach to wing design by inverse technique is illustrated. A brief review of the numerical tools employed in the design process is given and the involved technology is discussed in some detail. Finally, an application to a design study aimed to demonstrate potential improvements of supercritical wing technology is described. M.G.

N80-21260# Boeing Commercial Airplane Co., Seattle, Wash.
THE ROLE OF COMPUTATIONAL AERODYNAMICS IN AIRPLANE CONFIGURATION DEVELOPMENT

Bertil Dillner and Chester A. Koper, Jr. /in AGARD The Use of Computers as a Design Tool Jan. 1980 14 p refs

Avail: NTIS HC A19/MF A01

The role of computational aerodynamics in the design of aircraft configurations in steady flow conditions is explored through several examples. Subsonic high lift and wing strake designs, and transonic cruise wing designs are included. The use of these computer methods can substantially increase airplane performance capabilities, while reducing risk, flow time, and testing requirements. An assessment is made concerning the factors that have contributed to advancing computational aerodynamics. Deficiencies of existing programs are also noted with particular attention given to the user-system interface. M.G.

N80-21261# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
COMPUTATIONAL AERODYNAMIC DESIGN TOOLS AND TECHNIQUES USED AT FIGHTER DEVELOPMENT

P. Sacher, W. Kraus, and R. Kunz /in AGARD The Use of Computers as a Design Tool Jan. 1980 12 p refs

Avail: NTIS HC A19/MF A01

Various different numerical procedures to perform design trade-offs during fighter configuration development are discussed. An optimization cycle of techniques, necessary to cover the low speed range (high angle of attack), transonic speed (maneuvering capability), and the high speed supersonic region (maximum SEP) is described. Second stage optimization of components like direct design of wing, tail/canard, or maneuver devices is then presented giving further improvements of performance and leading finally to the definition of wind tunnel models. Experimental data compare well with predictions and emphasize the reliability of applied numerical methods. M.G.

N80-21262# Rockwell International Corp., Anaheim, Calif. Aircraft Div.
USE OF COMPUTERS IN THE AERODYNAMIC DESIGN OF THE HiMAT FIGHTER

R. D. Child, B. Panageas, and P. Gingrich /in AGARD The Use of Computers as a Design Tool Jan. 1980 19 p refs

Avail: NTIS HC A19/MF A01

The highly maneuverable aircraft technology remotely piloted research vehicle (HiMAT/RPRV) configuration was designed to achieve a high degree of transonic maneuverability. The performance goals for the advanced fighter concept were a sustained 8 g turn at Mach = 0.9, altitude of 9,144 meters, and a mission

radius of 300 nautical miles. Additionally, supersonic acceleration capability would not be compromised. Preliminary trade studies established a 7,740 kilogram fighter baseline along with a 44 percent scale RPRV that would allow a low risk demonstration of the advanced technologies. Tests of the baseline configuration indicated deficiencies in the technology integration and design techniques. After substantial reconfiguring of the vehicle, with improvements in the analytical methods, the subcritical and supersonic requirements were satisfied. A high level of efficiency for subsonic conditions was realized with the linear theory-optimization techniques and variable camber system. Drag due to lift levels only 5 percent higher than $1/\pi$ AR were obtained for the wind tunnel model at a lift coefficient of 1.0 for Mach numbers of up to 0.8. The transonic drag rise was progressively lowered with the application of nonlinear potential flow analyses. R.C.T.

N80-21263# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Theoretische Aerodynamik.

NUMERICAL METHODS FOR DESIGN AND ANALYSIS AS AN AERODYNAMIC DESIGN TOOL FOR MODERN AIRCRAFT

Wolfgang Schmidt /in AGARD The Use of Computers as a Design Tool Jan. 1980 21 p refs

Avail: NTIS HC A19/MF A01

The application and validation of several computational aerodynamic methods in the design and analysis of transport and fighter aircraft is established. An assessment is made concerning methods that solve transonic flow and boundary layers on maneuver flaps, wings, inlets, and bodies. Capabilities of subsonic and supersonic aerodynamic methods are demonstrated by the inlet integration on the Alpha-Jet design, supersonic Rautenflugelanalysis, subsonic and supersonic wing optimization for a fighter and high lift device analysis. The accuracy of transonic methods is demonstrated by comparison of computed results to experimental data for transport and fighter-type wing body combinations, axisymmetric inlet flowfields, two element airfoil systems and cascades. Special attention is given the capabilities of such methods to simulate wind tunnel effects. R.C.T.

N80-21265# Royal Aircraft Establishment, Farnborough (England).

A COMPUTER BASED SYSTEM FOR STRUCTURAL DESIGN, ANALYSIS AND OPTIMIZATION

A. J. Morris, P. Bartholomew, and J. Dennis /in AGARD The Use of Computers as a Design Tool Jan. 1980 26 p refs

Avail: NTIS HC A19/MF A01

A modular computer program developed for the automated design of optimum structures subject to a variety of constraints is described. The program employs several complex optimization and duality techniques linked together by a control module which also provides a mechanism for interfacing the program with the commercially available structural analysis systems. Although this gives rise to a highly sophisticated program structure it is made simple to operate by the aid of a convenient command language which provides the communication link with the design engineer. R.C.T.

N80-21266# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Structural Dynamics Dept.
STRUCTURAL OPTIMIZATION WITH STATIC AND AEROELASTIC CONSTRAINTS

D. Mathias, H. Roehle, and J. Artmann /in AGARD The Use of Computers as a Design Tool Jan. 1980 11 p refs

Avail: NTIS HC A19/MF A01

An optimization program is presented which is based on the finite element method and, within the actual optimization step, works according to the gradient method. The DYNOPT computer program was applied to a clamped straight wing. The wing was statically loaded and had eccentric masses and rotational inertias representing rudders and actuators. These eccentricities ensured the coupling between the bending and torsional deformations. The minimum weight of the structure was obtained

after 15 iteration steps while all boundary conditions were observed.
R.C.T.

N80-21268# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

FINITE ELEMENTS AND THE OPTIMIZATION OF AERONAUTICAL STRUCTURES [ELEMENTS FINIS ET OPTIMISATION DES STRUCTURES AERONAUTIQUES]

C. Petiau and G. Lecina /in AGARD The Use of Computers as a Design Tool Jan. 1980 16 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A19/MF A01

An optimization method which minimizes weight by using a finite element model is described. The optimization parameters, multiplicative factors of the stiffness of linked finite elements, are discussed. The optimization constraints which can be of different types, including technological minimum thicknesses, limited displacements, and limitations on flutter speed and dynamic responses, are delineated. The optimization process is iterative with each iteration containing three steps. The three steps are reported. Two examples of the optimization method are presented: the optimization of a delta wing and the optimization of a carbon epoxy empennage.
A.W.H.

N80-21270# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

COMPUTER PROGRAMS FOR THE DESIGN AND PERFORMANCE EVALUATION OF NACELLES FOR HIGH BYPASS-RATIO ENGINES

Richard Smyth /in AGARD The Use of Computers as a Design Tool Jan. 1980 21 p refs

Avail: NTIS HC A19/MF A01

The use of the computer as a design tool for the different stages of nacelle development and integration with the airframe is discussed. Trends in propulsion system development and methods of calculation suitable for computerized work with nacelles are reported. The computer program developed for nacelle synthesis consists of an executive program which uses program modules based on the engine component breakdown. The main program modules are the geometrical requirements, the inlet definition, the nozzle and afterbody definition, and the flow calculation. Each program module and its function in the executive program is discussed. The use of the computer program for the performance evaluation of nacelles during the aircraft design process is described.
A.W.H.

N80-21271*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COMPUTERIZED SYSTEMS ANALYSIS AND OPTIMIZATION OF AIRCRAFT ENGINE PERFORMANCE, WEIGHT, AND LIFE CYCLE COSTS

Laurence H. Fishbach /in AGARD The Use of Computers as a Design Tool Jan. 1980 15 p refs

Avail: NTIS HC A19/MF A01 CSCL 21E

The computational techniques are described which are utilized at Lewis Research Center to determine the optimum propulsion systems for future aircraft applications and to identify system tradeoffs and technology requirements. Cycle performance, and engine weight can be calculated along with costs and installation effects as opposed to fuel consumption alone. Almost any conceivable turbine engine cycle can be studied. These computer codes are: NNEP, WATE, LIFCYC, INSTAL, and POD DRG. Examples are given to illustrate how these computer techniques can be applied to analyze and optimize propulsion system fuel consumption, weight and cost for representative types of aircraft and missions.
F.O.S.

N80-21272# British Aerospace Aircraft Group, Preston (England).
MATHEMATICAL MODELLING IN MILITARY AIRCRAFT WEAPON SYSTEM DESIGN

N. Mitchell /in AGARD The Use of Computers as a Design Tool Jan. 1980 12 p

Avail: NTIS HC A19/MF A01

One of the main tools used in weapon system design and analysis is the mathematical model, i.e., a complete mathematical representation of the aircraft weapon system, programmed for running on a digital computer. The main elements of a model are described and the use of models is discussed in the chronological phases of weapon system design and development, including trials planning and analysis, with the associated model matching. Examples of the use of models to investigate and resolve design problems are given, including integrated modelling between several companies. There is a rapid growth in number and use of digital computers in aircraft weapon systems and some typical modelling input to the software of these airborne computers is discussed.
Author

N80-21273# British Aerospace Aircraft Group, Preston (England).
BACTAC: A COMBAT-WORTHY COMPUTERIZED OPPONENT

Ian Jones /in AGARD The Use of Computers as a Design Tool Jan. 1980 14 p ref

Avail: NTIS HC A19/MF A01

The formulation and performance of a computerized opponent are described. The opponent is used at British Aerospace, Warton Division, for air combat simulation. Over a period of seven years, BACTAC has progressed from its initial state as a digital computer model of close combat without the man in the loop, to a versatile and tenacious interactive opponent for use in a single-dome, piloted, air combat simulator. The process of matching the mathematical model against fighter pilots in the simulator is described, together with an account of the learning which took place on both sides of the fight, and adjustment of tactics to the radically different performance of a new generation of aircraft and missiles. It is only in the combat simulator that fighter pilots and designers can investigate future generations of fighter aircraft. In this environment, BACTAC is proving its value to scientific research as a combat-worthy adversary, capable of exploiting the higher levels of performance and providing a known datum against which to rank pilots, competing aircraft and their weapon systems.
Author

N80-21274# Messerschmitt-Boelkow-Blom G.m.b.H., Ottonbrunn (West Germany).

INTERACTIVE AIDED DESIGN SYSTEM FOR AIRCRAFT DYNAMIC CONTROL PROBLEMS

Wolfgang J. Kubbat, G. Oesterheld, and U. Korte /in AGARD The Use of Computers as a Design Tool Jan. 1980 18 p

Avail: NTIS HC A19/MF A01

A computer aided design system is described for control law design and system synthesis. A short description of the available methods (continuous - discrete, time domain-frequency domain) is followed by an illustration of the practical work. The designer has access to the huge program system via a graphical CRT display and a keyboard. Selection of method (i.e., discrete vs. continuous complete vs. incomplete state feedback, optimal control vs. pole-placement, etc.) is followed by a dialogue designer-computer with immediate results presented in numerical and graphical form (plots, print-outs). Each result is stored and can be compared with any other one via dual plots. The system also allows for the input of disturbances like white or colored noise, ramps, steps, sine- and cosine-combinations. No practical restriction for the number of state variables is present. An example for aircraft application is included.
Author

N80-21276 Engineering Sciences Data Unit, London (England).
TRANSONIC DATA MEMORANDUM: A FRAMEWORK RELATING THE DRAG-RISE CHARACTERISTICS OF A FINITE WING/BODY COMBINATION TO THOSE OF ITS BASIC AEROFOIL

1978 31 p
(ESDU-78009; ISBN-0-85679-269-1; ISSN-0141-4356) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC \$674.50

A framework for formulating a relationship between the drag-rise characteristics of a well-designed wing/body combination and the wing's basic airfoil is presented. Its application in

aircraft design is considered as well as its use in reconciling the drag rise characteristics of a swept wing/body combination and its basic airfoil. The results derived may be used to reconcile the known drag-rise characteristics of an existing wing design with the known drag-rise characteristics of its basic airfoil. The research applies to wings of aspect ratio greater than about 4 and sweep angles up to about 45 degrees. ESDU (GRA)

N80-21277 Engineering Sciences Data Unit, London (England). **TRANSONIC DATA MEMORANDUM: THE LIFT ACHIEVABLE BY AEROFOILS HAVING A PARTICULAR FORM OF SUPERCRITICAL UPPER-SURFACE PRESSURE DISTRIBUTION THAT YIELDS ONLY SMALL WAVE DRAG**

1978 31 p
(ESDU-78010; ISBN-0-85679-270-5; ISSN-0141-4356) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC \$434.50

Drag-rise Mach number is estimated as a function of lift-coefficient and thickness/chord ratio for a family of airfoils characterized by a particular form of supercritical upper-surface pressure distribution. The result obtained may be used to provide exchange rates between parameters pertinent to the design of the basic two-dimensional section of swept-winged aircraft intended to cruise at high-subsonic Mach numbers. The research is applicable to thickness/chord ratios ranging from 6 percent to 18 percent chord and upper-surface pressure distributions having supercritical flow for up to 60 percent chord.

ESDU (GRA)

N80-21278 Engineering Sciences Data Unit, London (England). **TRANSONIC DATA MEMORANDUM: NUMERICAL METHODS FOR SOLVING THE POTENTIAL FLOW EQUATIONS FOR TWO-DIMENSIONAL AEROFOILS IN SUBSONIC AND TRANSONIC FLOWS, BRIEF DETAILS, TEST CASES AND EXAMPLES**

1975 40 p
(ESDU-79009; ISBN-0-85679-271-3; ISSN-0141-4356) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC \$434.50

Numerical methods for calculating pressure distributions for two-dimensional airfoils in subsonic and transonic potential flow are described and recommendations regarding the use of computer programs of the methods are made. Examples of the pressure distributions obtainable are included. The results obtained may be used to provide pressure distributions and force and moment coefficients on airfoil sections for wings and rotors. The research applies to two-dimensional symmetrical and cambered airfoils of between 7% and 15% thickness chord ratio in potential flow with freestream Mach numbers from zero to near unity.

