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Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (121)
April 1980

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ACCESSION NUMBER RANGES

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

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NASA SP-7037(121)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 121

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 March 1980 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 411 reports, journal articles, and other documents originally announced in March 1980 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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

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TABLE OF CONTENTS

IAA Entries 87
STAR Entries 111

Subject Index A-1
Personal Author Index B-1
Contract Number Index C-1

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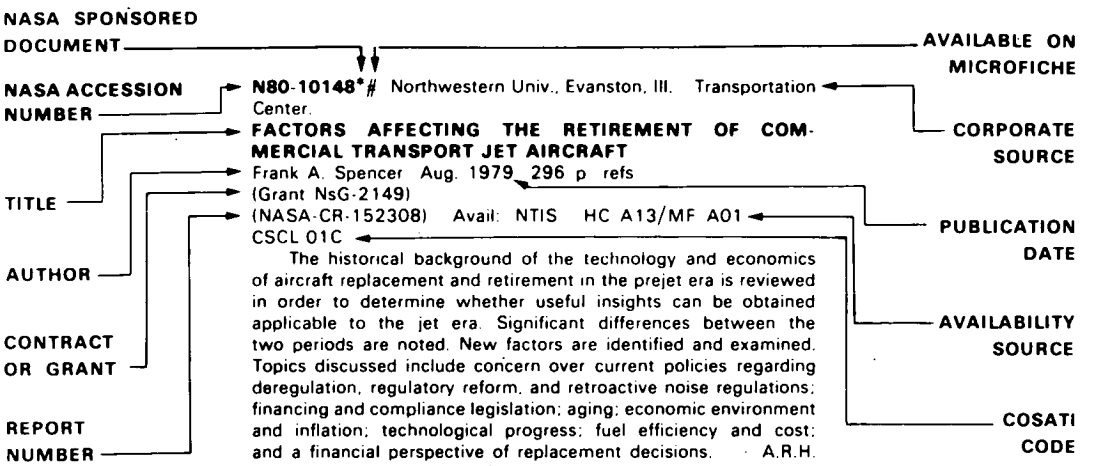

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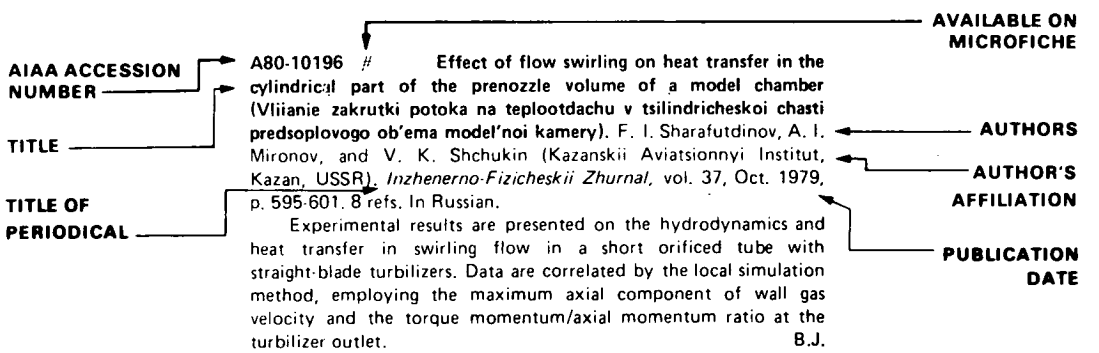


AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 121)

APRIL 1980

IAA ENTRIES

A80-17402 **Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects.** R. Kleehammer, J. Hunt (Fairchild Camera and Instrument Corp., Syosset, N.Y.), and A. Kleider (U.S. Army, Fort Monmouth, N.J.). In: Smart sensors; Proceedings of the Seminar, Washington, D.C., April 17, 18, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1979, p. 167-174. Grant No. DAAB07-77-C-2167.

A sensor has been designed to provide real-time detection and recognition of 3mm wires at a range of 300 meters during nighttime helicopter flight operations. An Army-sponsored program to demonstrate such automatic wire detection and warning for Nap-of-the-Earth (NOE) helicopter missions is currently in progress. Wire or wire-like objects are electro-optically detected and then recognized by a pattern recognition technique. The recognition algorithm is accomplished within 50 msec of the first wire detection indication. A flyable exploratory development WOWS model, consisting of a scanning laser transmitter, electro-optical receiver, real-time processor and display unit is described. (Author)

A80-17517 **Map-matching techniques for terminal guidance using Fourier phase information.** C. D. Kuglin, A. F. Blumenthal, and J. J. Pearson (Lockheed Research Laboratories, Palo Alto, Calif.). In: Digital processing of aerial images; Proceedings of the Seminar, Huntsville, Ala., May 22-24, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1979, p. 21-29. DARPA-sponsored research; Grant No. DAAK40-76-C-1193.

The application of Lockheed's phase correlation image matching technique to missile guidance has been systematically investigated during the past several years. An effective approach to the scene distortion problem has been developed and verified for a variety of sensor types by computer simulation. The method involves the computation of a full bandwidth Fourier phase difference matrix for the reference and sensed scenes to be matched, followed by the application of the inverse Fourier transform to the phase matrix modified by a series of bandwidth-reducing filters to produce a set of trial correlation functions. The 'best' matchpoint is then selected using parameters derived from each correlation function. A novel method for onboard reference map storage has been developed using quantized Fourier phase angles. (Author)

A80-17518 **Guidance system position update by multiple subarea correlation.** T. K. Lo and G. Gerson (Hughes Aircraft Co., Advanced Missile Systems Div., Canoga Park, Calif.). In: Digital processing of aerial images; Proceedings of the Seminar, Huntsville, Ala., May 22-24, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1979, p. 30-40. Contract No. F30602-77-C-0049.

Correlation is a common and powerful method for updating inertial guidance systems. Performance of correlation methods degrades in the presence of geometric distortion between the images being correlated, or when the image structure is strongly asymmetric. The Multiple Subarea Correlation (MSC) technique has been developed to reduce performance losses due to these effects. The MSC technique consists of selecting a set of subareas from the reference image, and correlating each reference subarea against the sensed image, producing a correlation function for each subarea. There must be at least three subareas; typically six subareas are selected. The correlation functions are processed to determine a consistent set of local maxima which are in gross agreement as to the relative displacement of the two images. Then, using this set of local maxima and the known subarea locations, a least-squared-error estimate of an affine transformation between the two images is computed. The transformation is applied to the update point in the reference image to find the corresponding point in the sensed image. The technique allows selection of subareas with the most favorable content for correlation. Optimum subarea dimensions exist and depend upon the amount of distortion expected. The variance of the update point position is shown to be inversely proportional to the number of subareas. (Author)

A80-17521 **Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques.** D. L. Davies, P. H. Smith, and J. F. Liutermoza (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). In: Digital processing of aerial images; Proceedings of the Seminar, Huntsville, Ala., May 22-24, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1979, p. 63-72. 9 refs.

Two methods of measuring internal machine part clearances by digital processing of industrial radiographs are presented. The first technique requires mathematical modeling of the expected optical density of a radiograph as a function of machine part motion. Part separations are estimated on the basis of individual image scan lines, with the final part separation estimate produced by fitting a polynomial to the individual estimates and correcting for imaging and processing degradations simulated by a mathematical model. The second method applies image registration where radiographs are correlated in a piecewise fashion to allow inference of relative motion of machine parts in a time varying series of images. Each image is divided into segments which are cross-correlated with subsequent images to identify machine part motion in image space. Since the magnitude of a correlation peak is a function of the similarity between an image segment and a subsequent image, it can be used to infer the presence of relative motion of features within each image segment thus identifying feature boundaries. A.T.

A80-17534 **Performance evaluation of image correlation techniques.** J. M. Geros and A. J. Witsmeer (Boeing Aerospace Co., Seattle, Wash.). In: Digital processing of aerial images; Proceedings of the Seminar, Huntsville, Ala., May 22-24, 1979. Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1979, p. 197-205. Contract No. F33615-76-C-1300.

A technique capable of improving the navigation system accuracy of operational systems using low-altitude correlation update information is desired. The technique makes use of the unique signature of the land mass passing beneath the vehicle to establish its position history and update its inertial navigation system. The generic types of sensors available to provide external mapping data for low-altitude correlation, the correlation performance measures developed for system analyses and the simulation studies performed to validate these performance measures are described. This paper will emphasize the ability to and the importance of developing analytical techniques in predicting the behavior of correlation update or image matching systems both in terms of fix accuracy and probability of correct correlation or acquisition. This type of analysis validated first by simulation and later by flight test results provides a solid basis on which to develop the system and bring it into operational utility with a high degree of confidence. (Author)

A80-17553 **Development aspects of a dynamically tuned gyro for strapdown - AHRS.** H. Sohst (Litton Technische Werke, Freiburg im Breisgau, West Germany). In: Symposium on Gyroscope Technology, Bochum, West Germany, September 18, 19, 1978, Proceedings. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979. 17 p.

The paper gives an overview of fundamental considerations regarding the development of dynamically tuned strapdown gyros. Especially guidelines and areas of significant efforts are reviewed which have important impact to the development of the K-273 strapdown gyro at LITEF. Design goal and technical resources are described. Emphasis is put on practical development aspects. Since the object of consideration is still in a process of development this paper has to be looked upon as an interim report. (Author)

A80-17558 **A strapdown inertial reference system for commercial airline use in navigation and flight control.** P. J. Donoghue and L. B. Cotter (Teledyne Systems Co., Northridge, Calif.). In: Symposium on Gyroscope Technology, Bochum, West Germany, September 18, 19, 1978, Proceedings. (Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979. 19 p.

This paper describes a strapdown inertial reference system (IRS) for use on next generation commercial airlines utilizing equipment complying with the new ARINC 704 standards. The system is derived from state-of-the-art inertial technology utilizing hardware already developed and flight tested specifically for this application. (Author)

A80-17559 **An integrated strapdown guidance and control system for launch vehicle application.** C. W. Kirk and P. J. Donoghue (Teledyne Systems Co., Northridge, Calif.). In: Symposium on Gyroscope Technology, Bochum, West Germany, September 18, 19, 1978, Proceedings. Düsseldorf, Deutsche Gesellschaft für Ortung und Navigation, 1979. 28 p.

This paper presents an application of strapdown technology and integrated systems concepts to a guidance and control system designed for a launch vehicle. The complete vehicle alignment, guidance, launch sequencing, timing, ignition commands, control and telemetry are provided by the strapdown system which can be adapted to other applications by simple software or custom I/O changes. (Author)

A80-17671 **Concerning the information efficiency of aerodynamic experiments.** G. L. Grodzovskii (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR). *(TsAGI, Uchenye Zapiski,* vol. 9, no. 2, 1978, p. 36-43.) *Fluid Mechanics - Soviet Research,* vol. 8, Jan.-Feb. 1979, p. 103-111. 11 refs. Translation.

The paper formalizes two concepts: (1) information efficiency of the measuring system, and (2) the information efficiency of the experiment. The determination methodology for these efficiencies for typical problems of aerodynamic experimentation is presented. The relationship between the minimum duration of the optimal experiment, the effective coefficient of noise levels, permissible relative error and the required degree of detail in the unknown functional relationship is established for the optimal experiment. This is accomplished by employing efficient optimal estimates of single measurements of parameters and D-G optimal polynomial experimental designs for determination of the functional relationship. M.E.P.

A80-17673 **Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel.** V. Ia. Bezmenov (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR). *(TsAGI, Uchenye Zapiski,* vol. 9, no. 2, 1978.) *Fluid Mechanics - Soviet Research,* vol. 8, Jan.-Feb. 1979, p. 122-132. 9 refs. Translation.

The paper examines the effect of relative area of the flow core on the performance of a hypersonic wind tunnel. Results of investigations of the performance of hypersonic wind tunnels, such as the pressure recovery coefficient in the diffuser and test-section blockage ratio, are usually plotted as a function of the Mach number M and Reynolds number Re. However, the results of study of flows in hypersonic nozzles are reduced to the dependence of the Mach number in the flow core, or of the boundary layer displacement thickness on similitude parameters. Expressions are derived for the relative wind tunnel operation time and the Reynolds number based on the maximum velocity, friction viscosity, and stagnation density. It is concluded that the relative pressure recovery of diffusers, the relative time of wind-tunnel operation, and the blocking of the test section by models, controlled by the operating regime and the startup regime of the wind tunnel are governed by the relative area of the flow core and pertinent similitude ratios describing the flow of gas in the nozzle. A.T.

A80-17675 # **Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel (Vliianie naftenoaromaticheskikh uglevodov na okisliaemost' gidroochishchennogo topliva RT).** V. M. Veselianskaia, E. D. Radchenko, B. A. Englin, and A. A. Kir'ianova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel,* no. 12, 1979, p. 27-31. 10 refs. In Russian.

A80-17696 # **Application of a higher order panel method to realistic supersonic configurations.** E. N. Tinoco, F. T. Johnson (Boeing Aerospace Co., Seattle, Wash.), and L. M. Freeman (Mississippi State University, University, Miss.). *(American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan. 15-17, 1979, Paper 79-0274.) Journal of Aircraft,* vol. 17, Jan. 1980, p. 38-44. 21 refs.

A higher-order panel method has been developed for the analysis of linearized subsonic and supersonic flow over configurations of general shape. This method overcomes many of the slender body limitations of present day programs in the analysis of supersonic configurations. The capabilities of this method are demonstrated through its application to the analysis of realistic supersonic cruise configurations. Comparisons are shown with experimental data and with results from other methods in current use. These comparisons demonstrate the unique capabilities of a major new software system called PAN AIR soon to be available as a general boundary value problem solver. (Author)

A80-17697 * # **Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow.** C. S. Reddy (Old Dominion University, Norfolk, Va.). *Journal of Aircraft,* vol. 17, Jan. 1980, p. 58, 59. 9 refs. Contract No. NAS1-14193-48.

Many modern aircraft designed for supersonic speeds employ highly swept-back and low-aspect-ratio wings with sharp or thin edges. Flow separation occurs near the leading and tip edges of such wings at moderate to high angles of attack. Attempts have been made over the years to develop analytical methods for predicting the aerodynamic characteristics of such aircraft. Before any method can really be useful, it must be tested against a standard set of data to determine its capabilities and limitations. The present work undertakes such an investigation. Three methods are considered: the free-vortex-sheet method (Weber et al., 1975), the vortex-lattice method with suction analogy (Lamar and Gloss, 1975), and the quasi-vortex lattice method of Mehrotra (1977). Both flat and cambered wings of different configurations, for which experimental data are available, are studied and comparisons made. S.D.

A80-17698 # **Comment on 'Handling quality criterion for heading control'.** C. R. Chalk (Calspan Corp., Buffalo, N.Y.). *Journal of Aircraft*, vol. 17, Jan. 1980, p. 60-63; Author's Reply, p. 63, 64. 9 refs.

A80-17699 # **Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics.** D. G. Mitchell and D. E. Johnston (Systems Technology, Inc., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0170.* 13 p. 14 refs. Contracts No. F33615-76-C-3072; No. F33615-78-C-3604.

A study has been performed to evaluate the contributions of the static aerodynamic cross-coupling and lateral acceleration derivatives on the denominator and numerator roots which affect lateral closed-loop control. Time vector analysis is shown to enhance physical insight to the contribution of each aerodynamic and kinematic term of the coupled 6 DOF math model and facilitate simplification so that tractable, literal transfer function approximate factors can be developed. Time vectors are also applied to 3 DOF models with and without lateral acceleration derivatives to illustrate their contribution. The method provides insight to the influence of the static and acceleration derivatives on key dynamic modes.
(Author)

A80-17700 * # **Estimation of the accuracy of dynamic flight-determined coefficients.** R. E. Maine and K. W. Iliff (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0171.* 18 p. 26 refs.

This paper discusses means of assessing the accuracy of maximum likelihood parameter estimates obtained from dynamic flight data. The commonly used analytical predictors of accuracy are compared from both statistical and simplified geometric standpoints. Emphasizing practical considerations, such as modeling error, the accuracy predictions are evaluated with real and simulated data. Improved computations of the Cramer-Rao bound to correct large discrepancies caused by colored noise and modeling error are presented. This corrected Cramer-Rao bound is the best available analytical predictor of accuracy. Engineering judgement, aided by such analytical tools, is the final arbiter of accuracy estimation.
(Author)

A80-17716 **Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response.** J. G. Yen and T. T. McLarty (Bell Helicopter Textron, Fort Worth, Tex.). *Vertica*, vol. 3, no. 3-4, 1979, p. 205-219. 13 refs.

The mode displacement, force integration, impedance and matrix displacement methods for the analysis of the dynamics of coupled helicopter rotor-fuselage systems are evaluated. The mode displacement method allows a completely coupled rotor-fuselage system to be analyzed by replacing rotor inertial couplings in the fuselage equations with stiffness couplings, and good results for rotor loads can be obtained. The force integration method is used to compute hub shears and moments by integrating dynamic and aerodynamic forces along each rotor blade, however this approach requires more computer time. Fuselage or rotor impedance, a useful concept in vibration analysis, is used to analyze rotor natural frequencies and rotor loads, and to calculate the vibration characteristics of a multi-bladed helicopter successfully and economically. The matrix displacement method systematically automates the coupling of rotating and nonrotating component equations, however requires longer computation time and exhibits poor numerical accuracy. A.L.W.

A80-17717 * **Formulation of coupled rotor/fuselage equations of motion.** W. Warmbrodt (NASA, Ames Research Center, Moffett Field, Calif.) and P. Friedmann (California, University, Los Angeles, Calif.). *Vertica*, vol. 3, no. 3-4, 1979, p. 245-271. 19 refs. Grant No. NsG-1578.

The governing equations of motion of a helicopter rotor coupled to a rigid body fuselage are derived. A consistent formulation is used to derive nonlinear periodic coefficient equations of motion which can be used to study coupled rotor/fuselage dynamics in forward flight. The methodology of rotor/fuselage coupling is clearly described and the importance of an ordering scheme in deriving consistent nonlinear equations of motion is reviewed. The final equations which are presented in partial differential form can be used to model coupled rotor/fuselage aeroelastic response or stability problems. (Author)

A80-17718 **Rotational noise of helicopter rotors.** Y. Nakamura and A. Azuma (Tokyo, University, Tokyo, Japan). *Vertica*, vol. 3, no. 3-4, 1979, p. 293-316. 48 refs.

The rotational noise of helicopter rotors is analyzed by means of the direct integration of distributed sources on an influential surface or surfaces. The sound pressure generated by a moving source as formulated by Ffowcs Williams and Hawkings (1969, 1963) is decomposed into the components of thickness noise, far field thrust noise, near field thrust noise, far field drag noise and near field drag noise. An analytical prediction of rotor noise characteristics is obtained for the integrand, integral region and observer time derivative portions of solutions to the wave equation. Noise characteristics such as directivity and wave form are expressed in terms of rotor parameters by numerical calculations. Parametric studies are used to determine the effects of rotor speed, advance ratio, blade number, chord length, rotor diameter, airfoil section, load distribution and directivity on noise levels, and means of reducing rotor noise are proposed on the basis of the computations. The analysis also indicates that the predominant source of noise is the thickness noise, and it is thus proposed as one of the probable causes of blade slap. A.L.W.

A80-17720 **Airport noise, location rent, and the market for residential amenities.** J. P. Nelson (Pennsylvania State University, University Park, Pa.). *Journal of Environmental Economics and Management*, vol. 6, Dec. 1979, p. 320-331. 23 refs.

The present study reports on the influence of aircraft noise on housing prices in the vicinity of six major U.S. airports, including San Francisco, St. Louis, Cleveland, New Orleans, San Diego, and Buffalo. The sampling procedures attempt to control for the effect of accessibility on location rent, and hence, housing prices. Regression results are reported for the individual samples and for a pooled sample consisting of 845 observations. The regression coefficients for aircraft noise are stable about their weighted mean and are comparable to coefficient estimates from the pooled sample. Dummy variables and partitioned regressions are used to test for remaining accessibility effects. (Author)

A80-17723 **The loads at landing impact (Die Lasten des Landestosses).** K. König (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Sitzung über Aeroelastik und Strukturdynamik, Immenstaad, West Germany, July 14, 1978.) Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 3, Nov.-Dec. 1979, p. 344-360. 9 refs. In German.