ESDU (GRA)

N80-21279*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va. **SUPERSONIC WINGS WITH SIGNIFICANT LEADING-EDGE THRUST AT CRUISE**

A. Warner Robins, Harry W. Carlson, and Robert J. Mack Apr. 1980 28 p refs
(NASA-TP-1632; L-13316) Avail: NTIS HC A03/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 having the geometry to support the theoretical thrust-distribution potential. The new analytical process employed provides not only the level of leading-edge thrust attainable but also the spanwise distribution of both it and that component of full theoretical thrust which acts as vortex lift. Significantly improved aerodynamic performance in the moderate supersonic speed regime is indicated.

Author

N80-21280*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va. **COMPARISON OF PREDICTED AND EXPERIMENTAL REAL-GAS PRESSURE DISTRIBUTIONS ON SPACE**

SHUTTLE ORBITER NOSE FOR SHUTTLE ENTRY AIR DATA SYSTEM

Judy L. Shinn Apr. 1980 29 p refs
(NASA-TP-1627; L-13341) Avail: NTIS HC A03/MF A01 CSCL 01A

An experimental investigation of inviscid real-gas effects on the pressure distribution along the Space Shuttle Orbiter nose center line up to an angle of attack of 32 deg was performed in support of the Shuttle Entry Air Data System (SEADS). Free-stream velocities from 4.8 to 6.6 kn/s were generated at hypersonic conditions with helium, air, and CO₂, resulting in normal-shock density ratios from 3.7 to 18.4. The experimental results for pressure distribution agreed closely with numerical results. Modified Newtonian theory deviates from both experiment and the numerical results as angle of attack increases or shock density ratio decreases. An evaluation of the use of modified Newtonian theory for predicting SEADS pressure distributions in actual flight conditions was made through comparison with numerical predictions. R.E.S.

N80-21282*# Analytical Methods, Inc., Bellevue, Wash. **USSAERO COMPUTER PROGRAM DEVELOPMENT, VERSIONS B AND C Final Report 1974 - 1979**

F. A. Woodward Washington, D.C. NASA Apr. 1980 82 p refs
(Contract NAS1-12900)

(NASA-CR-3227) Avail: NTIS HC A05/MF A01 CSCL 01A
Versions B and C of the unified subsonic and supersonic aerodynamic analysis program, USSAERO, are described. Version B incorporates a new symmetrical singularity method to provide improved surface pressure distributions on wings in subsonic flow. Version C extends the range of application of the program to include the analysis of multiple engine nacelles or finned external stores. In addition, nonlinear compressibility effects in high subsonic and supersonic flows are approximated using a correction based on the local Mach number at panel control points. Several examples are presented comparing the results of these programs with other panel methods and experimental data. Author

N80-21283*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

ADVANCED TECHNOLOGY AIRFOIL RESEARCH, VOLUME 2

1979 262 p refs Presented at conf., Langley Research Center, Hampton, Va. 7-9 Mar. 1978
(NASA-CP-2046; L-12232) Avail: NTIS HC A12/MF A01 CSCL 01A

A comprehensive review of airfoil research is presented. The major thrust of the research is in three areas: development of computational aerodynamic codes for airfoil analysis and design, development of experimental facilities and test techniques, and all types of airfoil applications. R.E.S.

N80-21285*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

HIGH SPEED TURBOPROPS FOR EXECUTIVE AIRCRAFT, POTENTIAL AND RECENT TEST RESULTS

Daniel C. Mikkelsen and Glenn A. Mitchell 1980 26 p refs Presented for the Turbine-Powered Executive Meeting, (Phoenix), 9-11 Apr. 1980, sponsored by the Soc. of Automotive Engr. (NASA-TM-81482; E-419) Avail: NTIS HC A03/MF A01 CSCL 01A

Four high speed propeller models were designed and tested in an 8x6 foot wind tunnel in order to evaluate the potential of advanced propeller technology. Results from these tests show that the combination of: increased blade number, aerodynamically integrated propeller/nacelles, reduced blade thickness, spinner area ruling, and blade sweep are important in achieving high propeller efficiency at the high cruise speeds. R.E.S.

N80-21286*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

THREE-DIMENSIONAL INTERACTIONS AND VORTICAL FLOWS WITH EMPHASIS ON HIGH SPEEDS

David J. Peake and Murray Tobak Mar. 1980 225 p refs

(NASA-TM-81169; A-6035) Avail: NTIS HC A10/MF A01 CSCL 01A

Diverse kinds of three-dimensional regions of separation in laminar and turbulent boundary layers are discussed that exist on lifting aerodynamic configurations immersed in flows from subsonic to hypersonic speeds. In all cases of three dimensional flow separation, the assumption of continuous vector fields of skin-friction lines and external-flow streamlines, coupled with simple topology laws, provides a flow grammar whose elemental constituents are the singular points: nodes, foci, and saddles. Adopting these notions enables one to create sequences of plausible flow structures, to deduce mean flow characteristics, expose flow mechanisms, and to aid theory and experiment where lack of resolution in numerical calculations or wind tunnel observation causes imprecision in diagnosing the three dimensional flow features. R.E.S.

N80-21287*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

AN EXPERIMENTAL EVALUATION OF A HELICOPTER ROTOR SECTION DESIGNED BY NUMERICAL OPTIMIZATION

R. M. Hicks and W. J. McCroskey (Army Aviation Res. and Development Command, St. Louis, Mo.) Mar. 1980 131 p refs

(NASA-TM-78622; AVRADCOM-TR-79-44; A-7956) Avail: NTIS HC A07/MF A01 CSCL 01C

The wind tunnel performance of a 10-percent thick helicopter rotor section design by numerical optimization is presented. The model was tested at Mach number from 0.2 to 0.84 with Reynolds number ranging from 1,900,000 at Mach 0.2 to 4,000,000 at Mach numbers above 0.5. The airfoil section exhibited maximum lift coefficients greater than 1.3 at Mach numbers below 0.45 and a drag divergence Mach number of 0.82 for lift coefficients near 0. A moderate 'drag creep' is observed at low lift coefficients for Mach numbers greater than 0.6. M.G.

N80-21288# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE GRAPHICAL DISPLAY OF MULTI-DIMENSIONAL AERODYNAMIC FLOW FIELD DATA M.S. Thesis

Elton Philip Amburn Dec. 1979 111 p refs

(AD-A080359; AFIT/GCS/MA/79D-1) Avail: NTIS HC A06/MF A01 CSCL 20/4

The Air Force Flight Dynamics Laboratory has solved aerodynamic problems using sophisticated numerical techniques. Large volumes of data are created during the numerical solution of a problem, and the purpose of this project was to build a computer graphics software system to display this data. The system is controlled by using a command language which is interpreted by a table-driven parser. The primary output of the system is computer generated movies of the aerodynamic data. GRA

N80-21289# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

ALLEVIATION OF THE SIDE FORCE AND THE YAWING MOMENT ACTING ON A SLENDER CONE-CYLINDER BODY AT HIGH ANGLES OF ATTACK, USING SMALL JET INJECTION AT SUBSONIC AND TRANSONIC SPEEDS Annual Technical Report, Sep. 1978 - Sep. 1979

D. Almosnino and J. Rom Sep. 1979 54 p refs

(Grant DA-ERO-78-G-119; DA Proj. 1L1-61102-BH-57)

(AD-A080317) Avail: NTIS HC A04/MF A01 CSCL 20/4

The effects of small symmetrical jets on the side forces of slender bodies at high angles of attack are investigated. Control as well as alleviation of these forces are considered. The effects of Reynolds number and blowing rate are investigated. Side force alleviation is obtained for subsonic and transonic flows. It is found that variation of Mach number affects the magnitude and direction of side forces. GRA

N80-21291# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.

STUDY OF ROTOR WAKES AT VERY LOW ADVANCE RATIOS Final Report, 30 Jun. 1976 - 30 Jun. 1979

Henry R. Velkoff 15 Dec. 1979 95 p refs

(Grant DAAG29-76-G-0260)

(AD-A080711; ARO-14142.1-EX)

Avail: NTIS

HC A05/MF A01 CSCL 20/4

With the recognition of the importance of operation of military helicopters at very low altitudes and very low velocities, the need for data on airflow under these conditions became apparent. Work was initiated to obtain data at very low advance ratios typical of such low speed helicopter flight. The original goals of the research were to try to obtain a description of the flow field both time averaged and instantaneous. Because of prior experience with hot wire anemometry the effort was directed towards using a hot wire probe to get all three components of velocity. The effort resulted in an operational rotor drive and measuring system, a probe calibration and positioning system, frequency response determination, and acquisition of average value data. The low speed flow fields found, demonstrated a squirting affect that could be seen on both sides of the rotor at very low advance ratios. Two non-steady data acquisition systems were considered, one developed to the point of use but was found awkward to use, and a second interactive system which progressed to the point that initial tests using it in a time average mode illustrated the interactive capability. GRA

N80-21293*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EMERGENCY IN-FLIGHT EGRESS OPENING FOR GENERAL AVIATION AIRCRAFT

Laurence J. Bement Apr. 1980 25 p refs

(NASA-TM-80235; L-13615) Avail: NTIS HC A02/MF A01 CSCL 01C

In support of a stall/spin research program, an emergency in-flight egress system is being installed in a light general aviation airplane. To avoid a major structural redesign for a mechanical door, an add-on 11.2 kg pyrotechnic-actuated system was developed to create an opening in the existing structure. The airplane skin will be explosively severed around the side window, across a central stringer, and down to the floor, creating an opening of approximately 76 by 76 cm. The severed panel will be jettisoned at an initial velocity of approximately 13.7 m/sec. System development included a total of 68 explosive severance tests on aluminum material using small samples, small and full scale flat panel aircraft structural mock-ups, and an actual aircraft fuselage. These tests proved explosive sizing/severance margins, explosive initiation, explosive product containment, and system dynamics. R.E.S.

N80-21294*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

NASA LOW- AND MEDIUM-SPEED AIRFOIL DEVELOPMENT

Robert J. McGhee, William D. Beasley, and Richard T. Whitcomb Mar. 1979 19 p Presented at NASA Conf. on Advanced Tech. Airfoil Res., Langley Research Center, Hampton, Va., 7-9 Mar. 1979

(NASA-TM-78709; L-12264) Avail: NTIS HC A02/MF A01 CSCL 01C

The status of NASA low and medium speed airfoil research is discussed. Effects of airfoil thickness-chord ratios varying from 9 percent to 21 percent on the section characteristics for a design lift coefficient of 0.40 are presented for the initial low speed family of airfoils. Also, modifications to the 17-percent low-speed airfoil to reduce the pitching-moment coefficient and to the 21-percent low speed airfoil results are shown for two new medium speed airfoils with thickness ratios of 13 percent and 17 percent and design-lift coefficients of 0.30. Applications of NASA-developed airfoils to general aviation aircraft are summarized. R.E.S.

N80-21295*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WIND-TUNNEL RESULTS FOR AN IMPROVED 21-PERCENT-THICK LOW-SPEED AIRFOIL SECTION

Robert J. McGhee and William D. Beasley Apr. 1978 47 p refs

(NASA-TM-78650; L-11970) Avail: NTIS HC A03/MF A01 CSCL 01C

Low speed wind tunnel tests were conducted to evaluate

the effects on performance of modifying a 23 percent thick low speed airfoil. The airfoil contour was altered to reduce the upper-surface adverse pressure gradient and hence reduce boundary layer separation. The chord Reynolds number varied from about 2,000,000 to 9,000,000. R.E.S.

N80-21296# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.

COMPUTER SIMULATION OF CANOPY-PILOT RESPONSE TO BIRD-STRIKE Final Technical Report, 1 Jun. 1977 - 15 Sep. 1978

T. Belytschko, E. Privityer, W. Mindle, and T. Wicks Wright-Patterson AFB, Ohio AMRL Oct. 1979 101 p refs (Contract F33615-77-C-0529; AF Proj. 7231) (AD-A080122; AMRL-TR-79-20) Avail: NTIS HC A06/MF A01 CSCL 06/5

A computer program was developed for simulating the complete scenario of a bird-strike event: bird-canopy impact, canopy-pilot impact, and the resulting response of the pilot. The response of the pilot was simulated by a previously developed head-spine model, but in order to predict the degree of pilot injury or impairment, a skull brain model based on the maximum strain criterion was incorporated. Additional features which were developed for these simulations are (1) a plate finite element with the capability of treating geometric nonlinearities due to large deflections and material nonlinearities; (2) a contact-impact algorithm for treating bird-canopy and canopy-helmet impact; and (3) a graphical display capability for illustrating the results of simulations. Simulations were first performed of bird-canopy impacts to determine the mesh refinement necessary to reproduce the magnitudes of experimentally observed deformations and the wave pattern of the observed displacement. It was found that only a very fine mesh proved satisfactory. This mesh could not be used in the computer simulations because of computer core-storage and cost limitations at our computer facility. Simulations of pilot response to canopy impact showed that the injury potential is quite sensitive to the initial impulse of the bird impact and its location relative to the pilot. A simulation with a 8 cm maximum deflection resulted in a head impact which was definitely tolerable. On the other hand, a 33% increase in this impulse was associated with irreversible injuries. GRA

N80-21297# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

ESTIMATION OF DYNAMIC WINDBLAST PRESSURE ON AIRCREWMAN EJECTION SYSTEMS Final Report

Thomas J. Zenobi 12 Dec. 1979 24 p (WF41400000) (AD-A080575; NADC-79168-60) Avail: NTIS HC A02/MF A01 CSCL 20/4

This report is intended to help designers and engineers, primarily involved in the design of aircraft ejection systems, understand and estimate windblast pressure. Effects of windblast pressure are addressed for a range of sonic velocities. Windblast pressure curves of various altitudes are included. GRA

N80-21298# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

EVALUATION OF A CENTRAL DATA ENTRY SYSTEM (CDES) FOR TRANSPORT AIRCRAFT

Fred Volker Schick (Technische Univ., Brunswick), Dirk Brunner (Technische Univ., Brunswick), Ernst-Heinrich Neumann (Deutsche Lufthansa AG), and Hans-Dieter Schenk Jul. 1979 179 p refs (DFVLR-FB-79-23) Avail: NTIS HC A09/MF A01

A Central Data Entry System (CDES) for transport aircraft was developed for saving panel space and for common operation of various onboard flight management systems. A fully functional CDES model was flown by 27 airline pilots under realistic mission conditions in a flight simulator based evaluation program. Pilot performance and judgment data were analyzed in view of comparing CDES entries with conventional entries and studying CDES location alternatives in the cockpit, turbulence effects on CDES handling, training required for familiarization with the CDES, layout of CDES hardware and software, and the range of CDES

capacities. The results show good feasibility and a high degree of pilot acceptance. Author (ESA)

N80-21299*# National Aeronautics and Space Administration, Washington, D. C.