The paper describes a comprehensive calculation method for determining landing gear loads. Several aircraft of the younger generation and of varying designs are used to exemplify the influence of system parameters and initial conditions. Attention is given to aircraft structure with emphasis on spring struts, shock absorbers, vertical impact shock, horizontal landing speed, and various roll, pitch, and yaw angles. A cost analysis is made to determine the overall cost of examining aircraft data by employing a digital computer program. It was found that the use of a program is comparable to five man hours of engineering and that the computers in aviation are basically cost effective. C.F.W.

A80-17724 **On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor (Zum Einfluss stationärer Temperatur- und Druckstörungen auf die Strömungsverhältnisse in einem installierten, vielstufigen Strahltriebwerk-Verdichter).** H. Künkler (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) and H. Tonskotter (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung,* vol. 3, Nov.-Dec. 1979, p. 360-378. 6 refs. In German. Deutsche Forschungsgemeinschaft Contract No. SFB-83.

The investigation presented here was aimed at the experimental determination of the local variation of flow fields due to steady state circular distortion in a multistage jet engine compressor taking into account the operating conditions and restraints of the complete turbine engine interaction. A qualitative analysis was made in advance on the effects of the disturbances on the flow characteristics considering the interaction between the disturbed and undisturbed compressor flow. With this prediction and by use of computer aided test methods it was possible to significantly reduce the complexity of the tests and the test equipment facilities. (Author)

A80-17730 **Gas turbine carcase and accessory vibration - Problems of measurement and analysis.** D. S. Pearson, A. H. E. Holme, and P. R. Watts (Rolls-Royce, Ltd., London, England). *(Society of Environmental Engineers, Symposium on Environmental Engineering Today, London, England, May 9-11, 1979.) Society of Environmental Engineers, Journal,* vol. 18-4, Dec. 1979, p. 15-22.

Measuring system requirements, pitfalls in data analysis and severity assessment, and the role of laboratory simulation are presented in terms of gas turbine engine vibration testing. Distortion in piezoelectric accelerometers due to a charge generated by temperature gradients or strain is described, and electrical noise and overload resulting from frequencies of 15 to 10,000 Hz, and peak accelerations from 0.3 to 1000 g during vibrational monitoring, are considered. Spectral analysis is discussed, as are frequency, coherence and transmission path analysis as means of presenting data in visual form, while modal analysis techniques appear capable of visually coordinating previously unrelated engine data. It is suggested that severity criteria be revised to assess 3-plane resolved true motion, the combined effect of simultaneous excitation at a range of frequencies, and the cumulative effect of individual vibration phenomena. J.P.B.

A80-17737 * # **Preparing aircraft propulsion for a new era in energy and the environment.** W. L. Stewart, D. L. Nored, J. S. Grobman, C. E. Feiler, and D. A. Petrash (NASA, Lewis Research Center, Cleveland, Ohio). *Astronautics and Aeronautics,* vol. 18, Jan. 1980, p. 18-31, 37. 22 refs.

Improving fuel efficiency, new sources of jet fuel, and noise and emission control are subjects of NASA's aeronautics program. Projects aimed at attaining a 5% fuel savings for existing engines and a 13-22% savings for the next generation of turbofan engines using advanced components, and establishing a basis for turboprop-powered commercial air transports with 30-40% savings over conventional turbofan aircraft at comparable speeds and altitudes, are discussed. Fuel sources are considered in terms of reduced hydrogen and higher aromatic contents and resultant higher liner temperatures, and attention is given to lean burning, improved fuel atomization, higher freezing-point fuel, and deriving jet fuel from shale oil or coal. Noise sources including the fan, turbine, combustion process, and flow over internal struts, and attenuation using acoustic treatment, are discussed, while near-term reduction of polluting gaseous emissions at both low and high power, and far-term defining of the minimum gaseous-pollutant levels possible from turbine engines are also under study. J.P.B.

A80-17876 **Low-aspect-ratio limit of the toroidal reactor - The spheromak.** M. N. Bussac, M. N. Rosenbluth (Institute for Advanced Study, Princeton, N.J.), H. P. Furth, M. Okabayashi, and A. M. M. Todd (Princeton University, Princeton, N.J.). In: Plasma physics and controlled nuclear fusion research 1978; Proceedings of the Seventh International Conference, Innsbruck, Austria, August 23-30, 1978. Volume 3. Vienna, International Atomic Energy Agency, 1979, p. 249-264; Discussion, p. 264. 24 refs. Contracts No. EY-76-C-02-3073; No. E(11-1)-3237.

The ideal and resistive MHD stability properties of a class of toroidal plasma configurations ('spheromaks') having internal toroidal and poloidal fields and external poloidal fields are considered. The reactor advantage of the spheromak is two-fold: (1) the maximum field strength at the external coils is about half the field at the plasma centre, rather than twice, as in a tokamak, and (2) a roughly spherical blanket can be used, rather than a blanket that links the plasma topologically. Taylor's criterion, which ensures stability against both ideal and resistive modes, has been applied to force-free spheromaks of unity aspect ratio. In the presence of a loosely fitting external conducting shell, oblate spheromaks are stable against all modes except short-wave surface kinks (which are an artifact of the idealized current density profile). The Mercier criterion gives a beta-limit below 1%; however, at aspect ratio greater than or almost equal to 1, the beta-limit for representative spheromak models rises into the range 2-4%. (Author)

A80-17900 **On the dynamics of compressor surge.** A. Tondl (Statni Vyzkumny Ustav Konstrukce Stroju, Bechovice, Czechoslovakia). *International Journal of Non-Linear Mechanics,* vol. 14, no. 4, 1979, p. 259-266. 5 refs.

Investigations concerned with the stability of stationary states and the possibility of self-excited oscillation (surge) occurring in systems with a centrifugal compressor (or a centrifugal pump) lead, for a simplified model, to an analysis of a set of two first-order differential equations. The paper presents such an analysis for the case when the machine characteristic can be expressed by a continuous unique curve as well as for that when the characteristic is neither a unique nor even a smooth curve. It is shown which of the singular points is the saddle point and in the case of the latter type of characteristic, which point can be taken for the saddle; this approach is believed to make practical analyses more straightforward. (Author)

A80-17958 # **Determination of the stress intensity factor of composite structural members (K opredeleniiu koeffitsienta intensivnosti napriazhenii v elementakh konstruktsii iz kompozitsionnogo materiala).** V. I. Grishin and B. M. Medvedev (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovsky, USSR). *Problemy Prochnosti,* Oct. 1979, p. 61-64. 6 refs. In Russian.

The paper deals with the numerical determination of the stress intensity factor of boron- and graphite-fiber plastics, of the type used in the aircraft industry, by the finite element method. The accuracy of this approach is analyzed. A simple relation is proposed for evaluating the stress intensity factor in terms of the stress concentration factor of a plate with a hole and two lateral cracks. V.P.

A80-17965 # **Evaluation of the intensity of beat-induced vibrations (Otsenka intensivnosti vibratsii pri bieniiakh).** M. K. Sidorenko (Kuibyshevskii Aviatsionnyi Institut, Kuibyshev, USSR). *Problemy Prochnosti,* Oct. 1979, p. 112-114. In Russian.

Beats in multiple-rotor gas-turbine engines may arise when the rotors rotate at roughly the same frequency or in the aerodynamic excitation of higher-order mode shapes of blade vibrations. In the present paper, beat-induced vibration standards are critically analyzed. It is proposed to evaluate the beat intensity on the basis of a generalized transfer function of oscillatory systems, which makes allowance for the ratio of the beat component frequencies. V.P.

A80-17998 An analytical method of testing pavement strength (Analytische Überprüfung der Tragfähigkeit von Flugbetriebsflächen). G. Beecken (Deutsche Shell AG, Hamburg, West Germany), R. C. Koole (Koninklijke/Shell-Laboratorium, Amsterdam, Netherlands), and W. Visser (Pavement Consultancy Services, Rotterdam, Netherlands). *Airport Forum,* vol. 9, Dec. 1979, p. 23-27, 30-33. In English and German.

The article presents a fully developed analytical method of designing airport pavements, measuring the residual bearing capacity of existing surfaces, and designing the reinforcements needed. Measurements, which are subsequently evaluated with the aid of a computer program, are made with falling weight devices which make allowance for the complex stress pattern produced by the various different aircraft types. The results can also be presented in the form of LCN values, a particular advantage of the method described here and one important reason why the analytical method may be expected to gain further ground at the expense of empirical methods. (Author)

A80-17999 Marseilles - Metamorphosis of an airport. *Airport Forum,* vol. 9, Dec. 1979, p. 51-55. In English and German.

The article surveys the program of enlargement and modernization at the Marseilles-Marignane airport which began in 1972. It is noted that passenger traffic at the airport has been growing at the rate of 5.3% a year, and cargo traffic at 7.5% annually. Attention is given to the principal requirements laid down for the planners and architects under the expansion program such as no interference with airport operations, and a final design flexible to ensure easy adaptation to future needs. Topics covered include organization of the terminal, the new control tower, runway extension and finally future plans. M.E.P.

A80-18000 Centralized ground power systems conserve energy. R. L. Frantz (Hobart Brothers Co., Troy, Ohio). *Airport Forum,* vol. 9, Dec. 1979, p. 63, 64, 66-68, 70. In English and German.

It is noted that fixed 400 Hz systems for supplying aircraft with ground power are increasingly being installed in new airport facilities. The article examines how economical the latest installations with centralized electricity generation can be. Discussion covers the advent of centralized power supplies, a typical system, the planning of a central system, cost aspects, and some present installations. It is concluded that in view of the new aircraft ordered for the eighties and the urgent need to conserve energy, ground power supply should be seriously considered by airport and airline operators. M.E.P.

A80-18022 * Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations. Y.-Y. Chu (Perceptronics, Inc., Woodland Hills, Calif.) and W. B. Rouse (Illinois, University, Urbana, Ill.). *IEEE Transactions on Systems, Man, and Cybernetics,* vol. SMC-9, Dec. 1979, p. 769-778. 15 refs. Grant No. NsG-2119.

As human and computer come to have overlapping decisionmaking abilities, a dynamic or adaptive allocation of responsibilities may be the best mode of human-computer interaction. It is suggested that the computer serve as a backup decisionmaker, accepting responsibility when human workload becomes excessive and relinquishing responsibility when workload becomes acceptable. A queueing theory formulation of multitask decisionmaking is used and a threshold policy for turning the computer on/off is proposed. This policy minimizes event-waiting cost subject to human workload constraints. An experiment was conducted with a balanced design of several subject runs within a computer-aided multitask flight management situation with different task demand levels. It was found that computer aiding enhanced subsystem performance as well as subjective ratings. The queueing model appears to be an adequate representation of the multitask decisionmaking situation, and to be capable of predicting system performance in terms of average waiting time and server occupancy. Server occupancy was further found to correlate highly with the subjective effort ratings. (Author)

A80-18062 * Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack. R. R. Wills, I. Sekercioglu, J. S. Ogden, C. A. Alexander, and D. E. Niesz (Battelle Columbus Laboratories, Columbus, Ohio). *American Ceramic Society Bulletin,* vol. 58, Dec. 1979, p. 1198. Contract No. NAS7-100.

A80-18186 Flight certification of the Cessna TU206G amphibious floatplane. R. K. Rice (Cessna Aircraft Co., Wichita, Kan.). *Society of Flight Test Engineers, Journal,* vol. 2, Jan. 1980, p. 2-15.

A flight test program to develop and certify the 1979 Cessna TU206G turbocharged amphibian is discussed. The test program consisted basically of two parts: certification and performance. Development testing showed that certain modifications were required, e.g., engine cowl inlet and cowl exit areas had to be increased to provide additional cooling air flow, the static system had to be modified to obtain satisfactory speed calibrations. A spin test, included into the test program, showed that the longest recovery from a one-turn spin was three-fourths of a turn and occurred with abnormal use of controls during recovery. Performance tests showed a significant improvement of rate of climb over the U206G floatplane, cruise speeds and specific range were significantly lower for the amphibian than the TU206G landplane, and takeoff and landing distances of the amphibian were similar to the landplane model for land operation but lengthened somewhat on water. The results of the test program were applied to a similar model, the TU206G floatplane, which, combined with the test programs of 206 floatplane models, allowed certification for two new models at the cost of only one flight test program. V.L.

A80-18235 * # Experimental and computational study of transonic flow about swept wings. A. Bertelrud, M. Y. Bergmann, and T. J. Coakley (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0005.* 17 p. 12 refs.

An experimental investigation of NACA 0010 and 10% circular arc wing models, swept at 45 deg, spanning a channel, and at zero angle of attack is described. Measurements include chordwise and spanwise surface pressure distributions and oil-flow patterns for a range of transonic Mach numbers and Reynolds numbers. Calculations using a new three-dimensional Navier-Stokes code and a two-equation turbulence model are included for the circular-arc wing flow. Reasonable agreement between measurements and computations is obtained. (Author)

A80-18238 # Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil. N. L. Sankar and Y. Tassa (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0010.* 15 p. 24 refs.

The unsteady two-dimensional Navier-Stokes equations are solved for laminar compressible flow around a NACA 0012 airfoil. The governing equations are cast in a strong conservation form in a body-fitted coordinate system, and solved using an alternating direction implicit procedure. Test cases are presented to establish the reliability and accuracy of the procedure, including a case dealing with the static stall of a Joukowski 9% airfoil. The present technique is applied to the dynamic stall of a NACA 0012 airfoil, for several combinations of Mach number, Reynolds number, and reduced frequency. The numerical results are compared with incompressible Navier-Stokes Solutions and water tunnel experiments. (Author)

A80-18245 # **Estimation of noise source strengths in a gas turbine combustor.** M. Muthukrishnan, W. C. Strahle, and D. H. Neale (Georgia Institute of Technology, Atlanta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0034.* 5 p. 8 refs. U.S. Department of Transportation Contract No. FA-77WA-4077.

Experiments were conducted to determine the cause(s) of gas turbine combustor noise and to quantify the portion of noise radiated from a combustor which is linearly, causally related to combustor events. Using multiple coherence analysis on results obtained with a combustor terminated by a choked nozzle-diffuser combination it was found that a) a two source model is adequate with the two sources being direct combustion noise and entropy noise, b) entropy noise is only important at low frequencies, but is highly coherent with combustion noise, c) with a choked nozzle termination the noise is higher frequency than previously demonstrated and d) some other uncertain source, external to the combustor, contaminated the results. (Author)

A80-18248 * # **Structural parameters that influence the noise reduction characteristics of typical general aviation materials.** J. Roskam and F. Grosveld (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0038.* 11 p. 7 refs. NASA-supported research.

Effect of panel curvature and oblique angle of sound incidence on noise reduction characteristics of an aluminum panel are experimentally investigated. Panel curvature results show significant increase in stiffness with comparable decrease of sound transmission through the panel in the frequency region below the panel/cavity resonance frequency. Noise reduction data have been achieved for aluminum panels with clamped, bonded and riveted edge conditions. These edge conditions are shown to influence noise reduction characteristics of aluminum panels. Experimentally measured noise reduction characteristics of flat aluminum panels with uniaxial and biaxial in-plane stresses are presented and discussed. Results indicate important improvement in noise reduction of these panels in the frequency range below the fundamental panel/cavity resonance frequency. (Author)

A80-18251 * # **An improved sensing element for skin-friction balance measurements.** J. M. Allen (NASA, Langley Research Center, Supersonic Aerodynamic Branch, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0049.* 6 p. 5 refs.

A nulling, parallel-linkage sensing element has been developed for a skin-friction balance in order to minimize the introduction of extraneous forces. Advantages of the present element over the conventional single-pivot sensing element include its insensitivity to element misalignment and off-center normal forces. Wind tunnel tests of the effects of gap size and element misalignment on parallel-linkage balance measurements indicate the greater sensitivity of the device to misalignment at small gap sizes and large lip sizes, as well as its relative insensitivity to off-center normal forces. It is concluded that a parallel-linkage device with a small lip is virtually insensitive to gap size and element misalignment, representing an improvement in skin-friction-measuring characteristics. A.L.W.

A80-18252 # **Controllers for aircraft motion simulators.** W. R. Sturgeon (Systems Analysis and Control, Ridgecrest, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0050.* 10 p. 6 refs.

Two techniques applicable to the design of motion simulator controllers have been developed. The first, a linear optimal controller synthesized with a quadratic performance index, provides all of the response characteristics previously obtained by classical designs, and consists only of constant gain feedforward and feedback loops around the actuators. The resulting closed-loop system is, therefore, relatively simple as no additional filters or compensators are required. The second technique involves the use of accelerometers and rate gyros, located at the pilot station, to close outer feedback loops around the simulator. This causes the fidelity to be dependent on the feedback (sensors) rather than the simulator, and results in a lower sensitivity to parameter variations and nonlinearities. These techniques, when applied to a planar model of the Vertical Motion Simulator, which had the synergistic, overcontrolled, and nonlinear properties of the actual system, provided a controller with the desired response characteristics. (Author)

A80-18253 * # **Computer simulation of engine systems.** L. H. Fishbach (NASA, Lewis Research Center, Flight Performance Section, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0051.* 15 p. 32 refs.

The paper discusses the availability throughout the government and industry of analytical methods for calculating both the steady state and transient performance of an aircraft engine during an entire flight regime. The historical development of some of the analytical tools capable of evaluating installation effects on engine performance is traced and their present status is described. C.F.W.

A80-18254 # **Multi-variable cycle optimization by gradient methods.** H. Brown (General Electric Co., Evendale, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0052.* 10 p.

Variable-cycle engine (VCE) concepts are being explored as a potential approach for advanced military or commercial supersonic propulsion. This paper represents a progress report on a continuing program for the development of a multivariable cycle optimization capability which can be applied to the problem of VCE control schedule development. The discussion covers conventional nonlinear optimization techniques, the cycle calculation process and its potential effect on the optimization process, two possible approaches to cycle optimization, and examples of their application to VCE control schedule development. Both approaches use internal unbalanced cycle calculations for generating partial derivatives, frequent derivative updates, and a constrained gradient approach to the optimization process. The first approach employs a numerical integration external to the cycle balance process, while the second approach incorporates the optimization within the internal cycle balance. S.D.

A80-18255 # **Regression techniques applied to parametric turbine engine simulations.** J. R. Ruble (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio), R. A. Sulkoske, and R. E. Clark (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0053.* 9 p. 5 refs.

Parametric gas turbine engine computer simulations are used in overall aircraft/mission analysis to develop optimum trends relative to system design variables. Regression analysis curve-fitting was applied to several areas of a base-line parametric engine simulation, and procedures were evaluated individually and collectively. These areas included thermodynamic properties, matrix coefficient pre-

diction, component characteristics, and the ideal compression process. Some areas of study are shown to be of general benefit to industry while others have more narrow application or could not be considered cost-effective changes. The collective evaluation demonstrated a 46% cost reduction. (Author)

A80-18260 # **A comparison of first and second order techniques for computing optimal horizontal gliding trajectories.** W. E. Williamson, Jr. (Sandia Laboratories, Albuquerque, N. Mex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0061*. 5 p. Research supported by the U.S. Department of Energy.

The problem of numerically computing maximum endurance subsonic gliding trajectories which remain in a horizontal plane and return to the original starting point is considered. The control is parameterized and numerical solutions for two different types of parameterization are shown. Piecewise continuous polynomial control approximations are shown to produce consistent results for the trajectories which should be close approximations for the true optimal solution. C.F.W.