GLOBAL POSITIONING SYSTEM FOR GENERAL AVIATION: JOINT FAA-NASA SEMINAR Summary Report

1978 236 p Seminar held at Washington, D. C., 16-17 Oct. 1978 Prepared in cooperation with FAA, Washington, D. C. (NASA-TM-81017) Avail: NTIS HC A11/MF A01 CSCL 17G

Programs to examine and develop means to utilize the global positioning system (GPS) for civil aviation functions are described. User requirements in this regard are discussed, the development of technologies in the areas of antennas, receivers, and signal processors for the GPS are examined, and modifications to the GPS to fit operational and design criteria are evaluated.

N80-21305*# Magnavox Co., Torrance, Calif. [CIVIL APPLICATIONS OF GLOBAL POSITIONING SYSTEMS]

Vito Calibi /n NASA, Washington Global Positioning System for Gen. Aviation: Joint FAA-NASA Seminar 1978 p 75-81

Avail: NTIS HC A11/MF A01 CSCL 17G

User requirements germane to civil applications in the GPS are discussed. The Z-set is discussed as a possible low cost set which might meet the civil requirement as a GPS receiver. A.W.H.

N80-21306*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

[A PROGRAM FOR PREDICTING ANTENNA RADIATION PATTERNS]

Melvin Gilreath /n NASA, Washington Global Positioning System for Gen. Aviation: Joint FAA-NASA Seminar 1978 p 83-105

Avail: NTIS HC A11/MF A01 CSCL 17G

The status of the aircraft antenna prediction program at Langley is reviewed with emphasis on the analytical techniques and computer programs developed for antenna siting and performance prediction. Scale-model aircraft are used to obtain experimental data for verification of analytical results. Computer generated models of the Boeing 737, the KC-135, the Cessna 402B, and the Gates lear jet are discussed. A.R.H.

N80-21307*# Stanford Telecommunications, Inc., Mountain View, Calif.

[DESIGNING LOW COST RECEIVERS FOR GENERAL AVIATION USERS]

Francis D. Natali /n NASA, Washington Global Positioning System for Gen. Aviation: Joint FAA-NASA Seminar 1978 p 107-117

Avail: NTIS HC A11/MF A01 CSCL 17G

Approaches to the design of a low cost receiver which meets all IFR requirements for 2D area navigation are discussed. These include: (1) using current technology with a minimum of specialized LSI, a minimum of circuit complexity, and minimal use of critical components; (2) emphasized microprocessor technology; and (3) a special analog/digital chip fabrication. A low cost GPS receiver configuration with a single sequencing tracking channel is examined. Problem areas are indicated. A.R.H.

N80-21308*# Teledyne Systems Co., Los Angeles, Calif.

[DESIGN APPROACHES FOR GPS RECEIVERS/PROCESSORS]

Robert V. Nino /n NASA, Washington Global Positioning System for Gen. Aviation: Joint FAA-NASA Seminar 1978 p 119-128

Avail: NTIS HC A11/MF A01 CSCL 17G

The design philosophy for a low-cost GPS receiver-processor is discussed. F.O.S.

N80-21314# National Bureau of Standards, Boulder, Colo. National Engineering Lab.

A STANDARD FOR RF MODULATION FACTOR

M. G. Arthur and G. R. Reeve Sep. 1979 94 p refs
(PB80-109085; NBS-TN-1016; FAA-RD-79-94) Avail: NTIS
HC A05/MF A01 CSCL 17G

A modulation factor standard was developed to support the Federal Aviation Administration's requirements for a measurement capability for the ILS and VOR navigation systems. The standard consists of both a precision modulation meter and a stable amplitude-modulated signal source. Although designed primarily for ILS and VOR signals, it has general purpose capabilities within an RF range of 10 MHz to 500 MHz and an AF range of 10 Hz to 20 KHz. Measurement uncertainty is less than 0.11 percent modulation below 90 percent modulation for ILS/VOR tones of 90 Hz and above, and is somewhat greater at 30 Hz. A circuit description and an error analysis are included. GRA

N80-21315# Royal Aircraft Establishment, Farnborough (England).

INVESTIGATIONS OF AN ACTIVE VIBRATION ISOLATION SYSTEM FOR HELICOPTERS

G. Reichert and H. Strehlow Nov. 1979 58 p refs Transl. into ENGLISH from Luftfahrt forschung und luftfahrttechnologie statusseminar (Bonn), 1978
(RAE-Lib-Trans-1993; BR73047) Avail: NTIS
HC A04/MF A01

Active and passive methods of minimizing the effects of rotor induced excitation forces on the fuselage vibration characteristics by isolating the rotor/transmission system from the fuselage are described. Attention is focussed on an active control system which was developed for eventual use on the BO 105 research helicopter. The advantages of active control systems over passive systems for isolating the helicopter fuselage from rotor induced excitation are discussed. R.E.S.

N80-21316*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

SUPERSONIC CRUISE AIRCRAFT RESEARCH: AN ANNOTATED BIBLIOGRAPHY

Marie H. Tuttle Apr. 1980 21 p
(NASA-TM-81781) Avail: NTIS HC A02/MF A01 CSCL 01C

This bibliography, with abstracts, consists of 69 publications arranged in chronological order. The material may be useful to those interested in supersonic cruise fighter/penetrator/interceptor airplanes. Two pertinent conferences on military supercruise aircraft are considered as single items; one contains 37 papers and the other 29 papers. In addition, several related bibliographies are included which cover supersonic civil aircraft and military aircraft studies at the Langley Research Center. There is also an author index. Author

N80-21318*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PARAMETRIC STUDY OF VARIATION IN CARGO-AIRCRAFT PERFORMANCE RELATED TO PROGRESSION FROM CURRENT TO SPANLOADER DESIGNS

Thomas A. Toll Washington Apr. 1980 53 p refs
(NASA-TP-1625; L-13208) Avail: NTIS HC A04/MF A01 CSCL 01C

A parametric analysis was made to investigate the relationship between current cargo airplanes and possible future designs that may differ greatly in both size and configuration. The method makes use of empirical scaling laws developed from statistical studies of data from current and advanced airplanes and, in addition, accounts for payload density, effects of span distributed load, and variations in tail area ratio. The method is believed to be particularly useful for exploratory studies of design and technology options for large airplanes. The analysis predicts somewhat more favorable variations of the ratios of payload to gross weight and block fuel to payload as the airplane size is increased than has been generally understood from interpretations of the cube-square law. In terms of these same ratios, large all wing (spanloader) designs show an advantage over wing-fuselage designs. J.M.S.

N80-21319# Army Research and Technology Labs., Fort Eustis, Va. Applied Technology Lab.

AN ANALYTICAL INVESTIGATION OF THE EFFECT OF VARYING ROTOR TIP SPEED TO REDUCE HELICOPTER ACOUSTIC DETECTION

Bill W. Scruggs, Jr. and Kenneth D. Hampton Aug. 1979 34 p refs
(DA Proj. 1L1-62209-AH-76)
(AD-A076961; USARTL-TN-37) Avail: NTIS
HC A03/MF A01 CSCL 01/3

The purpose of this study was to analytically determine the effect of incrementally varying helicopter rotor tip speed to decrease noise levels and detection distance. The basis for this study was that primary mission performance (PMP) would be maintained at each incremental change of rotor tip speed. A baseline helicopter was designed that met the Advanced Scout Helicopter (ASH) PMP requirements. It used a 700 fps tip speed four bladed rotor system. Four generic configurations of the baseline helicopter were also designed which met the PMP requirements. The design rotor tip speed of these configurations varied to 105, 95, 90, and 80 percent of the baseline tip speed. Overall sound pressure levels (OASPL), 1/3 octave band spectra, and detection distances were predicted for all helicopter configurations for a range of operational speeds. Results showed that the 90 percent (630 fps) tip speed configuration was optimum in terms of reduced OASPL. When all configurations were analytically displaced in distance to the point at which their noise signature could first be perceived, the 100 percent (700 fps) tip speed configuration was least detectable. It was also found that OASPL was not a reliable indicator of detectability and that ambient noise conditions had the largest net effect on detectability. GRA

N80-21320# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

AIRWORTHINESS AND FLIGHT CHARACTERISTICS EVALUATION. OH-58C INTERIM SCOUT HELICOPTER Final Report, Jun. - Dec. 1978

Sherwood C. Spring, John R. Niemann, Thomas E. Burch, and Robert M. Buckanin Apr. 1979 205 p refs
(AD-A080138; USAAEFA-76-11-2) Avail: NTIS
HC A10/MF A01 CSCL 01/3

The United States Army Aviation Engineering Activity conducted an airworthiness and flight characteristics evaluation of the OH-58C Interim Scout helicopter. Performance, handling qualities, and vibration characteristics were evaluated to provide engineering test data for use in the OH-58C Operator's Manual and to detect any aircraft deficiencies or shortcomings. The OH-58C was tested at Edwards Air Force Base, California (elevation 2302 feet), and alternate test site elevations of 4120, and 9980 feet. A total of 97 flights were conducted for a total of 123.5 flight hours. Due to the more powerful T63-A-720 engine installed in the helicopter, the hover and takeoff capability at heavy gross weights and high altitudes and the forward flight climb performance of the OH-58C is significantly improved over the OH-58A. Performance in terms of power required and fuel flow is slightly degraded when compared to the OH-58A at similar gross weights and altitudes and in general did not meet the estimates of the detail specification for the OH-58C. The handling qualities and vibrations of the OH-58C are similar to the OH-58A when operating at similar gross weights and altitudes. Three handling qualities deficiencies relative to the low speed flight characteristics were identified. GRA

N80-21322# Army Aviation Research and Development Command, St. Louis, Mo. Applied Technology Lab.

COST ANALYSIS OF A HELICOPTER TRANSMISSION AND DRIVE TRAIN

Richard F. Mulliken Nov. 1979 46 p
(AD-A080518; USAVRADCOM-TM-80-D-2) Avail: NTIS
HC A03/MF A01 CSCL 01/3

A cost analysis was conducted on a transmission and drive train system from a single-engine helicopter with an input of 1134 hp at 6600 rpm. Main rotor speed was 325 rpm. Details and subassemblies of this system were identified using the Army Technical Manual. Prices of spare parts were obtained from the Army Master Data File (AMDF). Irregularity in the prices found showed that it was impossible to identify specific cost drivers or to develop any valid cost baseline or to obtain valid comparative

detail costs using this data base. In view of this situation, plans to analyze a second system were abandoned. A detailed review of the data obtained strongly indicated that gears, forgings, and castings are the cost drivers in this system. Since all such systems employ components of similar nature and function, this indication is applicable to other transmission systems and should therefore be useful as an aid in directing cost-reduction efforts. Manufacturing approaches by which costs on such parts may be reduced are suggested. GRA

N80-21323*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF A SPINNING-MODE ACOUSTIC-TREATMENT DESIGN CONCEPT FOR AIR-CRAFT INLETS

Laurence J. Heidelberg, Edward J. Rice, and Leonard Homyak
Apr. 1980 29 p refs
(NASA-TP-1613; E-185) Avail: NTIS HC A03/MF A01 CSCL 21E

An aircraft-inlet noise suppressor method based on mode cutoff ratio was qualitatively checked by testing a series of liners on a YF-102 turbofan engine. Far-field directivity of the blade passing frequency was used extensively to evaluate the results. The trends and observations of the test data lend much qualitative support to the design method. The best of the BPF liners attained a suppression at design frequency of 19 dB per unit length-diameter ratio. The best multiple-pure-tone linear attained a remarkable suppression of 65.6 dB per unit length-diameter ratio. Author

N80-21324*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AERODYNAMIC PERFORMANCES OF THREE FAN STATOR DESIGNS OPERATING WITH ROTOR HAVING TIP SPEED OF 337 METERS PER SECOND AND PRESSURE RATIO OF 1.54. RELATION OF ANALYTICAL CODE CALCULATIONS TO EXPERIMENTAL PERFORMANCE

Thomas F. Gelder, James F. Schmidt, and Genevieve M. Esgar
Apr. 1980 53 p refs
(NASA-TP-1614; E-137) Avail: NTIS HC A04/MF A01 CSCL 21E

A hub-to-shroud and a blade-to-blade internal-flow analysis code, both inviscid and basically subsonic, were used to calculate the flow parameters within four stator-blade rows. The produced ratios of maximum suction-surface velocity to trailing-edge velocity correlated well in the midspan region, with the measured total-parameters over the minimum-loss to near stall operating range for all stators and speeds studied. The potential benefits of a blade designed with the aid of these flow analysis codes are illustrated by a proposed redesign of one of the four stators studied. An overall efficiency improvement of 1.6 points above the peak measured for that stator is predicted for the redesign. Author

N80-21325*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF SINGLE-STAGE AXIAL-FLOW TRANSONIC COMPRESSOR WITH ROTOR AND STATOR ASPECT RATIOS OF 1.19 AND 1.26 RESPECTIVELY, AND WITH DESIGN PRESSURE RATIO OF 2.05

Royce D. Moore and Lonnie Reid Washington Apr. 1980 103 p
(NASA-TP-1659; E-138) Avail: NTIS HC A06/MF A01 CSCL 21E

The overall and blade-element performances of a low-aspect-ratio transonic compressor stage are presented over the stable operating flow range for speeds from 50 to 100 percent of design. At design speed the rotor and stage achieved peak efficiencies of 0.876 and 0.840 at pressure ratios of 2.056 and 2.000, respectively. The stage stall margin at design speed was 10 percent. Author

N80-21326*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF UNCERTAINTIES IN TURBINE METAL TEMPERATURE PREDICTIONS

Francis S. Stepka Washington Apr. 1980 19 p refs

(NASA-TP-1593; E-228) Avail: NTIS HC A02/MF A01 CSCL 21E

An analysis was conducted to examine the extent to which various factors influence the accuracy of analytically predicting turbine blade metal temperatures and to determine the uncertainties in these predictions for several accuracies of the influence factors. The advanced turbofan engine gas conditions of 1700 K and 40 atmospheres were considered along with those of a highly instrumented high temperature turbine test rig and a low temperature turbine rig that simulated the engine conditions. The analysis showed that the uncertainty in analytically predicting local blade temperature was as much as 98 K, or 7.6 percent of the metal absolute temperature, with current knowledge of the influence factors. The expected reductions in uncertainties in the influence factors with additional knowledge and tests should reduce the uncertainty in predicting blade metal temperature to 28 K, or 2.1 percent of the metal absolute temperature. Author

N80-21327*# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

ELECTRICAL SERVO ACTUATOR BRACKET Patent Application

Ralph V. Sawyer, inventor (to NASA) Filed 20 Feb. 1980 10 p

(NASA-Case-FRC-11044-1; US-Patent-Appl-SN-135056) Avail: NTIS HC A02/MF A01 CSCL 21E

A bracket for an electrical servo actuator is disclosed which was developed particularly for jet engine fuel control valves. Said servo actuator is mounted on a support arm which is allowed to pivot on a bolt through a fixed mounting bracket. The actuator is pivotally connected to the end of the support arm by a bolt which has an extension that passes through a slot in the fixed mounting bracket. An actuator rod extends from the servo actuator to a crank arm which turns a control shaft. A short linear thrust of the rod pivots the crank arm through about 90 deg for full-on control with the rod contracted into the servo actuator, and full-off control when the rod is extended from the actuator. NASA

N80-21329*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.

MANUFACTURE OF LOW CARBON ASTROLOGY TURBINE DISK SHAPES BY HOT ISOSTATIC PRESSING. VOLUME 2, PROJECT 1 Final Report

R. D. Eng and D. J. Evans Jan. 1979 10 p

(Contract NAS3-20072)

(NASA-CR-135410; PWA-5574-37) Avail: NTIS HC A02/MF A01 CSCL 21E

The performance of a hot isotatic pressed disk installed in an experimental engine and exposed to realistic operating conditions in a 150-hour engine test and a 1000 cycle endurance test is documented. Post test analysis, based on visual, fluorescent penetrant and dimensional inspection, revealed no defects in the disk and indicated that the disk performed satisfactorily. R.E.S.

N80-21331*# AiResearch Mfg. Co., Phoenix, Ariz.

AIRESEARCH QCGAT PROGRAM Final Report

R. W. Heidenbrand and W. M. Norgren 10 Jan. 1979 199 p refs

(Contract NAS3-20585)

(NASA-CR-159758; AIRESEARCH-21-3071) Avail: NTIS HC A09/MF A01 CSCL 21E

A model TFE731-1 engine was used as a baseline for the NASA quiet clean general aviation turbofan engine and engine/nacelle program designed to demonstrate the applicability of large turbofan engine technology to small general aviation turbofan engines, and to obtain significant reductions in noise and pollutant emissions while reducing or maintaining fuel consumption levels. All new technology design for rotating parts and all items in the engine and nacelle that contributed to the acoustic and pollution characteristics of the engine system were of flight design, weight, and construction. The major noise, emissions, and performance goals were met. Noise levels estimated for the three FAR Part 36 conditions, are 10 to 15 ENPdB below FAA requirements; emission values are considerably reduced below that of current technology engines; and the engine performance

represents a TSFC improvement of approximately 9 percent over other turbofan engines. A.R.H.

N80-21332*# Pratt and Whitney Aircraft Group, East Hartford, Conn.

DEVELOPMENT OF IMPROVED HIGH PRESSURE TURBINE OUTER GAS PATH SEAL COMPONENTS Progress Report, Dec. 1976 - Oct. 1979

Lawrence T. Shiembob Jan. 1980 80 p
(Contract NAS3-20590)

(NASA-CR-159801; PWA-5568) Avail: NTIS HC A05/MF A01 CSCL 21E

A plasma sprayed graded layered ceramic/metallic (ZrO₂/CoCrAlY) seal was evaluated for JT9D turbine application by rig and engine tests. Four cyclic thermal shock rig tests were conducted during the program. Three completed 1000 simulated engine thermal cycle tests and the fourth completed 500 cycles without severe cracking or spalling. Three ceramic seals were installed in a JT9D experimental engine to evaluate the effect of the engine thermal environment on the seals. All three seals completed the test successfully without severe cracking or spalling. The three seals did have slight laminar cracks at the 85/15-40/60 ZrO₂/CoCrAlY interface. The second engine test evaluated the rub capabilities of the seal. Six ceramic seals were installed in the engine with fourteen abrasive tip blades. Three of the six seals rubbed to a depth of 24 mils. Eight of the fourteen abrasive tip blades showed evidence of wear. Three of the eight blades wore a maximum of five mils. Engine rub test results demonstrated the potential of reducing turbine clearances and thereby improving engine performance by use of sprayed ceramic seals. J.M.S.

N80-21333*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

STEADY-STATE PERFORMANCE OF J85-21 COMPRESSOR AT 100 PERCENT OF DESIGN SPEED WITH AND WITHOUT INTERSTAGE RAKE BLOCKAGE

Roger A. Werner Mar. 1980 36 p refs

(NASA-TM-81451; E-377) Avail: NTIS HC A03/MF A01 CSCL 21E

Internal compressor instrumentation blockage effects on steady state J85-21 compressor performance at 100 percent of design speed are determined. The blockage was generated by instrumented vanes for the first three compressor stages and by removal rakes for stages 4 to 9. Individual flow passage blockages ranged up to 4.5 percent with the instrumented vanes and up to 22 percent with the removable interstage rakes. At a Reynolds number index of 1.0, pressure ratio and airflow remained unchanged with insertion of the interstage rakes, but efficiency dropped 0.3 percentage point. Compressor exit profiles, compressor stage static pressure rise coefficients, turbine exit temperature, and fuel flow are also presented. J.M.S.

N80-21334*# Pratt and Whitney Aircraft Group, West Palm Beach, Fla.

DATA ANALYSIS OF P SUB T/P SUB S NOSEBOOM PROBE TESTING ON F100 ENGINE P680072 AT NASA LEWIS RESEARCH CENTER Final Report

C. H. Foote Mar. 1980 23 p

(Contract NAS3-19442)

(NASA-CR-159816; PWA-FR-12540) Avail: NTIS HC A02/MF A01 CSCL 21E

Results from the altitude testing of a P sub T/P sub S noseboom probe on the F100 engine are discussed. The results are consistent with sea level test results. The F100 engine altitude test verified automatic downmatch with the engine pressure ratio control, and backup control inlet case static pressure demonstrated sufficient accuracy for backup control fuel flow scheduling. The production P6 probe measured Station 6 pressures accurately for both undistorted and distorted inlet airflows. M.G.

N80-21335# Ford Motor Co., Dearborn, Mich.
X-RAY RADIOGRAPHY OF GAS TURBINE CERAMICS Annual Report, 1 Oct. 1978 - 30 Sep. 1979

D. J. Cassidy and M. F. Elgart Oct. 1979 28 p

(Contract N00014-78-C-0714)

(AD-A080440; AR-1) Avail: NTIS HC A03/MF A01 CSCL 11/2

This program was conceived for the purpose of investigating X-ray radiography and X-ray tomography in the detection of gross fabrication flaws in complex-shaped ceramic components such as those currently under development for advanced high temperature turbine engines. The first year effort of the program was directed towards the fabrication of ceramic test coupons with defects of known size and shape; the establishment of baseline data for the resolution of these defects using Microfocus X-ray equipment; the definition of equipment concepts for a computer assisted tomography (CAT) system; and the development of a CAT algorithm. Silicon nitride coupons with slot type defects (25-175 microns) and circular shaped defects (25-1000 microns) were fabricated. Baseline data were obtained from these test coupons using Microfocus X-ray and image enhancement techniques. A Computer Assisted Tomography (CAT) design concept was defined, which employs a computer-operated rotary stage, intensifying screen or X-ray film, TV camera, computer, digital image analyzer, and TV monitor. Computer reconstruction algorithms were investigated with respect to CAT and a preferred approach was determined. An appropriate CAT algorithm was written and tested. GRA

N80-21336*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

DYNAMICS STABILITY DERIVATIVES OF SPACE SHUTTLE ORBITER OBTAINED FROM WIND-TUNNEL AND APPROACH AND LANDING FLIGHT TESTS

Delma C. Freeman, Jr. Washington Apr. 1980 20 p refs

(NASA-TP-1634; L-13427) Avail: NTIS HC A02/MF A01 CSCL 01C

A comparison was made between ground facility measurements, the aerodynamic design data book values, and the dynamic damping derivatives extracted from the space shuttle orbiter approach and landing flight tests. The comparison covers an angle of attack range from 2 deg to 10 deg at subsonic Mach numbers. The parameters of pitch, yaw, and roll damping, as well as the yawing moment due to rolling velocity and rolling moment due to yawing velocity are compared. J.M.S.

N80-21337# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

ACTIVE CONTROL TECHNOLOGY, VOLUME 1

1978 224 p refs Lecture held at Rhode-Saint-Genese, Belgium, 4-8 Dec. 1978 2 Vol.

(VKI-Lec-Ser-1979-1-Vol-1) Avail: NTIS HC A10/MF A01

Active control technology is assessed. The theory behind active control is analyzed and active control systems and techniques including fly by wire control, are discussed. Active control capabilities in conjunction with electronic technology are examined in relation to increasing aircraft performance, operational flexibility, and design flexibility.

N80-21338# Air Force Flight Dynamics Lab., Wright-Patterson AFB Ohio.

ACTIVE CONTROL TECHNOLOGY

Morris A. Ostgaard In Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 59 p refs

Avail: NTIS HC A10/MF A01

Active control technology, defined as an extension of conventional feedback control systems which provide a multiple input, multiple output capability is assessed. Active control permits uncoupling of the aircraft equations for motion to allow full exploitation of the complete six degrees of control freedom as compared to the conventional four degrees of control freedom. Active control design considerations are discussed in which a B-52 aircraft was used as the test vehicle for the analysis, development, and flight demonstration of the load alleviation and mode stabilization concepts. Significant performance improvements in the areas of augmented stability, gust load alleviation, fatigue reduction, maneuver load control, ride control, and flutter mode control are reported. The historical background and the future potential of active control are discussed. A.W.H.

N80-21339# British Aerospace Aircraft Group, Warton (England).
ACTIVE CONTROLS FOR COMBAT AIRCRAFT
 B. R. A. Burns *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 14 p refs

Avail: NTIS HC A10/MF A01

The effects of active controls technology on combat aircraft, in terms of weight reduction achieved, performance, and handling improvements are reviewed. It is shown that significant improvements in performance are achieved with artificial longitudinal stability coupled with automatic operation of combat flaps. The adoption of spin prevention and automatic maneuver limitation is discussed. The engineering features of a full time fly by wire system are presented. A.W.H.

N80-21340# Controle Automatique Generaleise, Brussels (Belgium).
EXPERIMENTATION OF A GENERALIZABLE FLY-BY-WIRE CONTROL SYSTEM ON THE CONCORDE AIRCRAFT
 J. C. Maffre and Y. Negre (Soc. Nacl. Ind. Aerospatiale, Toulouse, France) *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 19 p ref

Avail: NTIS HC A10/MF A01

The principle of fly by wire controls in flight operations using the Concorde aircraft as the test vehicle is analyzed. Two factors in the design study, the safety level to be achieved and certain basic aircraft data, such as the number and type of control surfaces, the number of hydraulic systems, etc., are highlighted. The fly by wire control system tested on the Concorde aircraft is described and the various operating modes of the hybrid system are discussed. The digital techniques used for the fly by wire computers are reported. Ground tests on the system, including the computer tests and the rig tests, are described. The flight tests are summarized and the results for the computer systems and the controllability of the Concorde aircraft are presented. A.W.H.

N80-21341# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
ENGINEERING OF CONTROL SYSTEMS AND IMPLICATIONS ON CONTROL LAW DESIGN
 F. R. Gill *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 18 p refs

Avail: NTIS HC A10/MF A01

The state of the art of multiplexed digital flight control systems are reviewed in relation to integrity requirements and the means of achieving integrity. The need for variable and changeable control is discussed and the potential of pilot selectable task oriented control is examined. Several variable control concepts are discussed with emphasis placed on the problems in control law design. Integrity requirements are delineated and a multiplexed digital flight control system and its subsystems are described. A.W.H.

N80-21342# Marconi Avionics Ltd., Rochester (England).
HIGH INTEGRITY FIBER OPTIC DATA TRANSMISSION
 A. J. Alexander *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 23 p refs

Avail: NTIS HC A10/MF A01

The problem of data transmission in high integrity, safety critical, airborne applications, as found in fly by wire flight control or active controls techniques, is addressed. The general principles of data transmission as applied to the overall system design considerations are discussed. Two data transmission media, electrical and fiber optic links, are described. Aspects of fiber optic system design and implementation, component design, and availability as well as installation techniques and practices are discussed. The complete absence of electromagnetic interference in the data transmission medium with fiber optics and the inherent electrical isolation and resistance to failure propagation are addressed. A.W.H.

N80-21343# Royal Aircraft Establishment, Bedford (England).
THE FLYING QUALITIES OF AIRCRAFT WITH AUGMENTED

LONGITUDINAL AND DIRECTIONAL STABILITY
 W. J. G. Pinsker *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 1 1978 23 p refs

Avail: NTIS HC A10/MF A01

The flying qualities of relaxed stability aircraft, stabilized by various possible feedback strategies, are discussed. Flying qualities are defined as gust response, the behaviour near and beyond the stall, steady maneuvering characteristics, and control and stability during the ground roll. The augmentation of relaxed stability by active control using either direct feedbacks or indirect feedbacks is examined. A.W.H.