A80-18261 # **Conformal mapping analysis of multielement airfoils with boundary-layer corrections.** N. D. Halsey (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0069*. 8 p. 12 refs. Research sponsored by the McDonnell Douglas Independent Research and Development Program.

A conformal mapping technique for the potential-flow analysis of multielement airfoils is extended to include first-order viscous effects. Boundary layers are simulated by modification of either the airfoil coordinates (displacement method) or the boundary conditions (blowing method). In the displacement method, multiple bodies with open trailing edges are transformed to multiple (closed) circles. In the blowing method, the multiple circles are analyzed with nonzero specified normal velocity components. These extensions demonstrate that conformal mapping techniques can be applied to many problems formerly thought to fall in the exclusive realm of the more general distributed singularity techniques. (Author)

A80-18268 # **Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment.** W. L. Meyer, B. R. Daniel, and B. T. Zinn (Georgia Institute of Technology, Atlanta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0097*. 9 p. 7 refs. Contract No. F49620-77-C-0066.

A special integral representation of the exterior solutions of the Helmholtz equation is used to calculate the free field acoustic radiation patterns around two finite axisymmetric bodies; a straight pipe and a jet engine inlet. The radiation patterns around these bodies are then measured experimentally, with the free field being approximated through the use of an anechoic chamber. The inlet tested has a hard wall while the straight pipe is tested with both a hard and lined wall. The computed theoretical and the measured experimental acoustic radiation patterns are found to be in good agreement. A discussion of possible sources of error, both theoretical and experimental, is included. (Author)

A80-18271 # **Engine aerodynamic installation by numerical simulation.** L. Dutouquet and J. M. Hardy (SNECMA, Centre de Villaroche, Moissy Cramayel, Seine-et-Marne, France). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0108*. 16 p. 25 refs.

The aerodynamic optimization of current engines under various flight conditions involves the simultaneous computation of several streams. The paper demonstrates the necessity of studying transonic flows with a method capable of explaining the free streamlines, of introducing a plug in the supersonic region, and of being incorporated into the overall computational program. An analysis likely to meet all these requirements is proposed, and preliminary results are presented. The development of a combined computer program has proven to be very useful. S.D.

A80-18272 * # **Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles.** J. P. Weidner (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0111*. 9 p. 6 refs.

A study has been conducted to determine the implications of top-mounted inlet nacelles on propulsion performance and cruise range. The top-mounted nacelle would be less visible from ground-based radar below and ahead of the aircraft. For this study, the nacelle is integrated with a high altitude Mach 5 turbojet/ramjet-powered airplane concept requiring a large nacelle. Results of the study suggest nacelle installation advantages and improved inlet mass flow ratio for the top-mounted nacelle, but at the expense of a higher installed drag at transonic and supersonic speeds. (Author)

A80-18276 # **The criticality of engine exhaust simulations on VSTOL model-measured ground effects.** J. R. Lummus (General Dynamics Corp., Aerospace Technology Dept., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0230*. 10 p. 16 refs. Navy-supported research.

To improve the accuracy of current prediction methodologies and to gain physical understanding of the flow mechanisms involved, an experimental investigation was conducted to determine the criticality of full-scale engine-nozzle exit conditions (nozzle exit turbulence, total pressure distribution, and pressure ratio over the ranges expected for full-scale aircraft engines) on the propulsion-induced aerodynamic forces for two-, three-, and four-nozzle configuration models with flat plate blocking surfaces. The criticality of performing accurate full-scale engine exhaust simulations during model-measured VSTOL ground effects testing is demonstrated. If the effects of nozzle exit conditions of the engines expected for use on VSTOL aircraft are not considered, costly errors in aircraft sizing will result. S.D.

A80-18277 * # **Recent development of a jet-diffuser ejector.** M. Alperin and J. J. Wu (Flight Dynamics Research Corp., Van Nuys, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0231*. 10 p. Navy-NASA-supported research.

The paper considers thrust augmenting ejectors in which the processes of mixing and diffusion are partly carried out downstream of the ejector solid surfaces. A jet sheet surrounding the periphery of a widely diverging diffuser prevents separation and forms a gaseous, curved surface to provide effective diffuser ratio and additional length for mixing of primary and induced flows. Three-dimensional potential flow methods achieved a large reduction in the length of the associated solid surface; primary nozzle design further reduced

the volume required by the jet-diffuser ejectors, resulting in thrust augmentation in excess of two, and an overall length of about 2 1/2 times the throat width. A.T.

A80-18303 * # **Thermal barrier coatings for aircraft gas turbines.** R. A. Miller, S. R. Levine, and S. Stecura (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0302.* 6 p. 13 refs.

Improvements in gas turbine performance are approaching the limits imposed by alloy properties and excessive cooling air requirements. Thin ceramic coatings can increase the difference between gas temperature and metal temperature by several hundred degrees. Thus, they are potentially a major step forward in surface protection. These coatings offer the potential to reduce fuel consumption by permitting reduced coolant flow or higher turbine inlet temperature or to improve durability by reducing metal temperatures and transient thermal stresses. At NASA Lewis, in-house and contractual programs are in place to bring this promising technology to engine readiness in the early 1980's. Progress towards this goal is summarized in this paper. (Author)

A80-18304 # **Sonic fatigue design data for bonded aluminum aircraft structures.** M. J. Jacobson (Northrop Corp., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Aserospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0303.* 14 p. 12 refs. Contract No. F33615-75-C-3144; No. F33615-75-C-3016. AF Project 14710130.

A combined analytical/experimental program was conducted to determine sonic fatigue design properties of bonded structural sections commonly used in aircraft and to formulate data and criteria for the development of sonic fatigue designs of such structure. An objective of the program was to develop information applicable to aircraft fuselage panels using adhesive bonding in the primary structure, in lieu of mechanical fasteners such as are currently used. The lives of the bonded panels were generally much greater than the sonic fatigue lives of riveted 7075-T6 aluminum alloy panels of comparable size and thickness. Based on the test data and theoretical considerations, a sonic fatigue design chart was developed. It is expected that the approach in developing the sonic fatigue design chart will remain applicable when different bonding systems and surface preparations are considered. (Author)

A80-18306 # **Fatigue life prediction of a bonded splice joint.** C. T. Liu (U.S. Navy, Naval Air Station, Alameda, Calif.) and R. A. Heller (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0305.* 10 p. 15 refs.

A linear cumulative damage model utilizing the actual state of stress ahead of a crack tip is used to predict the fatigue life of a double-overlapped splice joint. The joint is made of 7075-T6 aluminum and SAE 4130 steel. Two stress states, normal stress and octahedral shear stress, are considered and calculated from a finite element method. The effect of the stress state on the fatigue life of the joint is investigated and cumulative damage calculations with two load levels are presented. (Author)

A80-18308 * # **Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel.** F. H. Lutze (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0309.* 8 p. 18 refs. Contract No. NAS1-13175-16.

The technique of using a curved and rolling flow wind tunnel to extract pure rotary stability derivatives is presented. Descriptions of the curved flow and the rolling flow test sections of the Virginia Tech Stability Wind Tunnel are given including methods for obtaining the proper velocity profiles and correcting the data acquired. Results of testing current fighter configurations in this facility are presented with particular attention given to comparing pure rotary derivatives with combined rotary and unsteady derivatives obtained by standard oscillation tests. Also the effect of curved and rolling flow on lateral static stability derivatives is examined. (Author)

A80-18309 # **Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack.** D. M. Rao (Old Dominion University, Norfolk, Va.) and T. D. Johnson, Jr. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0310.* 11 p.

This paper reports an experimental study of leading-edge flow manipulators for alleviating the lift-dependent drag due to breakdown of attached flow on blunt leading edges of highly swept wings. The potential of conventional as well as novel devices (fences, chordwise slots, pylon vortex generators and 'vortex-plate') was explored in subsonic wind tunnel tests on a 60-deg delta wing model. In addition to balance measurements, leading-edge suction distributions were obtained to monitor the spanwise flow development and its modification by the different types of devices. The results indicate significant possibilities of drag reduction to high angles of attack through partial recovery of leading-edge thrust by means of the proposed devices and their combinations. In addition, improvements in the longitudinal stability were also found. (Author)

A80-18315 * # **Studies of leading-edge thrust phenomena.** H. W. Carlson and R. J. Mack (NASA, Langley Research Center, Supersonic Aerodynamics Branch, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0325.* 11 p. 14 refs.

A study of practical limitations on achievement of theoretical leading-edge thrust has been made and an empirical method for estimation of attainable thrust has been developed. The method is based on a theoretical analysis of a set of two-dimensional airfoils to define thrust dependence on airfoil geometric characteristics and arbitrarily defined limiting pressures, an examination of two-dimensional airfoil experimental data to provide an estimate of limiting pressure dependence on local Mach number and Reynolds number, and employment of simple sweep theory to adapt the method to three-dimensional wings. Because the method takes into account the spanwise variation of airfoil section characteristics, an opportunity is afforded for design by iteration to maximize the attainable thrust and the attendant performance benefits. The applicability of the method was demonstrated by comparisons of theoretical and experimental aerodynamic characteristics for a series of wing-body configurations. Generally, good predictions of the attainable thrust and its influence on lift and drag characteristics were obtained over a range of Mach numbers from 0.24 to 2.0. (Author)

A80-18316 * # **Development of a vortex-lift-design method and application to a slender maneuver-wing configuration.** J. E. Lamar (NASA, Langley Research Center, Hampton, Va.), R. T. Schemensky (General Dynamics Corp., Fort Worth, Tex.), and C. S. Reddy (Old Dominion University, Norfolk, Va.). *American Institute*

of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0327. 12 p. 16 refs.

A method has been developed to optimize the mean camber surface of a cranked slender wing having leading-edge vortex flow at transonic-maneuver conditions using the suction analogy. This type of flow was assumed because it was anticipated that the slenderness of the wing would preclude attached flow at the required lift coefficient. A constraint was imposed in that the camber deflections were to be restricted by a realistic structural-box requirement. The resulting application yielded mean-camber shapes which produced effective suction levels equivalent to 77 percent of the full-planar leading-edge value at the design lift coefficient. (Author)

A80-18317 # **The rational design of an airfoil for a high performance jet trainer.** S. A. Powers and D. F. Sattler (Vought Corp., Dallas, Tex.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0328.* 10 p. 8 refs.

This paper discusses the preliminary design of an airfoil tailored to the design requirements of a high performance jet trainer. The airfoil design requirements are discussed, and the development of the pressure distribution model outlined. The use of an airfoil design program is discussed and the results presented. The indications are that the designed airfoil will have a majority of the desired characteristics. (Author)

A80-18318 # **Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration.** G. E. Erickson (Northrop Corp., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0329.* 10 p.

A low-speed wind tunnel investigation using a 1/10-scale model of a twin-jet fighter configuration to determine the effect on the aerodynamic characteristics of a nonplanar strake-wing arrangement is presented. The configuration has leading-edge vortex-generating surfaces mounted on and extending forward of the side-mounted engine inlets and are closely-coupled with a conventional planar strake-wing combination. These additional lifting surfaces result in vortex-induced lift increments, drag polar improvement, and undesirable pitch-up. Water tunnel flow studies of models indicate that the inlet hood vortex favorably interacts with the wing-strake vortex, delaying strake vortex breakdown to higher angles of attack. The lateral/directional stability levels are reduced but the turn performance is enhanced by implementation of the inlet hoods; the stability reduction indicates the need for further improvement in the inlet hood configuration. A.T.

A80-18319 # **An inverse transonic wing design method.** P. A. Henne (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0330.* 11 p. 21 refs.

An inverse, transonic flow method for the design of three-dimensional wings has been developed. The flow method is based on a three-dimensional, finite difference solution of the full-potential equation. The inverse scheme utilizes a Dirichlet boundary condition in conjunction with surface transpiration to affect geometry definition. Such a scheme has previously been utilized in a two-dimensional method. This paper summarizes an analogous development for three dimensions. Basic steps and underlying assumptions of the inverse scheme are described. Applications of the method to both simple and complicated design problems are discussed and advantages of the method are identified. (Author)

A80-18328 # **Photon correlation laser velocimeter measurements in highly turbulent flow fields.** C. D. Catalano, H. E. Wright (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), A. Cerrulo, and H. Rogers. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0344.* 6 p. 6 refs.

A laser velocimeter using a photon correlation processing scheme has been developed for use in obtaining reliable information in turbulent mixing regions. Quantities measured in this investigation include mean velocities and turbulent intensities. Measurements have been made in a rectangular nozzle free jet flow both with the laser velocimeter and with a hot wire anemometer. The Mach number at the exit plane of the nozzle was varied from 0.2 to 0.8. The laser velocimeter obtained mean velocity data was found to correspond quite closely to the information obtained by using the hot wire. The turbulent intensities were found to be much more difficult to measure using the laser velocimeter. Additionally, measurements have also been made in the inlet circular duct flow for an actual jet engine. The results pointed out the importance of particle dynamic analysis in establishing the credibility of laser velocimetry in specific flow fields. (Author)

A80-18336 # **Hinged vehicle equations of motion.** M. J. Abzug. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0364.* 11 p. 5 refs.

The six-degree-of-freedom equations of motion for flight vehicles having one or more hinged parts are derived from very general vector-dyadic equations that were originally written for space vehicles. The application of these equations is illustrated by the case of an interceptor vehicle consisting of a body of revolution that has a single two-degree-of-freedom hinge. Dynamic cross-coupling terms of up to third order in the variables of motion are obtained. Development of equations by the generalized method of this paper is considered preferable to ad hoc methods to minimize the possibility of errors. (Author)

A80-18340 # **Improved numerical simulation of high speed inlets using the Navier-Stokes equations.** D. D. Knight (Rutgers University, New Brunswick, N.J.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0383.* 17 p. 42 refs. Contract No. F33615-78-C-3008.

An improved numerical algorithm has been developed to calculate the flowfield in two-dimensional mixed-compression high speed inlets using the Navier-Stokes equations. The explicit finite-difference algorithm of MacCormack is utilized, together with a modified treatment of the viscous sublayer and transition wall region of the turbulent boundary layers. A variety of flows have been considered, including shock-turbulent boundary layer interaction on a flat plate and three different configurations of a simulated high speed inlet. The computed results compare favorably with the experimental data. (Author)

A80-18346 # **Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft.** M. Levy, A. S. Kuo, and K. Grube (Fairchild Republic Co., Farmingdale, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0405.* 11 p. 22 refs.

The relationship between crack growth rate under a variable-amplitude spectrum da/dF, and the stress intensity per unit stress,

alpha is found to be unique for similar loading spectra. Once this relationship, f of alpha, is established, the cycle-by-cycle integration is not needed and simple integration of f of alpha can be applied to obtain the crack growth curve. An illustration of the da/dF vs. alpha approach as recommended for the A-10A Damage Tolerance Reassessment is demonstrated. It includes two different stress spectra applied on coupon tests with various geometry and loading configurations. The function f of alpha assumes the form used by the Forman equation for da/dN, normalized about some reference stress. This function is shown to fit best the data points generated by the coupon test. (Author)

A80-18351 * # **Determination of the spin and recovery characteristics of a typical low-wing general aviation design.** M. B. Tischler and J. B. Barlow (Maryland, University, College Park, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0169.* 10 p. 17 refs. Research supported by the Minta Martin Fund for Aeronautical Research; Grant No. NsG-1570.

The equilibrium spin technique implemented in a graphical form for obtaining spin and recovery characteristics from rotary balance data is outlined. Results of its application to recent rotary balance tests of the NASA Low-Wing General Aviation Aircraft are discussed. The present results, which are an extension of previously published findings, indicate the ability of the equilibrium method to accurately evaluate spin modes and recovery control effectiveness. A comparison of the calculated results with available spin tunnel and full scale findings is presented. The technique is suitable for preliminary design applications as determined from the available results and data base requirements. A full discussion of implementation considerations and a summary of the results obtained from this method to date are presented. (Author)

A80-18352 # **Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation.** W. A. Moore, A. M. Skow, and D. J. Lorincz (Northrop Corp., Aircraft Group, Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0173.* 14 p. 21 refs.

A combined experimental and analytical study was undertaken to develop active blowing concepts to control the asymmetric orientation of the vortex system emanating from an aircraft forebody at high angles of attack. The objective of the study was to utilize the side-force associated with asymmetric vortices, in a controlled manner, to enhance the capability of a fighter to recover from a departure from controlled flight. Results from water tunnel and wind tunnel tests show a small amount of tangential blowing along the forebody can effectively alter the forebody vortex system and generate large restoring yawing moments. Six degree-of-freedom digital simulation results show this concept can substantially enhance departure recovery characteristics of fighter aircraft having long, slender forebodies. (Author)

A80-18356 # **Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane.** J. Roskam, C. P. G. van Dam, and M. Griswold (Kansas, University, Lawrence, Kan.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0186.* 7 p. 8 refs.

Current methods for predicting longitudinal aerodynamic characteristics of a light twin-engine airplane are compared with full-scale wind tunnel results. Correlations are performed on the lift, drag, and pitching moment coefficients for the following configurations: (1) tail-on and tail-off; (2) propellers removed; (3) power on. The methods used in arriving at theoretical predictions are essentially those outlined in the USAF Datcom (lifting line). In addition some use was made of computerized lifting surface methods. Fairly good agreement was obtained for both pitch and drag. Lift predictions show some discrepancy in both angle of zero lift and maximum lift. The increments due to power were well predicted. (Author)

A80-18357 # **Flow in transonic compressors.** J. L. Kerrebrock (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0124.* 22 p. 50 refs.

Current knowledge of the aerodynamics of transonic compressors and prospects for significant improvement in their efficiency are reviewed. Attention is given to describing the role of the technology and its status, to discussing some recent progress toward understanding the flow field, and to indicating the trends of future research work. It is concluded that the exercise of pertinent experimental and computational capabilities together in a rationalized design process can result in improvements of 5% or more in transonic compressor efficiency. S.D.

A80-18358 # **Multiple tactical aircraft combat performance evaluation system.** D. S. Hague (Aerophysics Research Corp., Bellevue, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0189.* 11 p. 13 refs. Contract No. F33615-78-C-3000.

The recently developed mutliple tactical aircraft combat performance evaluation system (MULTAC), designed to analyze the outcome of a close-in M-on-N air combat, is detailed. The trajectories of up to 20 aircraft engaged in an aerial combat are simultaneously integrated under the time varying angle-of-attack, bank angle and throttle history using the fourth-order Runge-Kutta algorithm. Encounter outcome is rated by the average survival probability using either a Monte-Carlo model or a co-kill probability model. The system is provided with a library of tactical aircraft and weapon characteristics encompassing current U.S. and Soviet tactical aircraft; these characteristics are stored in an on-line computerized data base. An example of the MULTAC system application illustrates a trade off between advanced technology and number of aircraft. In the series of encounters considered a 25 percent increment in lift capability could offset a 3:2 but not a 2:1 numerical advantage. V.L.

A80-18359 # **Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation.** G. H. Klopfer and J. N. Nielsen (Nielsen Engineering and Research, Inc., Mountain View, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0126.* 16 p. 14 refs. Navy-sponsored research.

A computational procedure is presented for computing steady supersonic flowfields surrounding wings and wing-body configurations with sharp leading edges. The Euler equations are solved by MacCormack's scheme. The viscous effects, important near the sharp edges, are simulated by a Kutta condition. Results are presented for two delta wings and a wing-body configuration at M = 3.0. The wing-body interference factor of a delta wing in the presence of a circular body at an angle-of-attack of 10 deg and M = 3.0 is also determined. (Author)

A80-18367 * # **Analysis of transonic flow about harmonically oscillating airfoils and wings.** W. H. Weatherill (Boeing Commercial Airplane Co., Seattle, Wash.) and F. E. Ehlers (Boeing Computer Services Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0149.* 9 p. 12 refs. Research supported by the Boeing Commercial Airplane Co.; Contract No. NAS1-15128.