N80-21344# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

ACTIVE CONTROL TECHNOLOGY, VOLUME 2
 1978 411 p refs Lecture held at Rhode-Saint-Genese, Belgium, 4-8 Dec. 1978 2 Vol.

(VKI-Lec-Ser-1979-1-Vol-2) Avail: NTIS HC A18/MF A01
 The technology of actively employing control to achieve aircraft design objectives is considered. Specific topics covered include gust alleviation, direct lift control, flutter suppression, and improved riding quality.

N80-21345# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

ACTIVE CONTROL TECHNOLOGY FOR GUST ALLEVIATION
 B. Krag *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 78 p refs

Avail: NTIS HC A18/MF A01

Wind tunnel tests utilizing remotely controlled models were performed in order to develop a gust alleviation system for future application in a small twin-engined transport aircraft. Emphasis was placed on open loop gust compensation systems. Gust angle of attack as well as the complicated interaction of downwashes, dead-times, actuator lags, sensor position, and unsteady aerodynamic transient effects were measured. The design methodology of a mixed open loop and closed loop gust alleviation system is presented. J.M.S.

N80-21346# British Aerospace Aircraft Group, Warton (England).
GUST LOAD ALLEVIATION

H. Hitch *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 12 p

Avail: NTIS HC A18/MF A01

Mathematical modeling of gust loads on wings is discussed with emphasis on gust load alleviation. Aircraft dynamic models are included. Load reduction achievable with an ACT load alleviation system is discussed. J.M.S.

N80-21347# Rockwell International Corp., Los Angeles, Calif. Dynamics Technology Staff.

B-1 RIDE CONTROL SYSTEM DESIGN DEVELOPMENT AND TEST

John H. Wykes *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 16 p refs

Avail: NTIS HC A18/MF A01

The design development, including system requirements and mechanization details of the B-1 aircraft control configured vehicle (CCV) concept ride control system is presented. The design implementation is also discussed, including hardware and installation details. Flight test performance evaluations, comparisons of analytical and test data, system improvements, and flight crew evaluations are presented. While the detailed information is provided for a system designed to improve ride quality through control of structural motion, it is concluded that the technology discussed is applicable to load relief and even flutter suppression of flexible vehicles, military or commercial. J.M.S.

N80-21348# Calspan Corp., Buffalo, N. Y.
DIRECT FORCE CONTROL AND TESTING

Robert P. Harper, Jr. *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 46 p refs

Avail: NTIS HC A18/MF A01

Direct lift and direct side force control is considered in terms of the potential in active control technology. The influence of fly by wire control systems on the development of direct lift and direct side force control is emphasized. Control in crosswind landing and air to ground weapon delivery situations is discussed. Conclusions are given. J.M.S.

N80-21349# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

DIRECT FORCES FROM FLIGHT TESTING

Claudius LaBurthe *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 26 p

Avail: NTIS HC A18/MF A01

Flight testing analysis of direct forces is discussed. Three kinds of problems, which may be artificially separated for study and explanation, but are in fact deeply interconnected are described. The results of an in-flight experimentation of the use of direct forces on the variable stability Navion aircraft are discussed. R.E.S.

N80-21350# Liege Univ. (Belgium).

ANALYTICAL TOOLS FOR ACTIVE FLUTTER SUPPRESSION

M. Geradin *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 47 p refs

Avail: NTIS HC A18/MF A01

Two analytical aspects of flutter mode control systems are discussed: (1) the unsteady aerodynamics of the lifting surface, and (2) the synthesis of the control law using modern control theory. Aerodynamic modeling via mathematical modeling is described for two dimensional incompressible flow. R.E.S.

N80-21351# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

EXTERNAL STORE FLUTTER SUPPRESSION WITH ACTIVE CONTROLS

H. Hoenlinger and R. Destuynder *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 86 p refs Prepared in cooperation with ONERA, Leclerc (France)

Avail: NTIS HC A18/MF A01

A review is made of recent advances in the development of active flutter suppression systems. The methods used to optimize control laws for active flutter suppression are presented. Practical applications on wing store flutter cases are described. Wind tunnel and flight test results are shown illustrating the efficiency of the systems. Problems of integration into the flight control system and flight testing are discussed. R.E.S.

N80-21352# Marconi Avionics Ltd., Rochester (England).

FLYING QUALITIES AND PILOTING WITH RESPECT TO CONTROLS AND DISPLAYS

R. H. Holmes *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 29 p refs

Avail: NTIS HC A18/MF A01

The problems of head-up presentation of flight path angle are discussed with particular reference to the increased maneuvering envelopes available through the use of active control technology. The peculiar problems created by VSTOL Aircraft flight path presentation are described. It is concluded that the stability conferred by active controls together with head-up flight path angle display will markedly reduce pilot workload during low altitude flight. R.E.S.

N80-21353# Centre d'Essais en Vol, Istres (France).

FLIGHT TESTING OF SEVERAL CONTROL LAWS OF A FLY-BY-WIRE SYSTEM

Jean-Pierre Petit *In* Von Karman Inst. for Fluid Dyn. Active Control Technol., Vol. 2 1978 18 p

Avail: NTIS HC A18/MF A01

A fly-by-wire system was installed on a Mirage 3 aircraft for study purposes. Four pitch controls laws associated with one roll control law were developed and tested. More than 40 pilots flew the aircraft for evaluation. The fly-by-wire installation, the controls laws used, and the flight tests methods are described and the main results are summarized. R.E.S.

N80-21354*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A MODEL-BASED TECHNIQUE FOR PREDICTING PILOT OPINION RATINGS FOR LARGE COMMERCIAL TRANSPORTS Final Report

William H. Levison Washington NASA Apr. 1980 78 p refs

(Contract NAS1-15529)

(NASA-CR-3257) Avail: NTIS HC A05/MF A01 CSCL 01C

A model based technique for predicting aircraft handling qualities is described. Features of this procedure, which is based on the optimal control model for pilot/vehicle systems, include (1) capability to treat unconventional aircraft dynamics, (2) a relatively free form pilot model, (3) a simple scalar metric for attentional workload, and (4) a straightforward manner of proceeding from descriptions of the flight task environment and requirements to a prediction of pilot opinion rating. The method was able to provide a good match to a set of pilot opinion ratings obtained in a manned simulation study of large commercial aircraft in landing approach. Author

N80-21355*# National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, Calif.

DESIGN OF A NONLINEAR ADAPTIVE FILTER FOR SUPPRESSION OF SHUTTLE PILOT-INDUCED OSCILLATION TENDENCIES

John W. Smith and John W. Edwards Apr. 1980 31 p refs (NASA-TM-81349; H-1119) Avail: NTIS HC A03/MF A01 CSCL 01C

Analysis of a longitudinal pilot-induced oscillation (PIO) experienced just prior to touchdown on the final flight of the space shuttle's approach landing tests indicated that the source of the problem was a combination of poor basic handling qualities aggravated by time delays through the digital flight control computer and rate limiting of the elevator actuators due to high pilot gain. A nonlinear PIO suppression (PIOS) filter was designed and developed to alleviate the vehicle's PIO tendencies by reducing the gain in the command path. From analytical and simulator studies it was shown that the PIOS filter, in an adaptive fashion, can attenuate the command path gain without adding phase lag to the system. With the pitch attitude loop of a simulated shuttle model closed, the PIOS filter increased the gain margin by a factor of about two. A.R.H.

N80-21356# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

MODEL ORDER REDUCTION USING THE BALANCED STATE REPRESENTATION THEORY, APPLICATION AND INTERACTIVE SOFTWARE IMPLEMENTATION M. S. Thesis

James Robert McClendon Dec. 1979 239 p refs (AD-A080371; AFIT/GE/EE/79-22) Avail: NTIS HC A11/MF A01 CSCL 20/4

This report investigates a model order reduction technique developed by Dr. Bruce Moore of the University of Toronto, as applied to the B-52E flutter control problem currently under study by the Air Force Flight Dynamics Laboratory. The algorithm, which is based upon singular value analysis, is applied to the full twenty-fourth order model yielding an internally balanced representation which is balanced with respect to controllability and observability properties. The system is reduced in order, and comparisons are made between the Moore algorithm model and that obtained via a method used by the Air Force Flight Dynamics Laboratory. In addition to this investigation, an interactive program is presented which contains the model order reduction algorithm. Other capabilities include: estimation of the condition number with respect to inversion, singular value and condition number plotting vs. sample time for discrete time controllability, observability, and Hankel matrices, frequency

response generation, and various special coordinate system transformation. GRA

N80-21357# Dynamic Controls, Inc., Dayton, Ohio.
RESEARCH AND DEVELOPMENT OF CONTROL ACTUATION SYSTEMS FOR AIRCRAFT, VOLUME 1 Final Report.
 Jun. 1977 - Feb. 1979

Gavin D. Jenny Aug. 1979 211 p refs
 (Contract F33615-77-C-3077; AF Proj. 2403)
 (AD-A080133; AFFDL-TR-79-3117-Vol-1) Avail: NTIS
 HC A10/MF A01 CSCL 01/3

This report describes the development of a flutter suppression actuator technique and the wind tunnel evaluation of that technique. The report also describes the flightworthiness testing of a direct drive Fly-By-Wire flight control system applied to the aileron axis of an F-4 aircraft. Also included is an evaluation of an angular rate sensing augmentation actuator supplied to the Air Force for evaluation. Presented in the material are the test results of all three experimental evaluations. Further testing of the flutter suppression is recommended to clarify an anomaly in the results of the testing. The direct drive control system passed its environmental testing used to establish flight worthiness. The rate sensing actuator operated as designed. GRA

N80-21358# European Space Agency, Paris (France).
IN FLIGHT TESTS OF A PARAMETER INSENSITIVE CONTROLLER

Gerhard Kreisselmeier and Reinhold Steinhauser Nov. 1979
 75 p refs Transl. into ENGLISH of "Flugversuchsergebnisse Mit Einem Parameterunempfindlichen Regler", Rept. DFVLR-FB-78-07 DFVLR, Oberpfaffenhofen, West Germany, May 1978
 Original report in GERMAN previously announced as N79-30197
 Original German report available from DFVLR, Cologne DM 30,30

(ESA-TT-565; DFVLR-FB-78-07) Avail: NTIS
 HC A04/MF A01

A design procedure for controllers is presented which makes it possible to allow for all the demands made on control behavior. It was used to design a controller for the longitudinal motion of the DO-28D Skyservant that ensures maintenance of the desired flying qualities in both the guidance and the disturbance behavior throughout the flight range of the aircraft. The design pays particular attention to obtaining a low elevator setting speed and a harmonic time pattern of the elevator deflection. The influence of the airborne computer on the control behavior is examined and the results of the flight tests are compared with those of the simulations. Author (ESA)

N80-21454*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

EVALUATION OF MICRON SIZE CARBON FIBERS RELEASED FROM BURNING GRAPHITE COMPOSITES

B. Sussholz Hampton, Va. NASA, Langley Res. Center Apr. 1980 82 p refs
 (Contract NAS1-15465)

(NASA-CR-159217; TRW-80-06) Avail: NTIS
 HC A05/MF A01 CSCL 11D

Quantitative estimates were developed of micron carbon fibers released during the burning of graphite composites. Evidence was found of fibrillated particles which were the predominant source of the micron fiber data obtained from large pool fire tests. The fibrillation phenomena were attributed to fiber oxidation effects caused by the fire environment. Analysis of propane burn test records indicated that wind sources can cause considerable carbon fiber oxidation. Criteria estimates were determined for the number of micron carbon fibers released during an aircraft accident. An extreme case analysis indicated that the upper limit of the micron carbon fiber concentration level was only about half the permissible asbestos ceiling concentration level. Author

N80-21488*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

APPLICATION OF SUPERALLOY POWDER METALLURGY FOR AIRCRAFT ENGINES

R. L. Dreshfield and R. V. Miner, Jr. 1980 21 p refs Proposed for presentation at Intern. Powder Met. Conf., Washington, D.C.,

22-27 Jun. 1980

(NASA-TM-81466; E-395) Avail: NTIS HC A02/MF A01 CSCL 11F

In the last decade, Government/Industry programs have advanced powder metallurgy-near-net-shape technology to permit the use of hot isostatic pressed (HIP) turbine disks in the commercial aircraft fleet. These disks offer a 30% savings of input weight and an 8% savings in cost compared in cast-and-wrought disks. Similar savings were demonstrated for other rotating engine components. A compressor rotor fabricated from hot-die-forged-HIP superalloy billets revealed input weight savings of 54% and cost savings of 35% compared to cast-and-wrought parts. Engine components can be produced from compositions such as Rene 95 and Astroloy by conventional casting and forging, by forging of HIP powder billets, or by direct consolidation of powder by HIP. However, each process produces differences in microstructure or introduces different defects in the parts. As a result, their mechanical properties are not necessarily identical. Acceptance methods should be developed which recognize and account for the differences. A.R.H.

N80-21493*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECTS OF FINE POROSITY ON THE FATIGUE BEHAVIOR OF A POWDER METALLURGY SUPERALLOY

R. V. Miner, Jr. and R. L. Dreshfield 1980 25 p refs Presented at Ann. Meeting of the Am. Inst. of Mining, Met. and Petroleum Engr., Las Vegas, Nev., 24-28 Feb. 1980

(NASA-TM-81448; E-367) Avail: NTIS HC A02/MF A01 CSCL 11F

Hot isostatically pressed powder metallurgy Astroloy was obtained which contained 1.4 percent fine porosity at the grain boundaries produced by argon entering the powder container during pressing. This material was tested at 650 C in fatigue, creep fatigue, tension, and stress-rupture and the results compared with previous data on sound Astroloy. The pores averaged about 2 micrometers diameter and 20 micrometers spacing. They did influence fatigue crack initiation and produced a more intergranular mode of propagation. However, fatigue life was not drastically reduced. A large 25 micrometers pore in one specimen resulting from a hollow particle did not reduce life by 60 percent. Fatigue behavior of the porous material showed typical correlation with tensile behavior. The plastic strain range life relation was reduced proportionately with the reduction in tensile ductility, but the elastic strain range-life relation was little changed reflecting the small reduction in sigma sub u/E for the porous material. R.C.T.