A finite difference method for analyzing the unsteady transonic flow about harmonically oscillating wings is discussed. The procedure is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting partial differential equations for small disturbances. Initial solutions were obtained using relaxation procedures, but the solution range proved to be limited in terms of Mach number and reduced frequency. Recent two-dimensional results are presented which have been obtained with direct solution procedures in which the difference equations are solved 'all at once' and these provide reasonable correlation for practical values of Mach number and reduced frequency. (Author)

A80-18375 * # **The effects of leading edge modifications on the post-stall characteristics of wings.** A. E. Winkelmann, J. B. Barlow, J. K. Saini, J. D. Anderson, Jr., and E. Jones (Maryland, University, College Park, Md.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0199.* 16 p. 18 refs. Research supported by the Minta Martin Fund; Grant No. NsG-1570.

An investigation of the effects of leading edge modifications on the post-stall characteristics of two rectangular planform wings in a series of low speed wind tunnel tests is presented. Abrupt discontinuities in the leading edge shape of the wings were produced by placing a nose glove over a portion of the span or by deflecting sections of a segmented leading edge flap. Six component balance data, oil flow visualization photographs, and pressure distribution measurements were obtained, and tests made to study the development of flow separation at stall on small scale planform wing models. Results of oil flow visualization tests at and beyond stall showed the formation of counter-rotating swirl patterns on the upper surface of the '2-D' and '3-D' wings, and results of a numerical lifting line technique applied to wings with leading edge modifications are included. A.T.

A80-18376 # **Streamwise development of the flow over a delta wing.** P. M. Sforza and M. J. Smorto (New York, Polytechnic Institute, Farmingdale, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0200.* 8 p. 10 refs.

An experimental investigation of the low speed flow over a highly swept delta wing with sharp leading edges is presented. Velocity measurements in the separated leading edge vortex which dominates the three-dimensional flow field are shown for several different chordwise stations, and serve to illustrate the streamwise development of the vortex. This data is also used to determine the trajectory of the vortex over the delta and to calculate the circulation distribution in the flow, and these results are compared to those of previous studies. (Author)

A80-18534 # **Modular strapdown guidance unit with embedded microprocessors.** J. P. Gilmore (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *(American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Palo Alto, Calif., Aug. 7-9, 1979, Paper 78-1239.) Journal of Guidance and Control,* vol. 3, Jan.-Feb. 1980, p. 3-10. 5 refs. Contract No. F08635-76-C-0306.

The Low-Cost Inertial Guidance System (LCIGS) is a modular strapdown implementation of attitude (gyro) and velocity (accelerometer) axes which permits the interchangeable use of different manufacturer's instruments without affecting the system's electronic or mechanical interfaces or processing software. This design flexibility is made possible by the use of microprocessors for processing and control. The microprocessors are embedded in each module and five are used: one per accelerometer triad, one each per gyro module, and one in the service module. The processors effect on-line digital torquing control of the gyros, active instrument error model compensation, including modeling for temperature sensitivity effects, temperature control, self-testing, etc. Adaptation of processing and calibration algorithms to accommodate for instrument changes or sensed environmental variations is achieved through the use of an alterable read-only data base that may be updated by the LCIGS support equipment as required at calibrations or upon an instrument replacement. This data base is accessed by the microprocessors and used to compute coefficient corrections for the processing algorithms. The system architecture is presented and the microprocessor software partitioning and functions are described. (Author)

A80-18537 # **A statistical method applied to pilot behavior analysis in multiloop systems.** N. Goto (Kyushu University, Fukuoka, Japan). *Journal of Guidance and Control,* vol. 3, Jan.-Feb. 1980, p. 62-68. 22 refs.

A recently developed statistical method has been applied to the analysis of pilot control behavior in multiloop systems. The method utilizes the so-called autoregressive scheme, and produces analytical results in terms of root mean square values, power spectra, and pilot describing functions. The method is practical in that it manipulates operating records and it can check the validity of the assumed compensatory control system structure. To show the usage and feasibility of the method, the data from a series of moving-base simulator experiments have been analyzed by the method. Emphasis of the experiment was placed on the lateral-directional control of an aircraft in the landing approach phase under the influence of turbulence. The variation of pilot control behavior with respect to two experimental variables, the Dutch-roll damping ratio and the flight rules, is presented with the discussion as to the system structure and the limitations of the method. Since the application of the method to the field of pilot behavior analysis is quite new, the described method and the presented results are considered to help better analyze and understand pilot behavior in multiloop systems. (Author)

A80-18538 # **Constrained optimum trajectories with specified range.** H. Erzberger and H. Lee (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Guidance and Control,* vol. 3, Jan.-Feb. 1980, p. 78-85. 7 refs.

The characteristics of optimum fixed-range trajectories whose structure is constrained to climb, steady cruise, and descent segments are derived by application of optimal control theory. The performance function consists of the sum of fuel and time costs, referred to as direct operating costs (DOC). The state variable is range-to-go and the independent variable is energy. In this formulation a cruise segment always occurs at the optimum cruise energy for sufficiently large range. At short ranges (500 n. mi. and less) a cruise segment may also occur below the optimum cruise energy. The existence of such a cruise segment depends primarily on the fuel flow vs thrust characteristics and on thrust constraints. If thrust is a free control variable along with airspeed, it is shown that such cruise segments will not generally occur. If thrust is constrained to some maximum value in climb and to some minimum in descent, such cruise segments generally will occur. The performance difference between free thrust and constrained thrust trajectories has been determined in computer calculations for an example transport aircraft. (Author)

A80-18722 # **Automation and air traffic control.** J. Goodwin (Royal Signals and Radar Establishment, Malvern, Worcs., England). *Journal of Navigation,* vol. 33, Jan. 1980, p. 18-22.

The present paper shows how a computer-based system may ease the tasks of a controller so that considering the increased demands for air transport the best combination of man and automation should assure safety and efficiency in air traffic control. Used as an example is the Computer Aided Approach Sequencing system (CAAS) designed with the aim of assisting air traffic controllers to bring aircraft through the final stages of approach to London's Heathrow Airport. A computer is used to process and distribute air traffic data making it possible for the controller to retrieve useful data that would otherwise be unobtainable, while changes in data values can be relayed to him swiftly, so that his information can be more accurate and up-to-date. This improves efficiency while the basic air traffic control procedures and patterns remain the same. Thus, the pattern recognition powers of the controller, vital to safety, have been preserved and combined with the exactitude of the computer. V.L.

A80-18723 # **The economics of air traffic control.** A. Hislop. *Journal of Navigation,* vol. 33, Jan. 1980, p. 23-29.

The economics of air traffic control (ATC) is becoming a critical element of aircraft operating costs due to a number of reasons, including the increase of fuel costs, rapid growth in air traffic, and the increase in air traffic control charges. A study into the long-term development of air traffic control systems in Europe showed that new ATC techniques, such as automatic collision-avoidance systems (CAS), computer aided approach-sequencing (CAAS) and time-slot systems, could considerably improve the operating economics of aircraft. Some of these improvements are: reductions in airway distance between destinations, reductions in number of 'restricted' climb and descent profiles, regular achievement of optimum cruise altitude at correct stage, and reduction in number and cost of delays. Estimated savings per flight in pounds sterling and as percentage of direct operating costs are presented and examples of costs of the new ATC system for general aviation are also given. V.L.

A80-18724 # **ATC and the airborne traffic-situation display.** R. L. Ford (Royal Signals and Radar Establishment, Malvern, Worcs., England). *Journal of Navigation,* vol. 33, Jan. 1980, p. 64-74; Discussion, p. 75-79. 12 refs.

An airborne traffic-situation display (ATSD) is basically a synthetic CRT display showing, in relative plan position, other aircraft which are at the same flight level as one aircraft or which could penetrate that flight level. It is proposed that ATSD be used as a back-up for ground-based ATC equipment. If correctly integrated into the ATC system, the use of ATSD could result in more efficient operations, particularly landing and take-off, more efficient use of airspace, minimization of communication problems, pilot assurance and increased safety. Some recent air disasters are examined and it is shown how they could have been avoided if the pilots had ATSD in their cockpits. Annual savings in operating costs to the airspace users through the adoption of ATSD are estimated at over one thousand million dollars for the mid '80s. The savings would result mainly from reduced delays at terminals, reduced flight time and fuel consumption as well as prevention of carrier losses due to accidents. V.L.

A80-18725 **What brings us down tomorrow - Landing guidance systems for the 1980s.** R. Goodson. *Interavia,* vol. 35, Jan. 1980, p. 58, 59.

Instrument landing systems (ILS) and precision approach radars (PAR) will continue to serve as basic landing aids in civil and military aviation in the U.S. and in other countries around the world well into the 1980's. Advanced ILS use 100 percent solid state electronic circuitry and allow for landings with zero ceiling and runway visibility as low as 200m (700 feet) and is a 'protected' ICAO navigation aid until 1995. PAR is a short-range primary radar landing aid and while ILS can only be installed on a single runway, PAR has the advantage of being movable and can be rotated from one landing strip to another as needed. The new microwave landing system (MLS) is being developed in the meantime and its prototype is now being tested in the U.S. The U.S./Australian Time Reference Scanning Beam (TRSB) Microwave Landing System has been selected by ICAO as the advanced all-weather airport landing system to replace ILS in the future. During the 1980s MLS will be brought nearer to practical realization but it is not yet known how long it will be until its final development. V.L.

A80-18864 # **Technology of the Rolls-Royce RB211 engine.** J. F. Coplin. *Aircraft Engineering,* vol. 51, Dec. 1979, p. 8-11.

Some of the proven advantages of the RB211 turbofan engine are discussed. These advantages, which result from the basic design and a series of improvements to the engine, include: low installed fuel consumption and low installed drag, excellent retention of low specific fuel consumption in airline service, good resistance to foreign object damage and demonstrated good record of integrity in service and capability for development to give both lower sfc and higher thrust levels in the future. A range of advanced engineering programs will contribute to the further development of the RB211: e.g. the quiet engine demonstrator (QED), advanced core engine technology (ACET), the high-temperature demonstrator unit (HTDU), and the life and methods design program. Prospects for the engine development in the 1980s and 1990s are outlined. The engine will have a better sfc (5 percent for the 1980s and at least 20 percent for the 1990s), higher bypass ratio, higher operating temperature and better component efficiencies. V.L.

A80-18865 # **Some practical aspects of the calibration of air data systems.** *Aircraft Engineering,* vol. 51, Dec. 1979, p. 21-24.

Three calibration techniques of the air data system consisting basically of an air speed indicator, altimeter and machmeter are analyzed. These instruments derive their readings from measurements of air pressures and correction is usually required for errors caused by the interference of the pressure field around the aircraft. Calibration procedures consist essentially in determining the system static pressure error over a range of aircraft incidence. One calibration technique, the Airborne Tracking method, is determining the true pressure height of the aircraft by a ground based tracking system (optical system, radar) and the simultaneous record of the indicated height from the aircraft altimeter, with the static pressure error determined from the observed error in indicated altitude. The Trailing Static method involves the use of a static tube trailed behind or below the aircraft. Once an aircraft has been calibrated by one of the absolute methods it can be used as a pacer aircraft for the calibration of the air data systems of other aircraft by a direct comparison technique. Advantages and limitations of each of these methods are discussed. V.L.

A80-19051 # **An overvoltage safety system for direct current aircraft generators (Uklad zabezpieczenia nadnapieciowego lotniczych pradnic pradu stalego).** W. Januszewski and I. Siemiradzki. *Instytut Lotnictwa, Prace,* no. 75, 1978, p. 29-42. In Polish.

The paper proposes a safety system for protection of the aircraft power circuit against excessive voltage. The system characteristics are in accordance with the requirements of the BS.3G.100:3 and GOST-19705-74 standard specifications for direct current generators. An analysis of the current overvoltage safety systems, a diagrammatic representation of the proposed system, and a discussion of the operating principle and the test results of a model device are presented. A.T.

A80-19052 # **Experimental investigation of the characteristics of pneumatic transfer lines (Badania eksperymentalne charakterystyk pneumatycznych linii przesylowych).** B. Niedzialek. *Instytut Lotnictwa, Prace,* no. 75, 1978, p. 43-64. In Polish.

The paper discusses the experimentally determined amplitude characteristics of air lines whose geometric dimensions are L/d of 30 to 500 and d = 1 to 5 mm, for the external pressure amplitude of A sub z = 1.5 to 7.5 kPa. The results obtained for ducts used for piston engine indicators are presented, and correlation between the theoretical and experimental amplitude characteristics is analyzed for small pulsations. The effects of parameters such as A sub z and L/d on duct characteristics are examined, and the generator of sinusoidal pressure pulsations used in tests is described. A.T.

A80-19053 # **Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit (Studia nad oznaczaniem zanieczyszczen metalicznych w oleju metoda pomiaru reluktancji i stratnosci obwodu elektrycznego).** J. Formaniak. *Instytut Lotnictwa, Prace,* no. 76, 1979, p. 3-37. 22 refs. In Polish.

The paper surveys the current methods for detection and evaluation of wear producing materials and presents results of experiments in the determination of metallic impurities in oil by a method based on the measurement of reluctance and the eddy current losses in an electric circuit into which a sample of oil of known contamination by metallic powder was introduced. The tests were performed in frequency ranges from 30 to 1000 kHz; the results were satisfactory for ferromagnetic materials and impurities which are good electrical conductors. The variation in natural frequency of the circuit due to changes in coil inductance or in coil losses was measured, showing that the variation in the Q-factor of the circuit with an oil core containing metallic particles is two orders of magnitude higher than the change in natural frequency. A.T.

A80-19070 # **A numerical approach to subsonic viscous-inviscid interaction.** K. Fujii and K. Karashima (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 575, vol. 44, Oct. 1979, p. 113-128. 17 refs.

In this paper is presented a numerical approach to a subsonic viscous-inviscid interaction involving a boundary layer separation. The formulation is made in such a way that a linear equation for the stream function obtained through a small perturbation scheme for the inviscid flow and intergral forms of the boundary layer equations for the viscous flow constitute a system of basic equations to be solved simultaneously in a flow field. In order to demonstrate the applicability of the present approach, subsonic flows past a divergent wall are solved using an iterative scheme based on the SLOR method and the effects of various parameters on the interaction phenomenon are examined in detail. It is shown that the solution can be obtained without any difficulty even at the separation point. The results indicate that the present approach is capable of predicting the viscous-inviscid interaction involving flow separation. (Author)

A80-19129 # **Weather detection using airport surveillance radar.** D. D. Hayes (Texas Instruments, Inc., Dallas, Tex.). *CATCA Journal,* vol. 11, Fall 1979, p. 4-9.

The FAA's newest airport surveillance radar system, the ASR-8, is described and improvements in weather detection and display are proposed. Features of the ASR-8 which eliminate weather from the display, thus enhancing aircraft display capability, are circular polarization, which reduces weather signals by up to a factor of 100, and moving target indication, which uses the Doppler frequency shift to cancel the returns from fixed objects. It is suggested that the function of weather detection be separated from that of aircraft detection, then optimized by signal processing techniques using microprocessors and minicomputers. While the ASR transmitter and antenna will continue as the source of weather signals, a separate receiver and signal processor channel will use the precipitation signal and tailor the sensitivity time control curve specifically to the weather detection process. J.P.B.

A80-19199 # **Aircraft torque motors (Aviatsionnye momentnye dvigateli).** L. I. Stolov, B. N. Zykov, A. Iu. Afanas'ev, and Sh. S. Galeev. Moscow, Izdatel'stvo Mashinostroenie, 1979. 136 p. 54 refs. In Russian.

The book deals with airborne dc and ac torque motors currently used for activating gyroscopic and servo systems, accelerometers, telescopes, star-trackers, etc. The classification, theory, design, and testing of torque motors with limited and unlimited delta-three angles are examined. V.P.

A80-19269 # **A pre-design code for predicting engine acquisition costs.** J. Cyrus (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.) and E. Onat (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0055.* 6 p. 7 refs.

A computer code has been developed to predict engine acquisition costs using thermodynamic and geometric inputs commonly available during the preliminary design phase. With these inputs the code selects component materials, estimates the weight of raw materials used within the engine, and estimates cost based on the raw material content and exotic material factor, or Maurer factor. At this time only a limited validation of the code has occurred. However, the results are encouraging in that the estimated costs for two production engines were within eight percent of the actual costs. (Author)

A80-19280 # **Installation effects on cycle selection for small turbo-fan engines.** B. F. Kerkam (Boeing Aerospace Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0106.* 10 p. 14 refs.

This paper provides a brief description of inlet and nozzle performance characteristics for small advanced subsonic air vehicles, applies these characteristics to a turbofan engine cycle analysis, and draws conclusions on the manner in which the installation performance affects engine cycle selection. The primary application of these air vehicles is for reconnaissance drone, target vehicle and cruise missile missions. (Author)

A80-19287 # **A computer code to model swept wings in an adaptive wall transonic wind tunnel.** J. E. Mercer, E. W. Geller, M. L. Johnson (Flow Research Co., Kent, Wash.), and A. Jameson (New York University, New York, N.Y.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0156.* 7 p. 6 refs. Contract No. F40600-79-C-001.

A computer program has been developed to calculate inviscid transonic flow over a swept wing in a wind tunnel with specified normal flow at the walls. An approximately orthogonal computational grid which conforms to the wing and the tunnel walls was developed for application of the Jameson-Caughey finite volume algorithm. The code solves the full potential equations in fully conservative form using line relaxation. This program is to be used in place of the wind tunnel for preliminary studies of the adaptive wall concept for three dimensional configurations. It can also be used to assess the magnitude of wall interference in a conventional tunnel. (Author)

A80-19300 * # **Engine component improvement program - Performance improvement.** J. E. McAulay (NASA, Lewis Research Center, Performance Improvement Section, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0223.* 10 p. 7 refs.

The Engine Component Improvement (ECI) Program is NASA sponsored and is specifically directed at reducing the fuel consumption of commercial aircraft in the near-term. As part of the ECI program, a Performance Improvement (PI) effort aimed at developing fuel saving and retention components for new production and retrofit of JT9D, JT8D, and CF6 engines is underway. This paper reviews the manner in which the PI concepts were selected for development and summarizes the current status of each of the 16 NASA selected concepts. (Author)

A80-19301 # **Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines.** P. F. Piscopo, R. T. Lazarick (U.S. Navy, Naval Air Propulsion Test Center, Trenton, N.J.), and J. D. Cyrus (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0224.* 10 p.

The Navy's growing concern for energy efficient propulsion systems has kindled interest in both the recuperative and advanced conventional turboshaft engine cycles as potential candidates for re-engining its long range subsonic patrol aircraft. Studies were conducted to define the specific fuel consumption characteristics of advanced conventional cycle turboshafts over a range of compressor pressure ratios from 10 to 30 and turbine rotor inlet temperatures from 1900 F to 3300 F. Similar studies were conducted to examine the same characteristics of recuperative cycle turboshafts over a range of compressor pressure ratios from 8 to 20 and turbine rotor inlet temperatures from 2200 F to 3400 F. This paper presents the results of these cycle studies and identifies the payoff and critical technology areas for each system. (Author)

A80-19302 # **An experimental model investigation of turbofan engine internal exhaust gas mixer configurations.** P. K. Shumpert (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0228.* 12 p. 6 refs.

The objective of the work described in the present paper was to improve the technology data base for internal exhaust gas mixer systems through an experimental model program. Tests were carried out with models representing a nominal engine airflow bypass ratio of 0.67 to 2.45. Flow parameters were investigated for a range of nozzle pressure ratios from 1.1 to 3.0 and primary exhaust to fan air temperature ratios from 1.0 to 2.7. A mixing effectiveness function is identified in terms of pertinent flow and geometric parameters. Results are given for mixer nozzle pressure losses, mixing effectiveness, thrust gain, primary thrust recovery during simulated reverser fan thrust operation, and ideal and actual turbofan engine performance. An improvement of 1.6 percent in cruise fuel consumption is indicated with a multi-lobe chute mixer nozzle and current-technology bypass ratio 6.0 engine at a flight Mach number of 0.82 and 35,000 feet. V.P.

A80-19303 * # **Large scale model tests of a new technology V/STOL concept.** D. C. Whittley (De Havilland Aircraft Co., Ltd., Downsview, Ontario, Canada) and D. G. Koenig (NASA, Ames Research Center, Large Scale Aerodynamics Branch, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0233.* 9 p.

An ejector design concept for V/STOL aircraft, featuring a double-delta configuration with two large chordwise ejector slots adjacent to the fuselage side and a tailplane or canard for longitudinal control is examined. Large scale model tests of the concept have shown that ejector systems are capable of significant thrust augmentation at realistic supply pressures and temperatures, so that power plant size and weight can be reduced accordingly. A thrust augmentation of at least 1.75 can be achieved for the isolated ejector, not making allowance for duct and nozzle losses. Substantial reductions in velocity, temperature and noise of the lifting jet are assured due to mixing within the ejector - this lessens the severity of ground erosion and the thrust loss associated with reingestion. Consideration is also given to the effect of ground proximity, longitudinal aerodynamic characteristics, transition performance, and lateral stability. V.L.

A80-19307 * # **Hybrid vortex method for lifting surfaces with free-vortex flow.** O. A. Kandil, L.-C. Chu (Old Dominion University, Norfolk, Va.), and E. C. Yates, Jr. (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0070.* 16 p. 52 refs. Grant No. NsG-1560.

A Nonlinear Hybrid Vortex method (NHV-method) has been developed for predicting the aerodynamic characteristics of wings exhibiting leading- and side-edge separations. This method alleviates the drawbacks of the Nonlinear Discrete Vortex method (NDV-method, also known as the multiple line vortex method.) The NHV-method combines continuous-vorticity and vortex-line representations of the wing and its separated free shear layers. Continuous vorticity is used in the near-field calculations, while discrete vortex-lines are used in the far-field calculations. The wing and its free shear layers are divided into quadrilateral vortex panels having second-order vorticity distributions. The aerodynamic boundary conditions and continuity of the vorticity distributions are satisfied at certain nodal points on the vortex panels. An iterative technique is used to satisfy these conditions in order to obtain the vorticity distribution and the wake shape. Distributed and total aerodynamic loads are then calculated. (Author)

A80-19308 * # **Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds.** E. J. Landrum and D. S. Miller (NASA, Langley Research Center, Supersonic Aerodynamics Branch, Hampton, Va.). *American*

Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0071. 8 p. 17 refs.

Trends toward the automation of the design process for airplanes and missiles accentuate the need for analytic techniques for the prediction of aerodynamic characteristics. A number of computer codes have been developed or are under development which show promise of significantly improving the estimation of aerodynamic characteristics for arbitrarily-shaped bodies at supersonic speeds. The programs considered range in complexity from a simple linearized solution employing slender body theory to an exact finite difference solution of the Euler equations. The results from five computer codes are compared with experimental data to determine the accuracy, range of applicability, ease of use, and computer time and cost of the programs. The results provide a useful guide for selecting the appropriate method for treating bodies at the various levels of an automated design process. (Author)

A80-19311 # **Mach 3 hydrogen external/base burning.** D. H. Neale, Sr., J. E. Hubbartt, and W. C. Strahle (Georgia Institute of Technology, Atlanta, Ga.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0280.* 9 p.

Experimental studies of base pressure manipulation for an axisymmetric model at Mach 3 with simulated and actual external/base burning are described. Early work using contoured test section walls and cold gas base region injection is reviewed to demonstrate wake detail and length scale changes under the influence of simulated external/base burning. Tests with actual combustion of radially and axially injected hydrogen are then reported. Outstanding performance values with significant base drag reduction is shown for injection and burning directly in the near-wake (base burning). Current attempts at radial injection and burning in the free stream (external burning) have not yet succeeded. These tests, however, have defined an envelope within which external burning, if feasible, will presently be achieved. (Author)

A80-19316 # **Optimization of turbine nozzle cooling by combining impingement and film injection.** M. R. Ayache (SNECMA, Moissy-Cramayel, Seine-et-Marne, France), W. Tabakoff, and A. Hamed (Cincinnati, University, Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0299.* 12 p. 15 refs.

An analytical approach of endwall cooling optimization is presented. The study is based on the use of existing computation programs, describing a step-by-step procedure for solving the combined impingement and film injection cooling optimization. Several configurations are considered and their results compared to determine the optimal one, corresponding to the maximum global thermal endwall cooling effectiveness. (Author)

A80-19374 # **Aircraft aerodynamics - Dynamics of longitudinal and lateral motion (Aerodinamika samoleta - Dinamika prodol'nogo i bokovogo dvizheniia).** G. S. Giushgens and R. V. Studnev. Moscow, Izdatel'stvo Mashinostroenie, 1979. 352 p. 107 refs.

The book deals with some aspects of the lateral-directional handling qualities of modern aircraft. A mathematical description of the piloting process and of pilot actions in performing single-channel stabilization tasks is given. The dynamics of directional motion, the equations of directional motion, and the stability and controllability at a constant flight velocity are studied, along with the lateral characteristics in perturbed and unperturbed motion. The influence of aircraft lateral motion parameters on the piloting characteristics is discussed. V.P.

A80-19412 # **Thermal state of structural members of aircraft engines (Teplovoe sostaianie elementov konstruktsii aviatsionnykh dvigatelei).** S. Z. Kopelev and S. V. Gurov. Moscow, Izdatel'stvo Mashinostroenie, 1978. 208 p. 74 refs. In Russian.

The book deals primarily with the cooling systems developed for heavy-duty elements of aircraft gas-turbine engines and with methods of calculating their thermal state. Theoretical and experimental methods of determining the value of fuel preheating in fuel supply lines are described and illustrated by examples. Some mechanical and aerodynamic aspects of turbine blade cooling are examined. V.P.

A80-19413 # **The Omega radio navigation system (Radionavigatsionnaia sistema 'Omega').** V. I. Bykov. Moscow, Izdatel'stvo Transport, 1978. 88 p. 9 refs. In Russian.

The principles of operation of a differential Omega system are outlined, and the influence of phase variations in around-the-world propagation of radio waves on the accuracy of the system is examined. The optimum implementation of the Omega system in marine navigation is discussed, along with the influence of the ionosphere on position finding. Attention is given to the calculation of corrections for compensating for the diurnal phase difference of signals and corrections in the region of surface-wave propagation. V.P.

A80-19414 # **Designing light airplanes (Proektirovanie legkikh samoletov).** A. A. Badiagin and F. A. Mukhamedov. Moscow, Izdatel'stvo Mashinostroenie, 1978. 208 p. 40 refs. In Russian.

The book deals with such aspects of light-airplane design as the development of light-weight, reliable and economical engines (including piston engines, and turboprop and turbofan engines); optimization of design solutions for greater efficiency and reliability; development of new wing profiles for high lift plus high L/D; decreasing fuselage drag; application of composites and plastics; and development of compact radio equipment and internal and external noise abatement systems. The principal design concepts are examined, and methods of calculating airplane mass and the aerodynamic and flight characteristics in the preliminary design stage are outlined. V.P.

A80-19579 **AEROPP - Message and data switching systems for aeronautical operations.** *The Controller,* vol. 18, Dec. 1979, p. 29-31.

AEROPP I and AEROPP II, the two categories of integrated hardware/software message and data switching systems by Philips, employ the latest of the DS-714 switching installation. A typical DS-714 installation for an AEROPP system comprises two control sections, generally referred to as processors X and Y, and an array of input/output equipment available for use by either processor. One of the two processors is normally handling traffic, while the other is in hot standby. The AEROPP system structure permits upgrading from the basic building block handling only the Aeronautical Fixed Telecommunications Network (AFTN) traffic to a multiuser center providing a full range of aeronautical communications services, e.g., operational METEO (OPMET), automatic air/ground interchange, Common ICAO Data Interchange Network (CIDIN), and automatic telex interface. A flexible range of communications multiplexers is available to provide interface and control facilities for changing combinations of line types, transmission speeds, and operating procedures as the center and the network evolve. V.L.

A80-19764 **Code optimization for solving large 3D EMP problems.** R. Holland, L. Simpson, and R. H. Saint John (Mission Research Corp., Albuquerque, N. Mex.). *(IEEE, U.S. Defense Nuclear Agency, and Jet Propulsion Laboratory, Annual Conference*

on Nuclear and Space Radiation Effects, 16th, Santa Cruz, Calif., July 17-20, 1979.) IEEE Transactions on Nuclear Science, vol. NS-26, Dec. 1979, p. 4964-4969. 5 refs. Contract No. DNA001-78-C-0345.

This paper describes techniques for implementing and optimizing large (50x50x50) three-dimensional finite-difference EMP codes. A number of procedures for speeding execution and minimizing memory requirements are presented and evaluated. As an example, we illustrate numerical results obtained when a B52 is modeled within a 50x43x59 mesh and illuminated by a nominal EMP simulation. (Author)

A80-19868 # **Damping capacity of plastic compressor blades (Dempfiruiushchaia sposobnost' lopatok kompressorov iz kompozitsionnykh materialov).** N. D. Stepanenko (Kiubyshevskii Aviatsionnyi Institut, Kuibyshev, USSR). *Problemy Prochnosti,* Nov. 1979, p. 109-114. 11 refs. In Russian.

A resonance test stand was used to study the damping behavior of unidirectionally strengthened plastic blades and their dovetail roots at various normal modes. Particular attention was given to the energy dissipation in the blades. The energy dissipation coefficient is plotted for several types of excitation. The logarithmic decrement is studied as a function of the strain level for plane, flexural, and torsional mode shapes of vibration. V.P.

A80-19990 # **Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles (Recherches de configuration optimale d'oscillateurs a quartz de haute stabilité pour avions et missiles).** J. Beaussier (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* Nov.-Dec. 1979, p. 375-386. 12 refs. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

Work done by ONERA on the optimal configuration of compact and easily startable quartz oscillators of stability close to that of atomic clocks for use in the time-frequency systems of aircraft and missiles is summarized. The stability requirements of a time-frequency standard are examined and the operating parameters of quartz oscillators and atomic clocks are compared. The configurations of oscillators developed are then discussed, taking into consideration problems encountered with the resonator and the electronic circuits associated with it and the specifications, operation, design and significance of the dual thermostats within the oscillators. The four 5-MHz and two 100-MHz oscillators realized are described, and results of test of long-, medium- and short-term frequency stability in nonperturbed environments and of acceleration and temperature sensitivity in simulated aircraft and missile environments are reported. It is found that the 5-MHz oscillators exhibit greater stability while the 100-MHz oscillators are smaller, and quartz oscillator stabilities surpassing those of rubidium standards are reported. A.L.W.

A80-20064 # **A method of evaluation of gas turbine engines (Ob odnom metode otsenki sostoianiia gazoturbinnogo dvigatelia).** G. N. Mendrul. *Problemy Tekhnicheskoi Elektrodinamiki,* no. 69, 1979, p. 99-102. In Russian.

The paper presents a classification method described by multiplicity of n-dimensional vectors in a definite type of condition - the test theory method. Engineering methodology of determining an object classification as an exact or inexact state is developed using a learning theory. A.T.

A80-20076 # **Technologies conceived for the utilization of ceramics in turboengines (Technologies conçues pour l'utilisation des céramiques dans les turboréacteurs).** S. Boudigues (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and G. Fratacci (Direction des Recherches, Etudes et Techniques, Paris, France). *(NATO, AGARD, Meeting on Ceramics for Turbine Engine Applications, Cologne, West Germany, Oct. 8-10, 1979.) ONERA, TP* no. 1979-132, 1979. 14 p. In French.

As compared to refractory alloys, ceramics used as heavy-duty elements in a turboengine provide higher operational temperatures at much lower densities. They also are characterized by higher strength in compression than in tension. In the present paper two approaches to the problem of incorporating ceramic elements in turboengines are examined. One approach is based on adaptation of technologies developed for refractory alloys, the other on aerodynamics and turbine-technology concepts adapted to ceramics. Several concepts of integrating a turbine into a complete engine are proposed, and the aerodynamic loads, temperatures, stresses, as well as production techniques and root designs, are determined for the blades. V.P.

A80-20083 # **Separation due to shock wave-turbulent boundary layer interaction (Décollement résultant d'une interaction onde de choc-couche limite turbulente).** J. Délery and P. Le Diuzet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 16th, Lille, France, Nov. 13-15, 1979.) ONERA, TP* no. 1979-146, 1979. 28 p. 25 refs. In French. Research supported by the Direction des Recherches, Etudes et Techniques.

Holographic interferometry and laser velocimetry have been jointly used for analyzing the flow resulting from the interaction between a shock wave and a turbulent boundary layer occurring in a two-dimensional transonic channel. The Mach number at the start of interaction is 1.37, and the local Reynolds number, calculated with the initial boundary layer thickness, is 85,000. The external flow has first been carefully explored in order to trace a precise chart of the nondissipative flow field. Laser velocimetry made it possible to characterize the organization of the dissipative layer, which includes a large separated zone. The following quantities have been measured: longitudinal and vertical components of the mean motion, the corresponding turbulence intensities and Reynolds stress. (Author)

A80-20086 # **A phenomenological model of the dynamic stall of a helicopter blade profile (Modèle phénoménologique de décrochage dynamique sur profil de pale d'hélicoptère).** R. Dat, C. T. Tran, and D. Petot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 16th, Lille, France, Nov. 13-15, 1979.) ONERA, TP* no. 1979-149, 1979. 43 p. 7 refs. In French.

A phenomenological model developed for the prediction of helicopter blade stall is presented. The model uses a system of differential equations to relate the aerodynamic forces and the variables determining the velocity of the blade profile in order to simulate the effects of flow history. Wind tunnel measurements of the profile in a stationary regime and oscillating at a small amplitude are required for model identification, and the model is validated by lift and moment measurements on a helicopter blade profile at high incidence. Preliminary results of the application of the model have been found to be encouraging. A.L.W.

A80-20088 # **Experimental study of confluence with separation on an afterbody of revolution (Etude expérimentale de la confluence avec décollement sur un arrière-corps de révolution).** J. L. Solignac. *(Canadian Congress of Applied Mechanics, 7th, May 27-June 1, 1979, Sherbrooke, Quebec, Canada.) ONERA, TP* no. 1979-151, 1979. 21 p. 8 refs. In French.

The confluence of internal and external flows at a trailing edge downstream of a separation region is investigated for an afterbody of revolution with a central jet. Aerodynamic data was obtained by means of pressure probes, hot-wire probes and laser velocimetry, as well as flow visualization at flow Reynolds numbers high enough to assure a turbulent boundary layer directly upstream of the separation points. The mean flow is found to include a separated flow region defined by a streamline extending from the separation point to the trailing edge, while turbulence is observed to be strongest in the vicinity of the separation point and in the extreme downstream portions of the separation zone in the internal and external flow mixing regions. The internal mixing layer also appears to be the source of strong quasi-sinusoidal low frequency fluctuations which are detectable in the potential regions of the central jet. A.L.W.

A80-20112 # **Integrated circuit characteristics at 260 C for aircraft engine-control applications.** L. J. Palkuti (ARACOR, Sunnyvale, Calif.), J. L. Prince (Clemson University, Clemson, S.C.), and A. S. Glista, Jr. (U.S. Navy, Naval Air Systems Command, Washington, D.C.). *(Institute of Electrical and Electronics Engineers, Electrical Components Conference, 29th, Cherry Hill, N.J., May 14-16, 1979.) IEEE Transactions on Components, Hybrids, and Manufacturing Technology,* vol. CHMT-2, Dec. 1979, p. 405-412. 8 refs. Research supported by the U.S. Navy and U.S. Department of Energy.

Bipolar circuits with junction or dielectric isolation, other discrete devices, and integrated circuits (ICs) were examined from room temperature to 250 and 300 C as part of a Navy program for the design of uncooled solid-state electronics for aircraft engine control applications. Discrete silicon semiconductor devices of essentially all generic types functioned with modified but usable characteristics at junction temperatures up to at least 300 C, but first-order device parameter changes resulted from increased leakage, reduced mobility, and changes in the Fermi level in the bulk and at the surface. Both analog and digital ICs exhibited dc as well as useful dynamic characteristics up to near 250 C. For a variety of CMOS devices tested, a pnpn latchup mechanism between the p-channel transistor and the input protection network limited useful device operation to 260 C, while no fundamental barrier to 300 C functionality of ICs designed specifically for high-temperature application was found. J.P.B.

A80-20151 **Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition.** N. A. Cumpsty (Cambridge University, Cambridge, England). *Journal of Sound and Vibration,* vol. 66, Oct. 22, 1979, p. 527-544. 10 refs.

By idealizing combustion or heat addition processes to occur over a short distance in the flow direction it is possible to calculate the amplitude and phase of the disturbances corresponding to small amplitude fluctuations in the heat addition. The fluctuating heat input is assumed to vary sinusoidally with time and with distance along the direction normal to the flow. Pressure waves propagate away from the heat input region upstream and downstream, whilst on the downstream side waves of vorticity and entropy are convected away. Strong resonant peaks in the pressure and vorticity waves are present close to the cut-off condition of the pressure waves in two dimensions. Generally the wave amplitudes tend to be higher when the mean flow velocity into the region is close to sonic and to become smaller as the steady heat input is increased. For a simplified calculation in which the combustion chamber discharges directly into a multi-stage turbine the down-stream noise was predominantly due to the interaction of the entropy with the turbine (i.e., 'indirect' rather than 'direct' combustion noise). (Author)

A80-20153 **Sound generation in a flow near a compliant wall.** W. Möhring and S. Rahman (Max-Planck-Institut für Strömungsforschung, Göttingen, West Germany). *Journal of Sound and Vibration,* vol. 66, Oct. 22, 1979, p. 557-564. 11 refs. Research supported by the Deutsche Forschungsgemeinschaft.

The generation of sound near an infinite compliant wall is studied, with account taken of a uniform mean flow. Stable and unstable configurations are looked at. It is shown that a possible influence of the wall on the sound generation occurs only via a modification of the turbulence if hydrodynamic non-linearities are responsible for the levelling-off of the instabilities. Then no fundamentally more efficient sound sources are found. An increase of the radiated sound may be possible because of the mirror sources and because of their possibly reduced compactness. (Author)

A80-20192 * **Atmospheric effects on Martian ejecta emplacement.** P. H. Schultz (Lunar and Planetary Institute, Houston, Tex.) and D. E. Gault (Murphys Center for Planetology, Murphys, Calif.). *Journal of Geophysical Research,* vol. 84, Dec. 10, 1979, p. 7669-7687. 53 refs. Contract No. NSR-09-051-001.

The paper presents analytical descriptions of crater growth and numerical calculations of aerodynamic drag to evaluate the possible effects of drag on impact crater ejecta emplacement on Mars. The critical particle size below which ejecta deposition is restricted in range increases with crater size; models of ejecta trajectories in the current Martian atmosphere under hydrostatic equilibrium reveal critical particle diameters ranging from 0.4 to 20 cm, noting that ejecta approaching the critical particle size may impact with crater radius of the excavation crater rim. Ejecta larger than the critical particle size are undecelerated and form secondary impact craters modified by the later arriving decelerated ejecta cloud; thus, ejecta emplacement will be multiphased, but the process depends on the ejecta size distribution. A.T.

A80-20214 **The next supersonic transport.** B. Sweetman. *Flight International,* vol. 116, Nov. 24, 1979, p. 1772-1774, 1779.

The article investigates future concepts for supersonic transports, noting that the concept is still viable because the efficiency of air travel is related to speed. In theory, the less time an aircraft has to be airborne, the less energy it will use, so faster aircraft should be more efficient. Discussion covers such areas as compromises in wing construction for take off and landing and supersonic cruise, and comparisons between delta and arrow wings. Similar problems in engine design are also considered such as the conflict between noise and supersonic performance. Weight factors are also investigated as regards the use of composites, as well as the use of hydrogen as a fuel. Finally, it is noted that the general consensus is that a future SST should be substantially larger than the Concorde (about 230 passengers) and have a non-stop Pacific range. M.E.P.