N80-21510# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics and Materials Science.

ULTRASONIC AND ACOUSTIC EMISSION DETECTION OF FATIGUE DAMAGE Annual Technical Report, 1 Jun 1978 - 31 May 1979

S. R. Buxbaum, C. L. Friant, S. E. Fick, and R. E. Green, Jr. Jul. 1979 74 p ref

(Contract F44620-76-C-0081; AF Proj. 2307)
 (AD-A079277; AFOSR-79-1287TR) Avail: NTIS
 HC A04/MF A01 CSCL 11/6

The purpose of the present research is to optimize existing ultrasonic and acoustic emission techniques and to investigate new ones for early detection of fatigue damage in aluminum alloys used in aircraft construction. An ultrasonic pulse-echo system was used during fatigue cycling to record conventional A-scan wave forms as well as to monitor ultrasonic attenuation on 7075-T651 aluminum alloy specimens possessing different surface conditions. In addition, acoustic emission signals were recorded simultaneously with the ultrasonic measurements on each test specimen using two different acoustic emission systems. The task of correlating evidence of cumulative fatigue damage and acoustic emission data was approached by the use of long term true-rms averaging of the system output and frequency domain analysis of acoustic emission signals recorded at selected intervals throughout the test. The integrity of the data was verified by independent electronic testing of the instrumentation, in situ eddy current and visual inspection, and metallographic examination. GRA

N80-21611# Royal Aircraft Establishment, Farnborough (England).

AN INVESTIGATION INTO THE REAL GAS EFFECTS OF CRYOGENIC NITROGEN IN INVISCID HOMETROPIC FLOW

C. M. Albone London HMSO May 1979 18 p refs
(RAE-TM-Aero-1805; BR68895) Avail: NTIS
HC A02/MF A01

The real gas effects of nitrogen at low temperatures are examined in terms of its use as a test gas in a high Reynolds number transonic wind tunnel. Inviscid, isentropic flow of a nonconducting gas is studied with the use of a simplified equation of state which enables an expression for enthalpy (and hence the terms in Bernoulli's equation) to be derived by analytic integration. Author (ESA)

N80-21627# Syracuse Univ., N. Y. Dept. of Electrical Engineering.

FEATURES STUDY: A STUDY OF RF EXTERNAL TRANSMISSIONS Final Technical Report, 15 Oct. 1978 - 30 Jun. 1979

J. Perini, B. Silverman, and E. Nyakabwa Griffiss AFB, N.Y. RADC Nov. 1979 78 p
(Contract F30602-78-C-0083; AF Proj. 0173)
(AD-A080604; RADC-TR-79-272) Avail: NTIS
HC A05/MF A01 CSCL 20/14

Cepstrum and Fast Fourier Transform techniques are developed which provide a theoretical basis for determining the configuration of aircraft and space vehicles. Some of the limiting assumptions of the analysis, and possible problem areas are discussed. The antenna radiation pattern of an omnidirectional antenna is largely determined by the shape, composition, location and size of the features of the vehicle to which the antenna is attached. The objective of this effort was to develop a method for determining the features and/or configuration of an aircraft or space vehicle from signals transmitted by those vehicles. A signal processing technique called Cepstral Processing offered the best chance to do this. Cepstral Processing is based on the fact that an RF signal sensed in the far field of the transmitting antenna will be a complex composite of the direct antenna signal path, and multipath reflections from vehicle wing surfaces, landing gear struts, fuel pods, etc. This report documents two possible approaches for extracting required feature information from omnidirectional signals. The first approach is Time Signal Processing. The second approach is Antenna Radiation Pattern Processing. GRA

N80-21640# Ohio State Univ., Columbus. Electroscience Lab.

RESEARCH ON NEAR FIELD PATTERN EFFECTS Final Report

N. Wang and W. D. Burnside Nov. 1979 27 p refs
(Contract N00019-78-C-0524)
(AD-A079325; ESL-711305-4) Avail: NTIS
HC A03/MF A01 CSCL 20/14

Under the present contract, a simple and efficient multiple-plate model has been developed for the aircraft substructures. Using this model, the tail, wings, stabilizer and engine housings can be easily simulated. A three dimensional model (i.e., prolate spheroid) is employed for investigating the radiation from an aircraft fuselage. In addition, high frequency solutions for the electric field due to antennas radiating from a perfectly conducting convex body are developed. The expressions are given in terms of a fixed ray coordinate system which follows the geodesic path on the conducting surface. These expressions are simple, compact, and are given in terms of some well known and tabulated Fock integrals. Furthermore, these expressions reduce to the geometrical optics solution in the 'deep' lit region and recover the Keller's surface ray representation in the deep shadow region. The continuity of the fields across the shadow boundary is also established. A major task of applying the high frequency solution to solve practical problems, (namely, determining the unique geodesic path on the conducting surface), is also accomplished in the case of a prolate spheroid. Numerical results obtained by employing the newly developed solution are in good agreement with eigenfunction solutions and measured results. GRA

N80-21649# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A STATISTICAL MODEL FOR MULTIPATH REFLECTION EFFECTS OF ANTENNAS MOUNTED ON AIRCRAFT M.S. Thesis

Jeffrey L. Frack Dec. 1979 103 p refs
(AD-A080369; AFIT/GE/EE/79-14) Avail: NTIS
HC A06/MF A01 CSCL 09/5

A statistical model of the effects of multipath reflections for antenna arrays mounted on aircraft is developed to predict antenna system performance as a function of communication signal arrival angle. Each array element is assumed to have an electric field pattern that is a Gaussian random process with known statistics. These assumptions are used to find the statistic for the array. From these statistics the performance of the antenna of the system can be found using three performance measures for the array: the probability that the array gain is above a threshold; probability level curves to show what threshold function the gain will be above a specified percentage of the time; and the probability that the array gain will be above some threshold on an entire interval. These performance measures are evaluated for a specific array configuration for a set of assumed statistics and then plotted versus arrival angle. The results for different array variance are compared and the result is that higher variance results in poorer average antenna performance. The same measures are than evaluated for an array whose statistics are determined from actual measured data. GRA

N80-21679# RCA Government Communications Systems, Camden, N. J.

SOLID STATE POWER CONTROLLERS (ISEM-2A) Final Report

P. J. Coyle and C. L. Whitman Nov. 1979 69 p ref
(Contract N62269-77-C-0413)
(AD-A080482; NADC-79094-60) Avail: NTIS
HC A04/MF A01 CSCL 09/5

This report covers an engineering study to determine the optimum dc power controller configuration for ISEM-2A modules. The study indicates that two 10 amp or four 5 amp controllers can be mounted on one ISEM-2A frame, and that each 10 amp unit will have a predicted reliability of nearly one million hours before failure. Mounting of dc controllers using existing technology is discussed, and thermal performance of various frame material is tabulated and evaluations made. Finally, methods of circuit simplification using recently developed components, LSI and advanced packaging techniques which reduce cost, increase reliability and improve manufacturability are described. GRA

N80-21702*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

VELOCITY-SPLIT NAVIER-STOKES SOLUTION PROCEDURE FOR INCOMPRESSIBLE HIGH REYNOLDS NUMBER EXTERNAL FLOWS

Douglas L. Dwyer Washington Apr. 1980 36 p refs
(NASA-TP-1655; L-13343) Avail: NTIS HC A03/MF A01
CSCL 20D

A method for solving the Navier-Stokes equations based on splitting the velocity vector into its rotational and irrotational parts was successfully applied to internal flow computations. The applicability of the method to external flows is examined by studying several model problems. The model problems are those of laminar and turbulent incompressible flow past a semi-infinite flat plate and laminar incompressible flow past a finite flat plate. For these problems, the procedure accurately reproduces the known solutions and is computationally very efficient even at high Reynolds numbers. Computational aspects of the method are discussed along with the possibility of using the procedure to retrofit a viscous capability into existing potential flow codes. J.M.S.

N80-21703*# Cambridge Hydrodynamics, Inc., Mass. **STABILITY ANALYSIS FOR LAMINAR FLOW CONTROL, PART 2 Final Report**

Steven A. Orszag Washington NASA Apr. 1980 23 p refs
(Contract NAS1-14907)
(NASA-CR-3249) Avail: NTIS HC A02/MF A01 CSCL 20D

Topics covered include: (1) optimization of the numerics of

the SALLY stability analysis code; (2) relation between temporal and spatial stability theory; (3) compressible flow stability calculations; (4) spectral methods for the boundary layer equations; and (5) numerical study of nonlinear, nonparallel stability of incompressible flows. A.R.H.

N80-21705# Naval Surface Weapons Center, Dahlgren, Va. Research and Technology Dept.

AN INTEGRAL METHOD AND ITS APPLICATION TO SOME THREE-DIMENSIONAL BOUNDARY-LAYER FLOWS

T. F. Zien 18 Jul. 1979 46 p refs
(ZR0140201)

(NSWC-TR-79-139) Avail: NTIS HC A03/MF A01

The simple integral method was developed and employed to provide accurate approximate solutions to a wide variety of problems in viscous boundary-layer flows and transient heat conduction with phase changes. A boundary value problem in ordinary differential equation is used as the model problem. Different schemes of the method used in earlier applications are examined along with a potentially more accurate scheme. On the basis of the comparison between the approximate solutions and the exact solution, the relative merits of the various schemes are assessed as well as the judicious choice of the approximate profiles for use in the calculation. The method is then applied to yield approximate solutions of a class of relatively simple three dimensional boundary-layer flows. Results on boundary layers on a semi-infinite flat plate with parabolic and circular inviscid surface streamlines, and boundary layers over an infinite yawed wing are presented in terms of skin-friction, and are all obtained in simple closed form. Comparisons with existing exact solutions indicate the accuracy of the method. A.R.H.

N80-21706# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMILARITY TESTS OF TURBINE VANES. EFFECTS OF CERAMIC THERMAL BARRIER COATINGS

Herbert J. Gladden 1980 14 p refs Proposed for Presentation at 1980 Natl. Heat Transfer Conf., Orlando, Fla., 27-30 Jul. 1980; sponsored by Heat Transfer and Gas Turbine Div. of ASME
(NASA-TM-81473; E-407) Avail: NTIS HC A02/MF A01 CSCL 20D

The role of material thermal conductivity was analyzed for its effect on the thermal performance of air-cooled gas turbine components coated with a ceramic thermal barrier material when tested at reduced temperatures and pressures. It is shown that the thermal performance can be evaluated reliably at reduced gas and coolant conditions; however, thermal conductivity corrections are required for the data at reduced conditions. Corrections for a ceramic thermal barrier coated vane are significantly different than for an uncoated vane. Comparison of uncorrected test data, therefore, would show erroneously that the thermal barrier coating was ineffective. When thermal conductivity corrections are applied to the test data these data are then shown to be representative of engine data and also show that the thermal barrier coating increases the vane cooling effectiveness by 12.5 percent. A.R.H.

N80-21753# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATING CHARACTERISTICS OF HIGH-SPEED, JET-LUBRICATED 35-MILLIMETER-BORE BALL BEARING WITH A SINGLE-OUTER-LAND-GUIDED CAGE

Fredrick T. Schuller, Stanley I. Pinel (Industrial Tectonics, Inc.), and Hans R. Signer (Industrial Tectonics, Inc.) Washington Apr. 1980 16 p refs

(NASA-TP-1657; E-220) Avail: NTIS HC A02/MF A01 CSCL 13 I

Parametric tests of a 35 mm bore, angular contact ball bearing with a single outer land guided cage were conducted on a high temperature, high speed bearing tester. Provisions were made for jet lubrication of the bearing and for outer ring cooling. Test conditions included two different thrust loads and a combined thrust and radial load. Nominal shaft speeds were 28,000 to 72,000 rpm, with an oil-in temperature of 394 K (250 F). The bearing was successfully operated to 2.5 million DN at a maximum thrust load of 1334 N (300 lb) and at a combined 667 N (150-lb) thrust and 222 N (50-lb) radial load.

Bearing temperatures increased with shaft speed and decreased with increasing lubricant flow rate. Inner-ring temperature was generally lower than outer ring temperature. Lower operating temperatures resulted from cooling the outer ring. Bearing power loss increased as the lubricant flow rate, speed, or load was increased. The increase in percent cage slip with increasing lubricant flow rate was minimal for all speed and load conditions tested. Percent cage slip decreased significantly when the thrust load was doubled, but it increased appreciably with speed.

Author

N80-21927# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LIGHTNING TECHNOLOGY: PROCEEDINGS OF A TECHNICAL SYMPOSIUM

Apr. 1980 444 p refs Symp. held in Hampton, Va., 22-24 Apr. 1980; sponsored in cooperation with Fla. Inst. of Technol. and DOT

(NASA-CP-2128; L-13666; FAA-RD-80-30) Avail: NTIS HC A19/MF A01 CSCL 04B

Several facets of lightning technology are considered including phenomenology, measurement, detection, protection, interaction, and testing. Lightning electromagnetics, protection of ground systems, and simulated lightning testing are emphasized. The lightning-instrumented F-106 aircraft is described.

N80-21929# Florida Univ., Gainesville. Dept. of Electrical Engineering.

CALCULATIONS OF LIGHTNING RETURN STROKE ELECTRIC AND MAGNETIC FIELDS ABOVE GROUND

M. A. Uman, Y. T. Lin, R. B. Standler, M. J. Master, and R. J. Fisher (Kaman Sciences Corp., Colo. Springs) In NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 21-28 refs

(Contracts N00014-75-C-0143; F33615-79-C-3412; Grant NSF ATM-76-01454)

Avail: NTIS HC A19/MF A01 CSCL 04B

A lightning return stroke model with which the two station electric and magnetic fields measured at ground level can be reproduced is used to compute fields at altitudes up to 10 km and at ranges from 20 m to 10 km. These calculations provide the first detailed estimates of the return strokes fields that are encountered by aircraft in flight. With the advent of modern aircraft utilizing low voltage digital electronics and reduced electromagnetic shielding by way of structures containing advanced composite materials, these calculations are of considerable practical interest. Further, since airborne electric and magnetic field measurements are presently being attempted, a comparison of the calculations presented with appropriate experimental data, when they are available, will constitute a test of the return stroke model. J.M.S.