A80-20251 **A light aircraft camera Pod - The Enviro-Pod.** G. E. Howard, Jr. (U.S. Environmental Protection Agency, Environmental Photographic Interpretation Center, Warrenton, Va.). In: American Society of Photogrammetry, Fall Technical Meeting,

Albuquerque, N. Mex., October 15-20, 1978, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1978, p. 283-295.

The paper deals with an airborne self-contained low-cost remote sensing system, called the Enviro-Pod (Pod), developed for monitoring the environment of the United-States territory to ensure the validity of environmental standards and assure legal compliance. The results of feasibility tests and demonstrations indicate that the camera-configured Pod will acquire cost effectively high-quality high-resolution imagery in routine monitoring of point targets, stream segments, and small areas of generally less than 25 square miles. In its current configuration, the Pod provides high-resolution panoramic imagery in both the oblique and vertical camera positions. At a typical flight altitude of 3000 ft. the resolution of panchromatic film at nadir is 18 cm. V.P.

A80-20626 Application of RCS guidelines to weight effective aircraft design. L. A. Irish and M. C. Vincent (Boeing Co., Seattle, Wash.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1270.* 9 p. Contract No. F33615-78-C-3422.

The need for an organized, proven body of trade data and guidelines on the relationship of radar cross section to the familiar aircraft design parameters is emphasized. The approach to developing information consisting of many different activities is examined and some key activities including data base development, parametric study and guideline development are presented. Attention is given to explanations of the relationship between parameters of wing size, sweep, engine inlet and tailsize and radar cross section. C.F.W.

A80-20627 Application of finite element analysis to derivation of structural weight. J. G. Hutton and L. D. Richmond (Boeing Aerospace Co., Seattle, Wash.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1271.* 29 p. 7 refs.

The paper presents application of finite element analysis to derive methodology for estimation of structural system weight. The study developed factoring logic and its testing, and the documentation of interdisciplinary interaction for model development. The numerical factors were composed of subfactors that accounted for modeling technique, construction method, material, and installation details. The F-15A was used as the known structural system for testing of the weight factor logic; a finite element model was developed for the wing box, and a simplified beam body and horizontal tail were included for simulation of the wing support and to provide balanced aircraft loads. The correlation of the factored finite element and as-built weights was good for the cover panels; the total cover weight compared within 3% with a plus or minus 10% spread among the individual panels. A.T.

A80-20628 Tilt rotor - An effective V/STOL concept. J. DeTore (Bell Helicopter Textron, Fort Worth, Tex.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1273.* 22 p. 6 refs.

The paper investigates how the tilt rotor V/STOL concept can be turned into an effective operational system and what such a mission-oriented tilt rotor aircraft is like. Attention is given to the variation of hover efficiency, speed capability, and previously determined weight empty ratios for various V/STOL concepts, such as the helicopter in comparison with the tilt rotor. A tilt rotor design aimed at satisfying Navy/Marine subsonic V/STOL needs is described. Results are presented which relate estimated performance capabilities during various modes of flight with useful mission elements. In conclusion, it is recommended that design investigations of operational tilt rotor V/STOL continue and that technology tasks involving experimental investigations with the XV-15 tilt-rotor research vehicle, laboratory test rigs, and models be undertaken. M.E.P.

A80-20630 A method of simplifying weight and balance for small aircraft. E. I. Miller (Boeing Co., Seattle, Wash.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1278.* 27 p. 5 refs.

This paper presents a nomographic method of figuring weight and balance (an alignment chart), similar to one used by many large aircraft operations because of its speed, simplicity and accuracy. Using a Basic Empty Weight Index, a simplified weight record (manifest), Loadlines and a C. G. Grid it can be easily adapted for use by light aircraft with a minimum of effort, no change in present methods, manual of F.A.A. Regulations, and does not require any special equipment. (Author)

A80-20631 Analog aircraft weight and balance computer. T. D. Boldt (Quik Trim, Egg Harbor City, N.J.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1283.* 20 p.

An analog weight and balance computer was developed for single-engine aircraft in response to a need by general aviation pilots for this type of aid. A detailed background is given for the reasons for the author to develop the computer. The relative merits of the analog vs. the digital computer are explained and the reasons given for the use of the analog techniques. In this respect, the use by the pilot and his understanding of aircraft weight and balance and the factors affecting aircraft balance are considered. The construction and layout of the computer are explained and the influence of pilot feedback on the design are discussed. The extension of the computer for use in general aviation twins, cargo operations and heavy aircraft are discussed. The accuracy of weight and balance computations is analysed to determine the accuracy necessary in the subject computer. Appropriate examples are given for various aircraft categories. (Author)

A80-20632 Advanced materials and the Canadair Challenger. D. R. Turner (Canadair, Ltd., St. Laurent, Quebec, Canada). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1284.* 9 p.

The Canadair Challenger is a business jet with take-off weight of 34,500 lb, 7500 lb thrust and space of at least 100 cu ft per person. In order to avoid the inherent weight penalties in the wide-body aircraft, composite materials with high specific strength and good fracture toughness were used. The airframe primary structure is made of advanced aluminum alloys and the secondary structural components are made of two epoxy resin based systems, the first being reinforced with Kevlar aramid fibers and the second being based on the higher strength and modulus graphite fibers. For further reduction of both weight and manufacturing costs (36% and 82% respectively) the application of graphite and Kevlar/epoxy composites in the primary structural areas is considered. L.M.

A80-20636 The modular life cycle cost model - An overview. B. I. Rachowitz (Grumman Aerospace Corp., Bethpage, N.Y.) and N. Sternberger (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1290.* 15 p.

An overview of the first subsystem level Life Cycle Cost Model (LCCM) for advanced aircraft is presented. The cost estimating relationships are based on design parameters which are available during conceptual and preliminary design phases of an advanced technology aircraft program. The modular LCCM was developed to provide design engineers with a tool and the capability to effectively conduct design/cost/performance trade studies of advanced fighter/attack and cargo/transport aircraft, in determining the cost impact of design decision on life cycle cost at the major subsystem level. C.F.W.

A80-20637 * Application of parametric weight and cost estimating relationships to future transport aircraft. M. N. Beltramo, M. A. Morris (Science Applications, Inc., Los Angeles, Calif.), and J. L. Anderson (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1292.* 23 p.

A model comprised of system level weight and cost estimating relationships for transport aircraft is presented. In order to determine the production cost of future aircraft its weight is first estimated based on performance parameters, and then the cost is estimated as a function of weight. For initial evaluation CERs were applied to actual system weights of six aircraft (3 military and 3 commercial) with mean empty weights ranging from 30,000 to 300,000 lb. The resulting cost estimates were compared with actual costs. The average absolute error was only 4.3%. Then the model was applied to five aircraft still in the design phase (Boeing 757, 767 and 777, and BAC HS146-100 and HS146-200). While the estimates for the 757 and 767 are within 2 to 3 percent of their assumed break-even costs, it is recognized that these are very sensitive to the validity of the estimated weights, inflation factor, the amount assumed for non-recurring costs, etc., and it is suggested that the model may be used in conjunction with other information such as RDT&E cost estimates and market forecasts. The model will help NASA evaluate new technologies and production costs of future aircraft. L.M.

A80-20638 Designing to life cycle cost in the Hornet program. R. D. Dighton (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1293.* 24 p.

A primary requirement in the Hornet program is significant reduction in life cycle cost from current Navy systems. In the present paper, the design and management techniques used to develop a new fighter/attack system at an affordable life cycle cost are described. V.P.

A80-20639 Small ship-based VTOL aircraft - A design exercise. J. W. Flaig (U.S. Naval Air Systems Command, Washington, D.C.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1296.* 23 p.

Proposals for moderate performance VTOL aircraft, other than the AV-8, which could be based aboard small ships in the mid-to-late 1980's are examined. The vehicles were to have a takeoff gross weight of about 20,000 lb with minimal external stores, and to perform only vertical take-off and landings. Current high-bypass-ratio engines are studied as possible effective power plants. It is found that uprated versions of the Rolls Royce Pegasus-11 engine give the most reasonable solutions. Attention is also given to hauldown and securing problems inherent in basing aircraft aboard small ships. It is concluded that a lightly armed reconnaisance vehicle having a radius of approximately 300 nmi appears feasible, provided that the mission requirements remain simple. M.E.P.

A80-20640 Advanced technology effects on V/STOL propulsive system weight. R. S. Saint John (Vought Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1300.* 23 p.

The paper identifies the distribution of the propulsive system weight for a typical V/STOL concept and illustrates how advanced technology will affect the weight of the various propulsive system components. Individual technology assessments are given for the following propulsive system components: (1) core engine compressor section, (2) core engine high pressure turbine section, (3) core engine low pressure turbine section, (4) core engine combustor section, controls and accessories, (5) lift cruise fan weight, (6) transmission system, (7) exhaust system, and (8) engine section and nacelle. It is concluded that the propulsive system weight decrease due to technology is almost equally distributed between the core engines, fans and nacelles. M.E.P.

A80-20645 Preliminary weight estimation of engine section structure. A. H. Schmidt (Boeing Co., Seattle, Wash.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1311.* 5 p.

The weight of the engine section is a part of the aircraft structural weight which has not been given much attention by weight methodology. This paper discusses a method of estimating the weight of the following engine section components-engine mounts, nacelles or cowlings, firewalls, and pylon support struts such as used on jet driven aircraft. Air intakes are not included. Parameters usually available from preliminary design three-view drawings and group weight statements are used. Factors for estimating the weight effects of propeller or jet drive are included along with factors for allowing for special features such as work platforms. A plot of calculated versus actual weight is included to show the accuracy of the method for a broad range of aircraft. (Author)

A80-20646 Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design. A. Gersch (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1312.* 36 p.

Two computerized preliminary design synthetic programs, WISE-One and WISE-Two (Weight Integrated Sizing Evaluation), have been developed to facilitate the initial phases of preliminary design. WISE-One is intended to calculate the TOGW of a design concept in the very early stages of preliminary design; layouts, based on its output, are produced from a computer based design/drafting system. WISE-Two is used to optimize weight/cost of a preliminary design based on an existing layout to aid in producing a final three-view drawing. WISE-One uses empirical methods, while WISE-Two used analytical tools (structural/weight multistation analysis). Both programs operate with minimum input and maximum output and are characterized by a dynamic methodology base and multi-discipline interfaces. V.L.

A80-20647 A simple design synthesis method used to estimate aircraft gross weight. K. W. Higham (Vought Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1313.* 17 p.

The paper presents a preliminary weight methodology specifically developed to augment synthesis techniques such as ASAP. Attention is given to two sample calculations, the first of which demonstrates a short method recommended only for aircraft with payloads in excess of twenty-five percent of the take-off weight. A sub-sonic transport is used in this example. The second sample calculation demonstrates an expanded method which provides greater accuracy and can result in a complete group weight summary

for balance calculations and improved cost analysis. An advanced jet trainer is used in this example and it is noted that the second method is best used when the payload is expected to be less than twenty-five percent of the take-off weight and is recommended for applications where time allows. M.E.P.

A80-20648 Problems associated with cargo airplanes having aft mounted engines. R. E. Stephens (Lockheed-Georgia Co., Marietta, Ga.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1314.* 36 p.

The effects of engine location are examined by means of comparing a baseline configuration with four wing mounted engines with several arrangements. Initially the analysis makes some simplifying assumptions which allow the establishment of some trends. Three aircraft with engines mounted on the aft fuselage are examined, each with a different approach to the solution to the balance problems. Two of the configurations are analyzed further and a third configuration, with two wing mounted engines and one tail mounted engine is added for comparison purposes. It is concluded that the results indicate that if an aircraft is designed for use as a cargo aircraft, it should have wing mounted engines. M.E.P.

A80-20655 Navy V/STOL - A continuing initiative. R. G. Perkins, Jr. (U.S. Naval Air Systems Command, Washington, D.C.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1325.* 26 p.

The progress of the project to develop a new subsonic multimission V/STOL aircraft initiated by the Navy in 1976 has been hampered by such problems as affordability, design complexity, and justification of the V/STOL concept. A decision as to the usefulness of the program will be based on the results of the Sea Based Air Master Study (SBAMS) which will provide a comparative analysis of sea based aircraft alternatives. If the SBAMS supports the project, the design definition phase will be founded on the outputs of SBAMS, initial industry studies and technology advancement efforts. A major aircraft development decision is not anticipated before 1982. V.L.

A80-20656 Weight impact of VTOL. S. Kalemaris and P. York (Grumman Aerospace Corp., Bethpage, N.Y.). *Society of Allied Weight Engineers, Annual Conference, 38th, New York, N.Y., May 7-9, 1979, Paper 1326.* 17 p.

This paper studies the weight increments associated with vertical takeoff and landing capability as compared to conventional (horizontal) takeoff and landing (CTOL). Weight increments for various physical and ground rule requirements that transform a CTOL aircraft into a VTOL aircraft are evaluated. In order to fully understand the weight increments, preliminary designs of comparable CTOL aircraft are examined, along with Grumman's VTOL designs. The 'VTOL weight penalty' for shipboard operation is further defined by a study of the weight penalty for carrier basing a CTOL aircraft. The total effect of VTOL on subsonic aircraft, with low thrust required for CTOL, is presumably different from the effect on high performance supersonic aircraft with mission demands close to the VTOL requirement, and this difference is addressed. Finally, consideration is given to possible additional mission requirements for CTOL aircraft that stem from the difference in operational capability. (Author)

A80-20690 # Unification of oils for aircraft gas-turbine engines (Unifikatsiia masel dlia aviatsionnykh gazoturbinnykh dvigatelei). G. T. Novosartov, V. A. Smeianov, A. V. Vilenkin, and A. I. Echin. *Khimiia i Tekhnologiia Topliv i Masel,* no. 11, 1979, p. 11-13. In Russian.

The reasons for the continuous increase in brands of oil for aircraft gas-turbine engines are examined, and methods of unifying them are suggested. Some brands of oil are recommended for gas-turbine engines, depending on the temperature at which they operate. V.P.

A80-20866 Computer simulation of an air cargo small package sorting system. A. Hargrove (Hampton Institute, Hampton, Va.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 333-340.

An automated baggage sorting system designed for use at the new Atlanta Midfield Airport is reviewed. Adaptation of the system to small air cargo packages is proposed. Computer simulation is used to analyze the system after reviewing results of manual simulation. This paper describes the simulation model, the parameters analyzed, the sensitivity of those parameters and a possible solution. (Author)

A80-20867 A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems. A. Farina and S. Pardini (Selenia S.p.A., Rome, Italy). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 341-351. 23 refs.

The application of stochastic filtering techniques for air-traffic control and surveillance systems is examined. The structure of these systems, their operational requirements and the environment in which they work is studied. A review of various stochastic filters such as adaptive and nonlinear filters are reviewed with respect to their different environments. Attention is given to the typical structure of radar data processing and to the adaptivity of filtering algorithms to target maneuver. C.F.W.

A80-20868 Shipping by air - Is the value of your time worth it. A. H. Hagedoorn (Florida Technological University, Orlando, Fla.) and J. B. Crittenden (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 391-396.

A cost comparison of cargo shipments by air, rail, and truck transportation is outlined. The economic model comparisons indicate which mode of transportation should be used under various circumstances. Nonconventional characteristics of the system models include a nonlinear cargo density function and a method for the calculation of the value of time. (Author)

A80-20869 Models for freight access to air terminals. W. A. Rabiega (Portland State University, Portland, Ore.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 397-401. 16 refs.

Demand and traffic volume prediction are necessary to the modeling of freight access to air terminals. The 'abstract modes' approach may be an appropriate demand submodel. Sequential queue models can be used for the traffic submodel, but require modification to the technologies, terminal configurations, and operations of air freight. (Author)

A80-20870 Air cargo container utilization optimization through modeling. R. M. Eastman (Missouri-Columbia, University, Columbia, Mo.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 403-406. 5 refs. Army-supported research.

A dynamic programming model is used to solve the problem of optimal air cargo container utilization; other methods are examined but were found to be infeasible, too costly, or incapable of reaching an optimal solution. Practical obstacles to widespread application of the model are discussed and alternatives mentioned. Attention is given to the dynamic programming model which is used to optimize the problem using various constraints and it is determined that the model can be used to solve the problem of optimum air cargo container utilization. C.F.W.

A80-20879 A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design. J. R. Broussard and S. W. Gully (Analytic Sciences Corp., Reading, Mass.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 2. Pittsburgh, Pa., Instrument Society of America, 1979, p. 599-609. 6 refs. Army-sponsored research.

A80-20900 Infrared sensor system performance simulations. F. T. Wu (U.S. Naval Weapons Center, China Lake, Calif.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 5. Pittsburgh, Pa., Instrument Society of America, 1979, p. 1755-1763.

This paper reports on a simulation technique used for surface target search and detection by airborne infrared sensor systems. The simulation provides a description of detection capability while the sensor is in high speed motion (relative to the target) towards the target area. The simulation also permits the scanning pattern and scanning rate to be input to the simulation, thus allowing different types of scans for different inputs. Hence an optimal scanning pattern and rate can be determined for different sensor altitudes and speeds. The simulation is designed for both automatic and manual search and detection. However, the current version of the simulation is used for the automatic mode only since the manual search algorithm is limited in its use to qualitative comparison of search patterns. In this paper, the results of runs for several scanning patterns are presented. For each scanning pattern, the scanning rate and fields-of-view have been varied. Some comparison of results is presented. (Author)

A80-20901 Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation. W. V. Albanes, J. T. Bosley (Computer Sciences Corp., Defense Systems Div., Huntsville, Ala.), and J. B. Meadows (U.S. Army, Technology Laboratory, Redstone Arsenal, Ala.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 5.
Pittsburgh, Pa., Instrument Society of America, 1979, p. 1815-1820. 8 refs.

Simulation permits the early detection of possible (and costly) errors in missile subsystem development. However, digital autopilot performance is difficult and expensive to verify in a six-degree-of-freedom digital simulation due to the small time steps required to simulate the digital effects of the microcomputer. To solve this problem, a microprocessor-based digital autopilot (DAP) is used as the hardware in the loop in a hybrid computer facility to simulate real-time trajectories. In this way, both the real flight microprocessor hardware and software will be verified. This paper presents such a hardware-in-the-loop analysis for two DAPs designed for a tactical six-inch test missile fitted with a semiactive laser seeker guidance head, and compares their performance. (Author)

A80-20904 Navigation error using rate of change of signal time of arrival from space vehicles. D. Terris (Rockwell International Corp., Satellite Systems Div., Downey, Calif.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 5.
Pittsburgh, Pa., Instrument Society of America, 1979, p. 1847-1852.

An error analysis model derived for a navigation concept using the measurement of rate of change of signal time of arrival (TOA dot) in addition to TOA is analyzed. An error equation for measurement of range in terms of TOA, error using TOA and TOA dot, and covariance error for TOA measurements only are discussed along with covariance error for TOA dot measurements and for both TOA and TOA dot measurements. Consideration is given to computer simulation. V.T.

A80-20907 Recent developments in flight simulation techniques. D. Raptis and M. McKinnon (CAE Electronics, Ltd., Saint Laurent, Montreal, Canada). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 5.
Pittsburgh, Pa., Instrument Society of America, 1979, p. 1901-1906. 5 refs.

This paper presents the main concepts in the control of the motion of the cabin of an aircraft simulator, by using a six degree of freedom electrohydraulic motion system controlled by a digital computer. The versatility and effectiveness of the cost function approach for solving this constrained problem are demonstrated. The main areas of active research as well as future trends are discussed. (Author)

A80-20915 Covariance simulation of BCAS - An aircraft collision avoidance system. H. J. Rome and G. Andriotakis (Lowell, University, Lowell, Mass.). In: Modeling and simulation. Volume 10 - Proceedings of the Tenth Annual Pittsburgh Conference, Pittsburgh, Pa., April 25-27, 1979. Part 5. Pittsburgh, Pa., Instrument Society of America, 1979, p. 2049-2060. U.S. Department of Transportation Contract No. TS-14698.

This paper presents algorithms developed and results obtained for a covariance simulation of BCAS-an aircraft collision avoidance system. The simulation models the stochastic environment, aircraft state uncertainties, and the various types of measurements available. The basic algorithms for optimal covariance analysis and specialized techniques utilized to obtain parameters germane to collision avoidance are presented. Simulation results which demonstrate the effectiveness of the system and compare it to other collision avoidance systems are presented. (Author)

A80-20952 * # Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics. U. von Glahn and D. Groesbeck (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 98th, Salt Lake City, Utah, Nov. 26-30, 1979, Paper.* 25 p. 5 refs.

On the basis of static zero/acoustic data obtained at model scale, the effect of exhaust nozzle size on flyover noise is evaluated at full scale for different STOL-OTW nozzle configurations. Three types of nozzles are evaluated: a circular/deflector nozzle mounted above the wing, a slot/deflector nozzle mounted on the wing, and a slot nozzle mounted on the wing. The nozzle exhaust plane location, measured from the wing leading edge was varied from 10 to 46 percent of the wing chord (flaps retracted). Flap angles of 20 deg (takeoff) and 60 deg (approach) are included in the study. Initially, perceived noise levels (PNL) are calculated as a function of flyover distance at 152 m altitude. From these plots static EPNL values, defined as flyover relative noise levels, then are obtained as functions of nozzle size for equal aerodynamic performance (lift and thrust). On the basis of these calculations, the acoustic benefits attributable to nozzle size relative to a given wing chord size are assessed. (Author)

A80-20953 * # **Dispersion of sound in a combustion duct by fuel droplets and soot particles.** J. H. Miles (NASA, Lewis Research Center, Cleveland, Ohio) and D. D. Raftopoulos (Toledo, University, Toledo, Ohio). *Acoustical Society of America, Meeting, 98th, Salt Lake City, Utah, Nov. 26-30, 1979, Paper.* 27 p. 22 refs.

Dispersion and attenuation of acoustic plane wave disturbances propagating in a ducted combustion system are studied. The dispersion and attenuation are caused by fuel droplet and soot emissions from a jet engine combustor. The attenuation and dispersion are due to heat transfer and mass transfer and viscous drag forces between the emissions and the ambient gas. Theoretical calculations show sound propagation at speeds below the isentropic speed of sound at low frequencies. Experimental results are in good agreement with the theory. (Author)

A80-20964 * # **Comparison of inlet suppressor data with approximate theory based on cutoff ratio.** E. J. Rice and L. J. Heidelberg (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0100.* 26 p. 21 refs.

This paper represents the initial quantitative comparison of inlet suppressor far-field directivity suppression with that predicted using an approximate liner design and evaluation method based upon mode cutoff ratio. The experimental data was obtained using a series of cylindrical point-reacting inlet liners on an Avco-Lycoming YF102 engine. The theoretical prediction program is based upon simplified sound propagation concepts derived from exact calculations. These indicate that all of the controlling phenomenon can be approximately correlated with mode cutoff ratio which itself is intimately related to the angles of propagation within the duct. The objective of the theory-data comparisons is to point out possible deficiencies in the approximate theory which may be corrected. After all theoretical refinements have been made, then empirical corrections can be applied. (Author)

A80-20965 * # **Acoustic considerations of flight effects on jet noise suppressor nozzles.** U. von Glahn (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0164.* 24 p. 14 refs.

Insight into the inflight acoustic characteristics of high-velocity jet noise suppressor nozzles for supersonic cruise aircraft (SCA) is provided. Although the suppression of jet noise over the entire range of directivity angles is of interest, the suppression of the peak noise level in the rear quadrant is frequently of the most interest. Consequently, the paper is directed primarily to the inflight effects at the peak noise level. Both single and inverted-velocity-profile multistream suppressor nozzles are considered. The importance of static spectral shape on the noise reduction due to inflight effects is stressed. (Author)

A80-20966 * # **Summary of advanced methods for predicting high speed propeller performance.** L. J. Bober and G. A. Mitchell (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0225.* 12 p. 10 refs.

Three advanced analyses for predicting aircraft propeller performance at high subsonic speeds are described. Two of these analyses use a lifting line representation for the propeller blades and vortex filaments for the blade wakes but differ in the details of the solution. The third analysis is a finite difference solution of the unsteady, three-dimensional Euler equations for the flow between adjacent blades. Analysis results are compared to data for a high speed propeller having 8 swept blades integrally designed with the spinner and nacelle. These analyses provide tools for the propeller designer ranging from a short running program for initial design studies to a very long running program for checking final configurations. (Author)

A80-20968 * # **Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system.** A. P. Kuchar (General Electric Co., Cincinnati, Ohio) and R. Chamberlin (NASA, Lewis Research Center, Energy Conservative Engine Office, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0229.* 10 p.

A scale model performance test was conducted as part of the NASA Energy Efficient Engine (E3) Program, to investigate the geometric variables that influence the aerodynamic design of exhaust system mixers for high-bypass, mixed-flow engines. Mixer configuration variables included lobe number, penetration and perimeter, as well as several cutback mixer geometries. Mixing effectiveness and mixer pressure loss were determined using measured thrust and nozzle exit total pressure and temperature surveys. Results provide a data base to aid the analysis and design development of the E3 mixed-flow exhaust system. (Author)

A80-20969 * # **Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis.** B. H. Anderson and C. E. Towne (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0384.* 15 p. 20 refs.

A three-dimensional fully viscous computer analysis, which retains the viscous nature of the Navier-Stokes equations, was evaluated to determine its usefulness in the design of supersonic inlets. This procedure takes advantage of physical approximations to limit the high computer time and storage associated with complete Navier-Stokes solutions. Computed results are presented for a Mach 3.0 supersonic inlet with bleed and a Mach 7.4 hypersonic inlet. Good agreement was obtained between theory and data for both inlets. Results of a mesh sensitivity study are also shown. (Author)

A80-20970 * # **An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet.** H. E. Neumann, L. A. Povinelli, and R. E. Coltrin (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0386.* 12 p.

An experimental investigation of a subscale HiMat forebody and inlet was conducted over a range of Mach numbers to 1.4. The inlet exhibited a transitory separation within the diffuser but steady state data indicated reattachment at the diffuser exit. A finite difference procedure for turbulent compressible flow in axisymmetric ducts was used to successfully model the HiMAT duct flow. The analysis technique was further used to estimate the initiation of separation and delineate the steady and unsteady flow regimes in similar S-shaped ducts. (Author)

A80-20971 # **Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle.** R. D. FitzSimmons, R. A. McKinnon, E. S. Johnson (Douglas Aircraft Co., Long Beach, Calif.), and J. R. Brooks (Rolls-Royce, Ltd., Derby, England). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 18th, Pasadena, Calif., Jan. 14-16, 1980, Paper 80-0165.* 49 p. 21 refs.

Comprehensive acoustic and propulsion data are presented, based on flight and wind tunnel tests, of a mechanical jet noise suppressor designed to satisfy the requirements of an advanced supersonic transport (AST) under study by the McDonnell Douglas Corporation. The flight program was conducted jointly by MDC, Rolls-Royce Ltd., and the British Aerospace Corporation, using an HS-125 aircraft modified to accept an upgraded RR Viper 601 engine with conical reference and mechanical suppressor nozzles and an acoustically treated ejector. The nacelle, engine and nozzle configurations from the HS-125 were also tested in one of NASA's wind tunnels to obtain thrust performance at forward velocity and acoustic data. The acoustic flight test data, when scaled to an AST engine nozzle size and projected to a typical sideline distance, indicate reduction in effective perceived noise level of 16 EPNdB at the takeoff power setting. It is estimated that the in-flight thrust loss for a typical AST suppressor/ejector nozzle configuration (37.5 inch equivalent diameter) would be 5.4 percent at takeoff power settings and 6.6 percent at cutback power settings. V.L.

A80-20982 **The Russian satellite navigation system.** C. D. Wood and G. E. Perry. *(Royal Society, Discussion on the Satellite Doppler Tracking and Its Geodetic Applications, London, England, Oct. 10, 11, 1978.) Royal Society (London), Philosophical Transactions, Series A,* vol. 294, no. 1410, Jan. 14, 1980, p. 307-315.

Since 1972, systematic analysis of Cosmos satellites, having near-circular orbits and periods close to 105 min, has revealed that several groups have had the necessary orbital plane spacing to give the global coverage suitable for satellite navigation systems. Replacements have been launched at regular intervals. The current systems comprise three satellites with 60 deg spacing, six with 30 deg spacing and three with 45 deg spacing. These satellites have been shown to transmit on frequencies close to 150 and 400 MHz. The modulation of the 150 MHz carrier frequencies is explained together with the techniques employed to decode Standard Moscow Time, the satellite's position in geocentric Cartesian coordinates with corresponding rates of change at 3 min intervals, plus the orbital parameters of all satellites forming the system. (Author)

A80-20992 **The Global Positioning System.** R. J. Anderle (U.S. Navy, Naval Surface Weapons Center, Dahlgren, Va.). *(Royal Society, Discussion on the Satellite Doppler Tracking and Its Geodetic Applications, London, England, Oct. 10, 11, 1978.) Royal Society (London), Philosophical Transactions, Series A,* vol. 294, no. 1410, Jan. 14, 1980, p. 395-405; Discussion, p. 405, 406.

The Global Positioning System is described. Consideration is given to the following aspects: the principle of operation; the experimental phase; alternatives for geodetic and geophysical applications; error budget for navigation applications; ephemeris accuracy; accuracy of absolute geodetic positions; the effect of ephemeris errors on relative station positions; and the Doppler approach. B.J.

STAR ENTRIES

N80-14017# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ADVANCES IN GUIDANCE AND CONTROL SYSTEMS USING DIGITAL TECHNIQUES
Aug. 1979 357 p refs In ENGLISH and FRENCH Presented at the Guidance and Control Panel Symp., Ottawa, 8-11 May 1979
(AGARD-CP-272; ISBN-92-835-0247-7) Avail: NTIS HC A16/MF A01

The application of digital methods to guidance and control systems is considered. Functional design concepts, trends, and requirements, advances in analytical and design techniques, and advances in digital system design and architecture to assure high integrity are among the topics covered. Data processing and computation techniques, software design validation techniques, including simulation, and operational and system development experience are included.

N80-14018*# Milco International, Inc., Huntington Beach, Calif.
STATE OF THE ART FOR DIGITAL AVIONICS AND CONTROLS, 1978
Richard K. Smyth *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 20 p refs

(Contract NASw-2691)
Avail: NTIS HC A16/MF A01 CSCL 02A

A brief summary of a comprehensive state of the art survey is presented. The survey includes five broadly applicable technology areas: flight path management, aircraft control systems, crew station & human factors, integration & interfacing technology, and fundamental technology. In addition the survey included military technologies which have a technology transfer potential to the five broadly applicable technology areas. J.M.S.

N80-14019# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Control Div.
A FLIGHT CONTROL SYSTEM USING THE DAIS ARCHITECTURE
A. P. DeThomas and R. A. Hendrix *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 9 p refs
Avail: NTIS HC A16/MF A01

The development of a digital flight control system simulation capability to examine advanced integrated control architectures, in order to increase system performance and availability, is described. Near term issues, such as multiplexing interfaces with other avionics functions and structuring of software, are covered. J.M.S.

N80-14020# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
TRENDS IN DIGITAL DATA PROCESSING AND SYSTEM ARCHITECTURE
A. A. Callaway *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 5 p

Avail: NTIS HC A16/MF A01

The utilization of airborne digital computers and methods for their integration into digital avionic systems are discussed. The architecture of two aircraft systems, one designed in the 1960s and one in the 1970s is described. The growth in complexity is discussed in terms of two factors: the total flow of data between the subsystems which form the elements of the system, and the total volume of the computing task in terms of the number of words of program required. Techniques which may assist in alleviating the growing complexity are then considered. These include: design management aids, such as requirement statement languages; architectural considerations, such as multiplex data busses and distributed processing; and software techniques, such as high level languages, MASCOT, and structured programming. J.M.S.

N80-14023# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
AN OBSERVER SYSTEM FOR SENSOR FAILURE DETECTION AND ISOLATION IN DIGITAL FLIGHT CONTROL SYSTEMS
Norbert Stuckenberg *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 11 p refs

Avail: NTIS HC A16/MF A01

For the sensor part of a flight control system a sensor failure detection and isolation concept is presented based on analytic redundancy. A conventional triplex sensor system is replaced by a duplex sensor system without loss of the fail-operational property. In the case of a sensor failure, deterministic Luenberger observers provide the information about which of the two sensors of the duplex system actually failed. The proposed concept is applied to a command and stability system of a flight control system. Author

N80-14024# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
AUTOMATIC RECOVERY AFTER SENSOR FAILURE ONBOARD
Marc Labarrere, Marc Pelegrin, and Marc Pircher *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 12 p refs

Avail: NTIS HC A16/MF A01

Two techniques are developed which provide reliable failure detection and isolation for a dual-redundant subset of sensors. A global procedure using a bank of stationary Kalman filters is described. Some difficulties of this technique lead to a sub-optimal procedure which is developed in order to give all the dynamic and static relationships between the measured outputs on the aircraft. These techniques are sucessfully applied to simulated sensor failure on a six degree of freedom aircraft simulation and are applying to sensor failures injected on flight data from the N262 aircraft. F.O.S.

N80-14025# Marconi Avionics Ltd., Rochester (England). Flight Automation Research Lab.
RECENT ADVANCES IN FIBRE OPTICS FOR HIGH INTEGRITY DIGITAL CONTROL SYSTEMS
R. P. G. Collinson *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 16 p

Avail: NTIS HC A16/MF A01

The methods for using fiber optic cables for interconnecting the elements of an active control system, and the advantages and disadvantages are discussed. The major factors in the use of fiber optics are practical ones, connectors, terminations, ruggedness, and environmental capability of cables. The techniques are described which were developed to make a fiber bundle a practical cable link. The use of multi-access optical highways, particularly for interfacing other systems with the flight control system, (e.g. Air Data and IN systems) is reviewed and principles of the candidate networks outlined. Finally, a new concept for a fiber optic multi-access network is presented which is fully compatible with the new data transmission specification. F.O.S.

N80-14026# General Dynamics/Fort Worth, Tex.
REDUNDANCY MANAGEMENT CONSIDERATIONS FOR A CONTROL-CONFIGURED FIGHTER AIRCRAFT TRIPLEX DIGITAL FLY-BY-WIRE FLIGHT CONTROL SYSTEM
John H. Watson, William J. Yousey, and James M. Railey *In* AGARD Advan. In Guidance and Control Systems Using Digital

Tech. Aug. 1979 23 p ref

(Contract F33615-77-C-3036)
Avail: NTIS HC A16/MF A01

To preclude the shut down of the flight control computers for control configured fighter aircraft, redundant (parallel) processing is used in conjunction with redundancy management concepts. Using reliability requirements and goals as expressed in loss-of-control per flight hour, a digital flight control system architecture is evolved with specific emphasis placed on the input, processor and output subsystems. The incorporation of an analog cross strapping of lower reliability sensors is shown to be an effective means of increasing system reliability by retaining sensor redundancy after a computer failure. A technique called control law reconfiguration is developed which insures system survival after a second like sensor failure. Computer contribution to loss-of-control is reduced by the addition of system monitors which increase the computer self-test confidence level. The resultant architecture is shown to have an inherent reliability which is relatively insensitive to the configuration of the actuator interface, thus allowing this interface to be designed based on hardware/software complexity tradeoffs. A.R.H.

N80-14027# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
FAILURE DETECTION, ISOLATION AND INDICATION IN HIGHLY INTEGRATED DIGITAL GUIDANCE AND CONTROL SYSTEM
Wolfgang J. Kubbat *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 17 p

Avail: NTIS HC A16/MF A01

A broad spectrum of modern failure detection and isolation techniques is discussed and it is shown that the failure problem can be significantly reduced with technology and design. Several advanced methods such as vector redundancy, dissimilar redundancy, and methods applied to computers are described and some are backed up by practical examples. Data bus orientated guidance and control systems are considered. Based upon a practical realization example, guidelines are given for the use of MIL STD 1553 B in redundant applications. A.R.H.

N80-14028# Electronique Marcel Dassault, St. Cloud (France).
THE INTEGRITY OF ONBOARD COMPUTER PROGRAMS: A SOLUTION [L'INTEGRITE DES LOGICIELS EMBARQUES: UNE SOLUTION]
G. Germain *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 8 p refs In FRENCH

Avail: NTIS HC A16/MF A01

A solution is provided for insuring the integrity of the operating system onboard aircraft and engines. The principle effect is to increase the security of the system so as to make it homogeneous with that of the material, which in the case considered, is very high. Interesting consequences are found in the level of reliability and maintainability of the system, as well as the costs of validation. The means used are the simplest and most economical possible. They are applied to the structure of the operating system and hardware of a computer well adapted for onboard applications. Emphasis is placed on mechanisms for controlling address, which prevents all untimely destruction of the software. Transl. by A.R.H.

N80-14031# Defence Research Establishment, Ottawa. (Ontario).
DEVELOPMENT OF AIDING GPS/STRAPDOWN INERTIAL NAVIGATION SYSTEM
D. F. Liang, D. B. Reid (Lapp (Philip A.) Ltd., Toronto), R. H. Johnson (S and S Software Ltd., Ottawa), and B. G. Fletcher *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 15 p refs

Avail: NTIS HC A16/MF A01

An overview is presented of the design and development of an integrated multisensor navigation system comprised of a NAVSTAR GPS receiver, an aiding strapdown inertial navigation system (ASIN) and a number of auxiliary sensors, namely, air data and strapdown magnetic sensors. In the present phase, comprehensive software packages were developed to simulate all the subsystems used. A modular and computationally efficient Kalman filtering algorithm was designed and implemented for the integration of the GPS and ASIN. During the course of the development, two techniques were developed. An exact algorithm was derived to transform inertially referenced data into geographic coordinates. Also, a dual channel attitude algorithm was formulated which increases the bandwidth of the attitude computation in the strapdown navigator. Other routines developed include the baro-damping algorithm, auxiliary sensor processing and calibration routines. To provide a baseline level of performance, simulation results were obtained for future flight testing of the hardware. M.M.M.

N80-14034# Twente Univ. of Technology, Enschede (Netherlands). Dept. of Electrical Engineering.
METHODS FOR STRAP-DOWN ATTITUDE ESTIMATION AND NAVIGATION WITH ACCELEROMETERS
R. P. Offereins and M. J. L. Tiernego *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 20 p refs
Avail: NTIS HC A16/MF A01

Methods are presented for calculating the attitude of a vehicle from the signals of three linear and three angular accelerometers which are rigidly attached to the vehicle. Also course, velocity and position measurements relative to some object can be used. Apart from the attitude, the velocity and position, with respect to this object, are also obtained as output signals. In fire control systems, filters for target position prediction and attitude determination can be combined in this way. M.M.M.

N80-14036# Lockheed-Georgia Co., Marietta.
AN ASSESSMENT OF AND APPROACH TO THE VALIDATION OF DIGITAL FLIGHT CONTROL SYSTEMS
D. B. Mulcare and W. G. Ness *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 12 p refs
Avail: NTIS HC A16/MF A01

Flight-critical digital flight control system functions are evaluated in the context of farther term implementations. The quality and safety associated with fault tolerant, highly integrated, control oriented system implementations are emphasized. Technology needs are addressed so that the verification and validation process for advanced digital flight control systems can be sufficiently developed and purposefully accomodated in system engineering methodologies. K.L.