N80-21934# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BROADBAND ELECTROMAGNETIC SENSORS FOR AIRCRAFT LIGHTNING RESEARCH

Thomas F. Trost (Texas Technological Univ.) and Klaus P. Zaepfel In its Lightning Technol. Apr. 1980 p 131-152 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

A set of electromagnetic sensors, or electrically-small antennas, is described. The sensors are designed for installation on an F-106 research aircraft for the measurement of electric and magnetic fields and currents during a lightning strike. The electric and magnetic field sensors mount on the aircraft skin. The current sensor mounts between the nose boom and the fuselage. The sensors are all on the order of 10 cm in size and should produce up to about 100 V for the estimated lightning fields. The basic designs are the same as those developed for nuclear electromagnetic pulse studies. The most important electrical parameters of the sensors are the sensitivity, or equivalent area, and the bandwidth (or rise time). Calibration of sensors with simple geometries is reliably accomplished by a geometric analysis; all the sensors discussed possess geometries for which the sensitivities have been calculated. For the calibration of sensors with more complex geometries and for general testing

of all sensors, two transmission lines were constructed to transmit known pulsed fields and currents over the sensors. J.M.S.

N80-21935*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

AIRBORNE LIGHTNING CHARACTERIZATION

Robert K. Baum *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 153-171 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

A WC-130 aircraft was instrumented with wideband electromagnetic field sensors and flown near active thunderstorms to obtain data on the characteristics of nearby and direct strike lightning. An electric field ground station and time-of-arrival network provided time correlated data to identify the three dimensional locations of the discharge and the different events in the lightning flash. A description of the sensors, calibration procedures, and recording equipment is presented. Data are presented on return stroke characteristics in the 5 to 50 km range. Author

N80-21940*# SRI International Corp., Menlo Park, Calif.

SHIELD TOPOLOGY IN LIGHTNING TRANSIENT CONTROL

E. F. Vance and F. M. Tesche (LuTech, Inc.) *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 229-244 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

A formalism in which the interaction of a system with an electromagnetic source is described by sets of scattering, penetrations, and propagation functions is reviewed and interpreted in the context of the lightning interaction problem. In this formalism, the system is decomposed into simple volumes separated by closed shield surfaces. These surfaces are nested and interconnected to produce higher levels of shielding and subvolumes within a given level. The interaction analysis uses scattering theory to define current and charge densities on the shield surface in conjunction with the diffusion, apertures, and transmission line analysis to define penetration through shield imperfections and propagation within the protected volume. Author

N80-21941*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.

THE SEM DESCRIPTION OF INTERACTION OF A TRANSIENT ELECTROMAGNETIC WAVE WITH AN OBJECT

L. Wilson Pearson and Donald R. Wilton (Mississippi Univ., University) *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 245-263 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

The singularity expansion method (SEM), proposed as a means for determining and representing the transient surface current density induced on a scatterer by a transient electromagnetic wave is described. The resulting mathematical description of the transient surface current on the object is discussed. The data required to represent the electromagnetic scattering properties of a given object are examined. Experimental methods which were developed for the determination of the SEM description are discussed. The feasibility of characterizing the surface current induced on aircraft flying in proximity to a lightning stroke by way of SEM is examined. A.W.H.

N80-21942*# Air Force Weapons Lab., Kirtland AFB, N. Mex. **TRANSIENT CORONA EFFECTS ON A WIRE OVER THE GROUND**

Kenneth C. Chen *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 265-281 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

The nuclear EMP effect on VLF/trailing wire antennas is investigated in relation to new features of corona effects. Previous experimental results on transmission lines with corona under $E < 80$ kV/cm recorded in the nanosecond time frame are analyzed. A nonlinear macroscopic model which describes a transmission line with corona is discussed. The model not only accounts for

overall waveform, but also describes the sharp changes in the waveform associated with the corona onset. A.W.H.

N80-21947*# South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.

DIRECT EFFECTS OF LIGHTNING ON AN AIRCRAFT DURING INTENTIONAL PENETRATIONS OF THUNDERSTORMS

Dennis J. Musil and John Prodan *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 363-370 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

An armored T-28 aircraft was struck by lightning on two different days while participating in the 1979 severe environmental storm and mesoscale experiment in Oklahoma. The T-28, which is specially armored and instrumented, was making intentional penetrations of thunderstorms and was struck twice on 30 May and once on 5 June. Various degrees of damage, mainly in the form of large burn spots and holes, resulted to the aircraft. Author

N80-21948*# Electro Magnetic Applications, Inc., Albuquerque, N. Mex.

STATE-OF-THE-ART METHODS FOR COMPUTING THE ELECTROMAGNETIC INTERACTION OF LIGHTNING WITH AIRCRAFT

F. J. Eriksen, R. A. Perala, and John C. Corbin, Jr. (Wright-Patterson AFB, Ohio) *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 371-391 refs

(Contract F33615-79-C-3412)

Avail: NTIS HC A19/MF A01 CSCL 04B

Nuclear electromagnetic pulse (NEMP) coupling codes and methods are evaluated and summarized. The differences between NEMP and lightning interaction with aircraft are discussed and critical parameters peculiar to lightning are examined. R.E.S.

N80-21949*# McDonnell Aircraft Co., St. Louis, Mo.

ANOTHER LOOK AT AIRCRAFT-TRIGGERED LIGHTNING

D. W. Clifford *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 393-416 refs

Avail: NTIS HC A19/MF A01 CSCL 04/2

There is positive evidence that a rapidly moving aircraft charged to high potentials by triboelectric processes can trigger lightning discharges by passage through freezing precipitation. The freezing zone in a nonstormy rain cloud is shown to be an electrically volatile region because of the potent charge exchange mechanisms which are active in agitated mixtures of supercooled water droplet and ice. Several intensifying effects are suggested which can be produced by the passage of an aircraft through this precipitation, resulting in a highly-ionized wake which acts like a trailing conductor. If weak charge centers are present in the cloud, the ionized wake acts to short out the gradient field resulting in very high potentials at the aircraft. The high potentials explain the electrical activity at the aircraft described by pilots, including intense corona, sparks and radio interference terminating in a loud discharge. Lightning strikes to naval aircraft towing gunnery targets at the end of long steel cables are described, showing that the same triggering mechanism may be involved in those cases. Recommendations are made to include triggering experiments in government flight programs now in progress. Author

N80-21950*# Northrop Corp., Hawthorne, Calif. Aircraft Group.

F-5F SHARK NOSE RADOME LIGHTNING TEST

George W. Scott *In* NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 421-429 refs Sponsored by Air Force

Avail: NTIS HC A19/MF A01 CSCL 04B

A unique F-5F radome with a geometry similar to a Shark Nose profile was tested with a high voltage Marx generator, 1,200,000 volts in order to demonstrate the effectiveness of the lightning protection system with currents from 5,000 amperes or greater. An edge discontinuity configuration is a characteris-

tic feature in the forward region of the radome and occasionally serves as an attachment point. The results of nineteen attachment tests at various aspect angles with an air gap of one meter indicated that no damage occurred to the dielectric material of the radome. The test proved the effectiveness of the lightning protection system. R.E.S.

N80-21951*# Lightning and Transients Research Inst., Minneapolis, Minn.

ANALYSIS AND MEASUREMENTS OF LOW FREQUENCY LIGHTNING COMPONENT PENETRATION THROUGH AEROSPACE VEHICLE METAL AND GRAPHITE SKINS

John D. Robb and Ta Chen (Texas Instruments, Inc.) In NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 431-448 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

An analysis of the shielding properties of mixed metal and graphite composite structures has illustrated some important aspects of electromagnetic field penetration into the interior. These include: (1) that graphite access doors on metallic structures will attenuate lightning magnetic fields very little; conversely, metal doors on a graphite structure will also attenuate fields from lightning strike currents very little, i.e., homogeneity of the shield is a critical factor in shielding and (2) that continuous conductors between two points inside a graphite skin such as an air data probe metallic tubing connection to an air data computer can allow large current penetrations into a vehicle interior. The true weight savings resulting from the use of composite materials can only be evaluated after the resulting electromagnetic problems such as current penetrations have been solved, and this generally requires weight addition in the form of cable shields, conductor bonding or external metallization.

Author

N80-21952*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

FULL SCALE LIGHTNING TEST TECHNIQUE

Lawrence C. Walko and John G. Schneider (Technology/Scientific Service, Inc.) In NASA. Langley Res. Center Lightning Technol. Apr. 1980 p 449-450 refs

Avail: NTIS HC A19/MF A01 CSCL 04B

A test technique was developed for applying a full scale mean value (30 kiloampere peak) simulated lightning return stroke current on a complete flight ready aircraft to assess the threat of lightning to aircraft electrical circuits. A computer-aided generator design was used to establish the parameters of the test system. Data from previous work done on development of low inductance current paths determined the basic system configuration. R.E.S.

N80-22000*# Aerospace Corp., El Segundo, Calif.
RELIABILITY MEASUREMENT FOR OPERATIONAL AVIONICS SOFTWARE Final Report

John Thacker and F. Ovidia Sep. 1979 40 p refs (Contract NAS1-14392) (NASA-CR-159224; ATR-79(7590)-2) Avail: NTIS HC A03/MF A01 CSCL 09B

Quantitative measures of reliability for operational software in embedded avionics computer systems are presented. Analysis is carried out on data collected during flight testing and from both static and dynamic simulation testing. Failure rate is found to be a useful statistic for estimating software quality and recognizing reliability trends during the operational phase of software development. M.G.

N80-22047*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NOISE SUPPRESSION DUE TO ANNULUS SHAPING OF CONVENTIONAL COAXIAL NOZZLE

U. vonGlahn and J. Goodykoontz 1980 19 p refs Prepared for the 99th Meeting of the Acoust. Soc. of Am., Atlanta, 21-25 Apr. 1980 (NASA-TM-81461; E-390) Avail: NTIS HC A02/MF A01 CSCL 20A

A method which shows that increasing the annulus width of a conventional coaxial nozzle with constant bypass velocity

will lower the noise level is described. The method entails modifying a concentric coaxial nozzle to provide an eccentric outer stream annulus while maintaining approximately the same through flow as that for the original concentric bypass nozzle. Acoustical tests to determine the noise generating characteristics of the nozzle over a range of flow conditions are described. The tests involved sequentially analyzing the noise signals and digitally recording the 1/3 octave band sound pressure levels. The measurements were made in a plane passing through the minimum and maximum annulus width points, as well as at 90 degrees in this plane, by rotating the outer nozzle about its axis. Representative measured spectral data in the flyover plane for the concentric nozzle obtained at model scale are discussed. Representative spectra for several engine cycles are presented for both the eccentric and concentric nozzles at engine size.

A.W.H.

N80-22048*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN IMPROVED PREDICTION METHOD FOR THE NOISE GENERATED IN FLIGHT BY CIRCULAR JETS

James R. Stone and Francis J. Montegani 1980 33 p refs Prepared for the 99th Meeting of the Acoust. Soc. of Am., Atlanta, 21-25 Apr. 1980 (NASA-TM-81470; E-403) Avail: NTIS HC A03/MF A01 CSCL 20A

A semi-empirical model for predicting the noise generated by jets exhausting from circular nozzles is presented and compared with small-scale static and simulated-flight data. The present method is an updated version of that part of the original NASA aircraft noise prediction program relating to circular jet noise. The earlier method agreed reasonably well with experimental static and flight data for jet velocities up to approximately 520 m/sec. The poorer agreement at higher jet velocities appeared to be due primarily to the manner in which supersonic convection effects were formulated. The purely empirical supersonic convection formulation is replaced in the present method by one based on theoretical considerations. Other improvements of an empirical nature were included based on model-jet/free-jet simulate-flight tests. The effects of nozzle size, jet velocity, jet temperature, and flight are included. A.R.H.

N80-22049# Naval Ocean Systems Center, San Diego, Calif.
AIRCRAFT NOISE MONITORING AT NAVAL TRAINING CENTER AND MARINE CORPS RECRUIT DEPOT, SAN DIEGO, CALIFORNIA, IN 1978 AND 1979 Technical Report, Jul. 1978 - Jun. 1979

D. R. Schmidt and R. G. Klumpp Sep. 1979 24 p refs (AD-A080261; NOSC/TR-465) Avail: NTIS HC A02/MF A01 CSCL 20/1

Aircraft noise from Lindbergh Field was measured during 1978 and 1979 at selected locations within the Naval Training Center (NTC) and the Marine Corps Recruit Depot (MCRD) and compared with noise measured in 1972. The comparison showed that at two locations the noise level had increased and at one location it had decreased. Noise contours based on the 1978-1979 measurements were generated for NTC and MCRD using a NOISEMAP computer program. Contours were then projected to 1985 by using assumptions concerning aircraft mix and numbers of operations. The projected contours show that if compliance with existing FAA noise regulations is obtained the noise impact of Lindbergh Field on NTC and MCRD will be reduced substantially. GRA

N80-22051# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 117: F-16A IN-FLIGHT CREW NOISE

Herald K. Hille Jul. 1979 15 p (AD-A080642; AMRL-TR-75-50-Vol-117) Avail: NTIS HC A02/MF A01 CSCL 01/2

The F-16 A is a USAF lightweight fighter. This report provides measured data defining the bioacoustic environments at the pilot's location inside this aircraft for 16 flight conditions. Data are reported for one location in a wide variety of physical and psychoacoustic measures overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech

interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. GRA

N80-22223# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

LA RECHERCHE AEROSPATIALE BI-MONTHLY BULLETIN NUMBER 1979-1

ESA Nov. 1979 107 p refs Transl. by ONERA into ENGLISH of 'La Rech. Aérospatiale, Bull. Bimestriel' (Paris) No. 1979-1, Jan.-Feb. 1979 p 1-85 Original French report available from ONERA, Paris FF 36

(ESA-TT-599) Avail: NTIS HC A06/MF A01

Various topics include studies of noise generated aerodynamically, adaptive linear filtering, sampling techniques for hot wire signals, turbulent boundary layer and blade to blade flow, ultrasonic measurement of solid propellant burning rate, and determination of crack fronts in metallic parts.

N80-22224# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

NOISE GENERATED AERODYNAMICALLY

Robert Lesendre *In its* La Rech. Aérospatiale, Bi-monthly Bull. No. 1979-1 (ESA-TT-599) Nov. 1979 p 1-14 refs Transl. by ONERA into ENGLISH of La Rech. 1979-1, Jan.-Feb. 1979 p 1-9 Original report in FRENCH previously announced as A79-30933

Avail: NTIS HC A06/MF A01

A wave equation satisfied by an acoustic potential for the noise generated by aerodynamic turbulence is presented. A definition of noise as a pulsation of the irrotational component of velocity and the distinction between sound and pseudosound are introduced to aid in the analysis. The wave equation is derived from a combination of equations of fluid mechanics and thermodynamics and contains a term relating the intensity of the noise source to the rate of variation of the specific mass. It is noted that integration of the acoustic potential equation allows a more accurate prediction of the direct effects of convection and refraction on noise propagation to be made. The mechanism of noise generation in turbulent flow is also discussed, taking into account the tendency of the fluid to avoid changes in volume. Author (ESA)

N80-22225# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

ADAPTIVE LINEAR FILTERING IN THE PRESENCE OF AN EVOLUTION NOISE OF POORLY KNOWN VARIANCE

Huu Thanh Huynh *In its* La Rech. Aérospatiale, Bi-monthly Bull. No. 1979-1 (ESA-TT-599) Nov. 1979 p 15-30 refs Transl. by ONERA into ENGLISH of La Rech. Aérospatiale Bull. Bimestriel (Paris), No. 1979-1, Jan.-Feb. 1979 p 11-22

Avail: NTIS HC A06/MF A01

The application of the Kalman-Bury linear filter raises a particular problem when the covariance matrix of the evolution noise is poorly known. An algorithm for the adjustment of this covariance is presented for a linear, stationary system whose evolution noise has independent components. It comprises a preliminary test on observation residues (difference between actual observations and those predicted by the filter); the estimation of the covariance is then performed by a least square method on these residues. A numerical simulation, made on a simplified model of missile trajectory restitution, emphasizes the improvement of the state estimating over a classical filtering. Author (ESA)

N80-22228# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

BLADE-TO-BLADE FLOW OF IDEAL FLUID WITH WALL INJECTION

Alain LeMeur and Philippe Morice *In its* La Rech. Aérospatiale Bi-monthly Bull. No. 1979-1 (ESA-TT-599) Nov. 1979 p 63-70 refs Transl. by ONERA into ENGLISH of La Rech. Aérospatiale Bull. Bimestriel (Paris), No. 1979-1, Jan.-Feb. 1979 p 49-54 Original report in FRENCH previously announced as A79-30496

Avail: NTIS HC A06/MF A01

The perturbation of the subsonic, two dimensional flow of an ideal fluid in the region between turbine blades, caused by the injection of cooling gas at the walls, is considered. A model of irrotational, two fluid flow is used and variational principles approximated by finite elements are derived. The analysis takes into account free boundaries between various flows and is used to calculate velocity distributions and pressure profiles.

Author (ESA)

N80-22232# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

DIFFERENTIAL GAMES OF INTERCEPTION AND AERIAL COMBAT: SOLUTION BY DIFFERENTIAL DYNAMIC PROGRAMMING

Van Nhan Nguyen *In its* La Rech. Aérospatiale Bi-monthly Bull. No. 1979-2 (ESA-TT-605) Nov. 1979 p 1-14 refs Transl. by ONERA into ENGLISH of La Rech. Aérospatiale Bull. Bimestriel (Paris) No. 1979-2, Mar.-Apr. 1979 p 78-54 Original report in FRENCH previously announced as A79-34976

Avail: NTIS HC A05/MF A01

A two-dimensional realistic model for interception and air combat is presented, involving variable velocities and taking into account the characteristics of both aircraft and constraints on maneuvering (limited turning rates). A differential game of pursuit-evasion is then formulated on this basis; the chosen performance index takes into account the final relative distance and deviation angle. Complete determination of the optimal controls and trajectories is effected by differential dynamic programming. Illustrative examples of interception are presented. Author (ESA)

N80-22233# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

A NOTE ON AN INSTABILITY MECHANISM FOR THE CORE OF A ROLLED-UP VORTEX SHEET

Jean-Pierre Guiraud and Radyadour K. Zeytounian *In its* La Rech. Aérospatiale Bi-monthly Bull. No. 1979-2 (ESA-TT-605) Nov. 1979 p 15-19 refs Transl. by ONERA into ENGLISH of La Rech. Aérospatiale Bull. Bimestriel (Paris) No. 1979-2, Mar.-Apr. 1979 p 85-88 Original report in FRENCH previously announced as A79-34977

Avail: NTIS HC A05/MF A01

The mechanism which affects the structure of the rolled up vortex is discussed. Author (ESA)

N80-22234# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

SUPPRESSION OF ELECTROSTATIC RADIOELECTRIC INTERFERENCE ON AIRCRAFT

Jean-Louis Boulay *In its* La Rech. Aérospatiale Bi-monthly Bull. No. 1979-2 (ESA-TT-605) Nov. 1979 p 21-45 refs Transl. by ONERA into ENGLISH of La Rech. Aérospatiale Bull. Bimestriel (Paris) No. 1979-2, Mar.-Apr. 1979 p 89-108 Original report in FRENCH previously announced as A79-34978

Avail: NTIS HC A05/MF A01

The paper reviews the main effects of accumulation of electrostatic charge on aircraft. Some models for corona discharge and the antenna discharge coupling phenomenon are presented as well as some of the principal methods of suppressing radio electrical disturbances. The mathematical demonstration of coupling between an electric discharge and an antenna is reviewed and interpreted, and experimental methods for determining two key functions which appear in the analysis are presented. The characteristics of orthogonal decoupling dischargers and dischargers with multiple and independent discharges are summarized and types of antistatic protection of dielectric surfaces are defined. Author (ESA)

N80-22237# Office National d'Etudes et de Recherches Aérospatiales, Paris (France)

PROPELLER DRIVEN LIGHT AIRCRAFT NOISE

Claude Dahan, Leon Avezard, Georges Guillion, Christian Malarmey, and Jacques Chombard *In its* La Rech. Aérospatiale

Bi-monthly Bull. No. 1979-2 (ESA-TT-605) Nov. 1979 p 73-84 refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale Bull. Bimestriel (Paris) No. 1979-2, Mar.-Apr. 1979 p 129-137 Original report in FRENCH previously announced as A79-34980

Avail: NTIS HC A05/MF A01

The acoustic field of a Rallye 235 aircraft was investigated by the microphone technique in conjunction with a model for predicting propeller noise. The microphone measurements were complemented by flyover noise measurements by a technique which made it possible to avoid difficulties associated with the Doppler effect. The calculation model was modified to take into account ground reflection, but although the model predicted well for the fly-away phase, the measured levels are higher than predicted for the approach phase. It is concluded that further analysis should take into consideration thickness noise and noise due to unsteady loading. Author (ESA)

N80-22238# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NOISE GENERATED AERODYNAMICALLY

Robert C. Legendre *In its* La Rech. Aerospatiale Bi-Monthly Bull. No. 1979-2 (ESA-TT-605) Nov. 1979 p 85-87 ref Transl. by ONERA into ENGLISH of La Rech. Aerospatiale Bull. Bimestriel (Paris) No. 1979-2, Mar.-Apr. 1979 p 139-140 Original report in FRENCH previously announced as A79-34981

Avail: NTIS HC A05/MF A01

A justification is given of certain calculations presented on the production of aerodynamic noise in a turbulent fluid. A model for the acoustic field in an ideal fluid in isentropic irrotational flow is considered, and the extension of the model to the center of a turbulent field is carried out on the basis of a nonintegrated enthalpy equation. Author (ESA)

N80-22239# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LA RECHERCHE AEROSPATIALE BI-MONTHLY BULLETIN NUMBER 1979-3

ESA Jan. 1980 87 p refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris) No. 1979-3, May-Jun. 1979 p 153-218 Original French report available from ONERA, Paris FF 36 (ESA-TT-609) Avail: NTIS HC A05/MF A01

Topics include the functioning of small rocket motors, titanium alloy powder metallurgy, flow visualization in wind tunnels, stress analysis by mixed variational principles, vibration tests on models, harmonic vibration problems, and laminar flow.

N80-22242# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

APPLICATION OF A LAMINAR LIGHTING DEVICE TO THE SMOKE VISUALIZATION OF FLOWS IN A WIND TUNNEL

Michel Philbert, Robert Beaupoil, and Jean-Pierre Faleni *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1979-3 (ESA-TT-609) Jan. 1980 p 25-34 refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris) No. 1979-3, May-Jun. 1979 p 173-179 Original report in FRENCH previously announced as A79-41304

Avail: NTIS HC A05/MF A01

The application of a 1-W argon ion laser to the three dimensional smoke visualization of wind tunnel flows is studied. Photographs of turbulent flows past delta and swept wing models are presented and discussed. Author (ESA)

N80-22245# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

SYMMETRIC VARIATIONAL FORMULATION OF HARMONIC VIBRATIONS PROBLEM BY COUPLING PRIMAL AND DUAL PRINCIPLES. APPLICATION TO FLUID-STRUCTURE COUPLED SYSTEMS

Roger Ohayon *In its* La Rech. Aerospatiale Bi-monthly Bull. No. 1979-3 (ESA-TT-609) Jan. 1980 p 69-78 refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel

(Paris) No. 1979-3, May-Jun. 1979 p 207-211 Original report in FRENCH previously announced as A79-41307

Avail: NTIS HC A05/MF A01

A methodology is presented for the coupling of a primal principle and an indirect dual principle leading to a symmetric variational formulation for the harmonic vibrations problem. The symmetric formulation governing the elasto-acoustic vibration problems and more generally fluid-structure coupling are found directly. Author (ESA)

N80-22246# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EXPLORATORY STUDY OF A LAMINAR-TURBULENT TRANSITION PROCESS CLOSE TO LAMINAR BOUNDARY LAYER SEPARATION

Jean Cousteix and Guy Pailhas *In its* La Rech. Aerospatiale Bi-monthly Bull. No. 1979-3 (ESA-TT-609) Jan. 1980 p 79-85 refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris) No. 1979-3, May-Jun. 1979 p 213-218 Original report in FRENCH previously announced as A79-41308

Avail: NTIS HC A05/MF A01

The point and nature of laminar-turbulent transition were studied systematically in a small subsonic wind tunnel, using models with various angles of sweep and a wide range of angles of attack. The technique employed was based on sublimation of acenaphthene coatings and on hot-wire anemometer probing of the boundary layer. Transition was found to be a phenomenon whose characteristics are strongly influenced by such parameters as the pressure gradient. Author (ESA)

N80-22247# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LA RECHERCHE AEROSPATIALE BI-MONTHLY BULLETIN NUMBER 1979-4

ESA Jan. 1980 90 p refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale, Bull. Bimestriel (Paris) No. 1979-4, Jul.-Aug. 1979 p 219-285 Original French report available from ONERA, Paris FF 36 (ESA-TT-612) Avail: NTIS HC A05/MF A01

Topics include flows on a variable sweep wing, turbine wall temperature calculation, production of composite materials from prealloyed powders, salt stress corrosion cracking of a titanium alloy, wind tunnel signal measurements, noise generation by an eddy, and identification of a vibrational behavior model of complex structures.

N80-22248# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

SUBSONIC AND TRANSONIC FLOWS ON A VARIABLE SWEEP WING

Volker Schmitt and Francis Manie *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1979-4 (ESA-TT-612) Jan. 1980 p 1-23 refs Transl. by ONERA into ENGLISH of La Rech. Aerospatiale Bull. Bimestriel (Paris) No. 1979-4, Jul. - Aug. 1979 p 219-237 Original report in FRENCH previously announced as A79-48849

Avail: NTIS HC A05/MF A01

Experiments were performed on models of a variable sweep wing emphasizing flow separation and development vortex structures in the whole speed range and, in addition, the shape of shock waves at transonic speeds. The results of these tests are compared with those of calculations made with available codes such as an incompressible panel method for unseparated flows and an unsteady method based on a point discretization of the vortex vector for separated flows. Transonic flows were calculated using different relaxation methods: one based on the perturbation theory and two others on the fuel potential equation. Author (ESA)

N80-22253# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NOISE GENERATED BY AN EDDY

Robert C. Legendre *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1979-4 (ESA-TT-612) Jan. 1980 p 79-84 ref Transl.

by ONERA into ENGLISH of La Rech. Aerospatiale. Bull. Bimestriel (Paris) No. 1979-4, Jul. - Aug. 1979 p 279-282 Original report in FRENCH previously announced as A79-48854

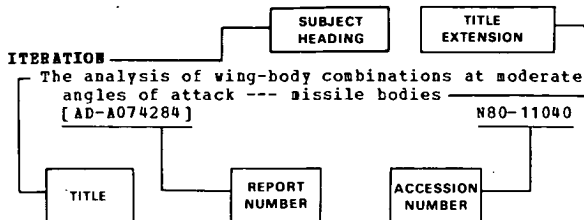
Avail: NTIS HC A05/MF A01

A very simple model of vorticity distribution in a turbulent flow is described. This model makes it possible to demonstrate a mechanism of noise generation during the temporal evolution of a viscous eddy. It is shown that the temporal variation of the specific mass determines the intensity of emitted sound, which is also related to the temporal variation of a centrifugal acceleration within a small fluid mass of high vorticity.

Author (ESA)

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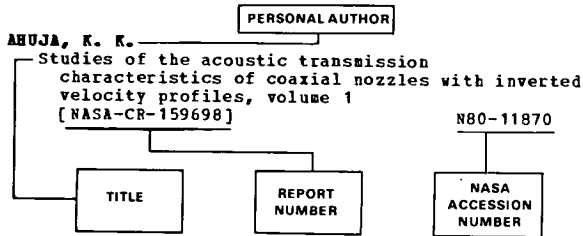
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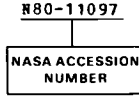
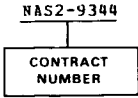
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