N80-14037# Electronique Marcel Dassault, St. Cloud (France).
THE AVIONICS COMPUTER PROGRAM: PRACTICAL EXPERIENCES WITH A METHODOLOGY [LOGICIEL AVIONIQUE: EXPERIENCES PRATIQUES D'UNE METHODOLOGIE]
J. Perin *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 17 p In FRENCH

Avail: NTIS HC A16/MF A01

The organization and methodology used in the construction of operating systems in the principle computers of the Mirage F1 and Mirage 200 aircraft are described. Particular emphasis is placed on the definition phases and program validation.
Transl. by A.R.H.

N80-14038# Westland Helicopters Ltd., Yeovil (England).
EXPERIENCE IN PRODUCING SOFTWARE FOR THE GROUND STATION OF A REMOTELY PILOTED HELICOPTER SYSTEM

J. P. Webby, P. L. Wescott, M. I. Tucker, and H. M. Smith *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 9 p

Avail: NTIS HC A16/MF A01

A computer system to control the aircraft, produce graphic displays, and handle data received from the aircraft was produced using the Modular Approach to System Construction, Operation, and Test, written in CORAL 66 language. The overall design of the software and the methods used to design, code, and test the software system are described in detail. K.L.

N80-14042# Litton Systems (Canada) Ltd., Rexdale, (Ontario).
A HIGH ACCURACY FLIGHT PROFILE DETERMINING SYSTEM
Peter Roy Vousden and Peter Jonathon Gollop *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 16 p
Avail: NTIS HC A16/MF A01

The characteristics of a system that determines the flight profile of an aircraft in three orthogonal coordinates to an accuracy of a few feet are described. A standard commercial quality inertial navigation system provides the required aircraft dynamic and attitude data while a special infrared sensor provides periodic updates. A digital computer implements an 18 state Kalman filter for estimation of the inertial errors. Filter data is stored on magnetic tape for immediate reprocessing by a fixed interval Bryson-Frazier smoothing algorithm that further refines the system performance. The techniques, applied in real time, are controlled in a multitask environment by a software operating system. Applications for the systems capability are discussed with emphasis on the initial purpose of providing an accurate self contained trajectory measuring system for ILS and MLS flight checking. Other uses such as airborne surveying and weapon release determining systems are examined. A.W.H.

N80-14043# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
INTEGRATION OF FLIGHT AND FIRE CONTROL
Robert K. Huber *In* AGARD Advan. in Guidance and Control Systems Using Digital Tech. Aug. 1979 9 p refs

Avail: NTIS HC A16/MF A01

An evaluation of an integrated flight and fire control (IFFC) system in modern fighter aircraft is described. The IFFC systems for air to air gunnery, air to ground gunnery, and bombing are outlined. The concept involves the coupling of fire control commands into the flight control system. The concept will be tested on a F-15B aircraft. Primary modifications to the F-15B aircraft include the addition of a digital computer for flight control and fire control signal processing, an electro-optical tracker, and a 1553A multiplex bus for communication between the F-15 central computer, the tracker, and the added digital computer. The IFFC concepts, the planned hardware implementation on the F-15B, and safety of flight considerations are discussed.
A.W.H.

N80-14045*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SONIC-BOOM WAVE-FRONT SHAPES AND CURVATURES ASSOCIATED WITH MANEUVERING FLIGHT
Raymond L. Barger Dec. 1979 30 p refs
(NASA-TP-1611; L-13339) Avail: NTIS HC A03/MF A01 CSCL 01A

Sonic-boom wave shapes and caustic lines generated by an airplane performing a general maneuver are studied. The equations are programmed for graphical output as a perspective view of the wave shape. This quasi three-dimensional presentation provides a qualitative insight into the effects of the maneuver on the wave shape and the caustic locations. For the special case of planar maneuvers, the principal curvatures of the wave front are derived. These curvatures are needed to calculate the sound field in the vicinity of a caustic. The results of the analysis are applicable not only to sonic-boom studies but also to the calculation of noise generated by a supersonic rotor or propeller blade tip. Author

N80-14047*# Nevada Univ., Las Vegas.
TWO DIMENSIONAL AERODYNAMIC INTERFERENCE EFFECTS ON OSCILLATING AIRFOILS WITH FLAPS IN VENTILATED SUBSONIC WIND TUNNELS
Joseph Fromme, Michael Golberg, and John Werth Washington NASA Dec. 1979 150 p refs
(Grant NsG-2140)
(NASA-CR-3210) Avail: NTIS HC A07/MF A01 CSCL 01A

The numerical computation of unsteady airloads acting upon thin airfoils with multiple leading and trailing-edge controls in two-dimensional ventilated subsonic wind tunnels is studied. The foundation of the computational method is strengthened with a new and more powerful mathematical existence and convergence theory for solving Cauchy singular integral equations of the first kind, and the method of convergence acceleration by extrapolation to the limit is introduced to analyze airfoils with flaps. New results are presented for steady and unsteady flow, including the effect of acoustic resonance between ventilated wind-tunnel walls and airfoils with oscillating flaps. The computer program TWODI is available for general use and a complete set of instructions is provided. Author

N80-14049*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECT OF TIP PLANFORM ON BLADE LOADING CHARACTERISTICS FOR A TWO-BLADED ROTOR IN HOVER
John D. Ballard, Kenneth L. Orloff, and Alan B. Luebs (Gates Lear Corp., Wichita, Kan.) Nov. 1979 89 p refs
(NASA-TM-78615; A-7939) Avail: NTIS HC A05/MF A01 CSCL 01A

A laser velocimeter was used to study the flow surrounding a 2.13 m diam. two-bladed, teetering model-scale helicopter rotor operating in the hover condition. The rotor system employed interchangeable blade tips over the outer 25% radius. A conventional rectangular planform and an experimental ogee tip shape were studied. The radial distribution of the blade circulation was obtained by measuring the velocity tangent to a closed rectangular contour around the airfoil section at a number of radial locations. A relationship between local circulation and bound vorticity was invoked to obtain the radial variations in the sectional lifting properties of the blade. The tip vortex-induced velocity was also measured immediately behind the generating blade and immediately before the encounter with the following blade. The mutual influence between blade loading, shed vorticity, and the structure of the encountered vortex are quantified by the results presented and are discussed comparatively for the rectangular and ogee planforms. The experimental loading for the rectangular tip is also compared with predictions of existing rotor analysis. Author

N80-14051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODIFICATION OF AXIAL COMPRESSOR STREAMLINE PROGRAM FOR ANALYSIS OF ENGINE TEST DATA
Jeffrey G. Williams Nov. 1979 49 p refs
(NASA-TM-79312; E-268) Avail: NTIS HC A03/MF A01 CSCL 01A

An existing axial compressor streamline analysis computer program to allow input of measured radial pressure and temperature profiles obtained from engine or cascade data is described. The proposed modifications increase the input flexibility and are accomplished without changing the computer program's input format. A.R.H.

N80-14052*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
THE QUASI-VORTEX-LATTICE METHOD FOR WINGS WITH EDGE VORTEX SEPARATION Final Report
Jenn-Louh Pao and Edward Lan Jan. 1980 25 p refs
(Grant NsG-1537)
(NASA-CR-162530; CRINC-FRL-385-1) Avail: NTIS HC A02/MF A01 CSCL 01A

The aerodynamic characteristics of wings with leading-edge vortex separation were predicted using a method based on a flow model with free vortex elements which are allowed to merge into a concentrated core. The calculated pressure distribution is more accurate than that predicted by methods with discrete vortex filaments alone. In addition, the computer time is reduced approximately by half. A.R.H.

N80-14053*# Old Dominion Univ. Research Foundation, Norfolk, Va.
THEORETICAL STUDY OF AERODYNAMIC CHARACTERISTICS OF WINGS HAVING VORTEX FLOW Report, 1 Feb. - 31 Aug. 1978
C. Subba Reddy Nov. 1979 63 p refs
(Contract NAS1-14193)
(NASA-CR-159184) Avail: NTIS HC A04/MF A01 CSCL 01A

The aerodynamic characteristics of slender wings having separation induced vortex flows are investigated by employing three different computer codes--free vortex sheet, quasi vortex lattice, and suction analogy methods. Their capabilities and limitations are examined, and modifications are discussed. Flat wings of different configurations: arrow, delta, and diamond shapes, as well as cambered delta wings, are studied. The effect of notch ratio on the load distributions and the longitudinal characteristics of a family of arrow and diamond wings is explored. The sectional lift coefficients and the accumulated span loadings are determined for an arrow wing and are seen to be unusual in comparison with the attached flow results. The theoretically predicted results are compared with the existing experimental values. A.W.H.

N80-14054*# Old Dominion Univ. Research Foundation, Norfolk, Va.
OPTIMIZED AERODYNAMIC DESIGN PROCESS FOR SUBSONIC TRANSPORT WING FITTED WITH WINGLETS
John M. Kuhlman Dec. 1979 184 p refs
(Contract NsG-1357)
(NASA-CR-159180) Avail: NTIS HC A09/MF A01 CSCL 01A

The aerodynamic design of a wind-tunnel model of a wing representative of that of a subsonic jet transport aircraft, fitted with winglets, was performed using two recently developed optimal wing-design computer programs. Both potential flow codes use a vortex lattice representation of the near-field of the aerodynamic surfaces for determination of the required mean camber surfaces for minimum induced drag, and both codes use far-field induced drag minimization procedures to obtain the required spanloads. One code uses a discrete vortex wake model for this far-field drag computation, while the second uses a 2-D advanced panel wake model. Wing camber shapes for the two codes are very similar, but the resulting winglet camber shapes differ widely. Design techniques and considerations for these two wind-tunnel models are detailed, including a description of the necessary modifications of the design geometry to format it for use by a numerically controlled machine for the actual model construction. Author

N80-14055*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPUTERIZED METHOD FOR CALCULATING FLUTTER CHARACTERISTICS OF A SYSTEM CHARACTERIZED BY TWO DEGREES OF FREEDOM
Winifred A. Stalnaker and William F. Hunter Nov. 1979 52 p ref
(NASA-TM-80153) Avail: NTIS HC A03/MF A01 CSCL 01A

A formulation is given for calculating flutter frequency and flutter speed for a problem with two degrees of freedom. Two different solutions for evaluating the flutter determinant are presented and the results for each method are compared. A program flow diagram, partial program listing, and a sample problem with input and output for the two different methods are included. Although the method was developed for computing flutter characteristics of a pylon installed in the NASA Langley VSTOL tunnel, it is sufficiently general to solve any flutter system that can be characterized by two degrees of freedom. A.R.H.

N80-14056*# Boeing Commercial Airplane Co., Seattle, Wash.
AN INVESTIGATION OF SEVERAL FACTORS INVOLVED IN A FINITE DIFFERENCE PROCEDURE FOR ANALYZING THE TRANSONIC FLOW ABOUT HARMONICALLY OSCILLATING AIRFOILS AND WINGS
F. E. Ehlers, J. D. Sebastian, and W. H. Weatherill May 1979 89 p refs
(Contract NAS1-15128)
(NASA-CR-159143; D6-48852) Avail: NTIS HC A05/MF A01 CSCL 01A

Analytical and empirical studies of a finite difference method for the solution of the transonic flow about harmonically oscillating wings and airfoils are presented. The procedure is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady equations for small disturbances. Since sinusoidal motion is assumed, the unsteady equation is independent of time. Three finite difference investigations are discussed including a new operator for mesh points with supersonic flow, the effects on relaxation solution converence of adding a viscosity term to the original differential equation, and an alternate and relatively simple downstream boundary condition. A method is developed which uses a finite difference procedure over a limited inner region and an approximate analytical procedure for the remaining outer region. Two investigations concerned with three-dimensional flow are presented. The first is the development of an oblique coordinate system for swept and tapered wings. The second derives the additional terms required to make row relaxation solutions converge when mixed flow is present. A finite span flutter analysis procedure is described using the two-dimensional unsteady transonic program with a full three-dimensional steady velocity potential. Author

N80-14058# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
HIGH ANGLE OF ATTACK CHARACTERISTICS OF DIFFERENT FIGHTER CONFIGURATIONS
Helmut John and Kraus Werner 7 Sep. 1978 40 p refs Presented at Symp. on High Angle of Attack Aerodyn., Sandefjord, Norway, 4-6 Oct. 1978
(MBB-UFE-1443(O)) Avail: NTIS HC A03/MF A01

Basic aerodynamic characteristics of different fighter configerations at separated flow beyond maximum lift where the resultant derivatives are completely different from those associated with attached flow are reviewed. The change in trim conditions is primarily dependant on wing planform and overall aircraft configuration. Results are shown for the aerodynamic development of aircraft configurations which meet these requirements and, at the same time, minimize the resulting drag penalties in the conventional angle of attack regime. Furthermore, problem areas and deficiencies must be identified to allow the definition of concepts for stabilizing such configurations artificially by aid of a flight control system. It is shown that an auxiliary momentum generating system is necessary for controlling the aircraft at flight conditions where aerodynamic control power is not sufficient. Author (ESA)

N80-14061# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Technical and Resources Management Div.
AERONAUTICAL SYSTEMS TECHNOLOGY NEEDS: ESCAPE, RESCUE AND SURVIVAL Annual report for calendar year 1979
Donald C. Kittinger Aug. 1979 30 p refs Supersedes ASD-TR-78-21

(AD-A074906; ASD-TR-79-5038; ASD-TR-78-21) Avail: NTIS HC A03/MF A01 CSCL 06/7

This report is a part of a compilation of formalized Technology Needs TN covering Equipment Subsystems as identified in the Aeronautical Systems Division. They are based on development/ operational experience, systems studies and new concepts - all related to future system applications. Their presentation is to serve a threefold purpose, i.e., 1 guidance for technology program, 2 proven development potential, and 3 engineering data/ requirements essential for technology use in systems. The identified needs delineate progress desired in performance, control, design flexibility, safety and cost. GRA

N80-14063# Air Force Engineering and Services Center, Tyndall AFB, Fla. Directorate of Environmental Planning.

AN EVALUATION OF THE BIRD/AIRCRAFT STRIKE HAZARD AT BARKSDALE AIR FORCE BASE, LOUISIANA (SAC) Final Report

Jeffrey J. Short and James S. Kent Feb. 1979 68 p (AD-A074390; AFESC-TM-2-79) Avail: NTIS HC A04/MF A01 CSCL 06/6

Barksdale Air Force Base was surveyed from 31 January to 9 February 1979 by the Air Force Engineering and Service Center's Bird/Aircraft Strike Hazard Team. During this period, operational and environmental factors which combine to create bird strike hazards were observed. Specific recommendations based on observations are provided to reduce the bird strike hazard. GRA

N80-14064# Lincoln Lab., Mass. Inst. of Tech., Lexington.

AIR TRAFFIC DENSITY AND DISTRIBUTION MEASUREMENTS

W. H. Harman 3 May 1979 63 p refs (Contract DOT-FA77WAI-817; FAA Proj. 052-241-04) (AD-A073229; FAA-RD-78-45; ATC-80) Avail: NTIS HC A04/MF A01 CSCL 01/2

The measurements made in 1976 to determine the peak air traffic density, the spatial distribution, and the variation with time for transponder equipped aircraft in the Los Angeles area and at several locations on the east coast are presented. The use of these measurements for the design and evaluation of the discrete address beacon system and the air traffic control radar beacon system is discussed. A.W.H.

N80-14065# Fondazione Ugo Bordoni, Rome (Italy).

ON RADAR IN AIR TRAFFIC CONTROL Final Report [IL RADAR NEL CONTROLLO DEL TRAFFICO AEREO]

Jul. 1979 485 p refs In ITALIAN; ENGLISH summary Proc. of lectures at CNR Aiuti alla Navagazione e Controllo del Traffic Aereo, Rome 3-5 Jul. 1979 (FUB-11-1979) Avail: NTIS HC A21/MF A01

A collection of 41 papers is presented, grouped in the following main chapters: planning and operation of radar networks, automation in air traffic control, processing and visualization of radar data, developments in primary radar, radar antennas and wave propagation, and developments in secondary radar.

N80-14066# Aeronautica Militare Italiana, Rome.

PROBLEMS RELATED TO THE DESIGN AND CONSTRUCTION OF A RADAR NETWORK Final Report [PROBLEMATICHE NELL'IMPOSTAZIONE E REALIZZAZIONE DELLA RETE RADAR]

A. Tangorra *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 14-23 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The radar planning for Italy, issued in 1976 by the Italian Air Force, is discussed. The more interesting features connected with the construction of a radar center are examined with special regard to operational availability, automation, and costs. Some of the problems of the execution phase are especially analyzed, including siting criteria, social and administrative problems, and coordination between various organizations involved.

Author (ESA)

N80-14067# Selenia S.p.A., Rome (Italy). Div. Radar e Sistemi Civili.

METHODOLOGY FOR THE EVALUATION OF A RADAR SITE Final Report [METODOLOGIA DI VALUTAZIONE DI UN SITO RADAR]

B. Labozzetta *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 25-30 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The technical and economical factors involved in a radar site selection are described. The operation requirements are expressed as covered volume, and data flow rate. The macrositing and micrositing criteria are discussed jointly with the analysis of the factors that determine the radar performance for reducting the candidate sites. The fixed echoes, the angles, other signal interference, the overall visibility, and the impact on environment are examined as relevant to the procedure. The analysis is limited to implementation cost only. Running costs are deemed similarly structured. Author (ESA)

N80-14068# Selenia S.p.A., Rome (Italy).

PERFORMANCE EVALUATION METHODS OF A SECONDARY RADAR NETWORK Final Report [METODI DI VALUTAZIONE DELLE PRESTAZIONI DI UNA RETE DI RADAR SECONDARI]

G. Fraschetti and U. Merlo (Fond. Ugo Bordoni, Rome) *In* Fond. Ugo Bordoni On radar in Air Traffic Control Jul. 1979 p 31-41 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

Interference in secondary surveillance radar is evaluated. Analytical and simulation methods for the evaluation of the effects of sensor network and transponder spatial density on detection probability, azimuth measurement, and code identification are proposed. Some results obtained under a typical Italian air traffic condition, taking into account propagative effects, are reported. Extention of the proposed methods to the case of monopulse radar is also outlined. Author (ESA)

N80-14069# Compagnia Italiana Servizi Tecnici, Rome.

ORGANIZATION OF AN INTEGRATED GLOBAL MAINTENANCE SERVICE Final Report [ORGANIZZAZIONE DI UN SERVIZIO INTEGRATO DI MANUTENZIONE GLOBALE]

R. Grazi *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 43-54 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The development of integrated maintenance techniques is examined to better satisfy the requirements of a future comprehensive radar system. The present situation is described showing that the present organization for air traffic control is adequate for present and immediate future requirements. For the planned expansion of the radar network an automated, and centralized radar control is proposed. The details of the technical control centers and the organization of the new system are discussed.

Author (ESA)

N80-14070# Consiglio Nazionale delle Ricerche, Rome (Italy). Centrol di Studi dei Sistemi di Controllo e Calcolo Automatici.

AUTOMATION OF FLIGHT ON-LINE STRATEGIC CONTROL: THE CASE OF SPEED CONTROL ON PRE-ESTABLISHED ROUTES Final Report [L'AUTOMAZIONE DEL CONTROLLO STRATEGICO ON-LINE DELVOLI: IL CASO DEL CONTROLLO DI VELOCITA' SU ROTTE PRESTABILITE]

L. Bianco, M. Cini, and L. Grippo *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 58-68 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The problem of on-line strategic control is examined with reference to speed control on preassigned routes, and under the hypothesis that planning is performed for each flight on the basis of the first in, first out discipline. The control problem is formulated as a constrained mathematical programming problem. A real time working algorithm is proposed. Author (ESA)

N80-14071# Consiglio Nazionale delle Ricerche, Rome (Italy). Centro di Studi dei Sistemi di Controllo e Calcolo Automatici.
RADAR DATA UTILIZATION IN AUTOMATING THE SEQUENCING OF AIRCRAFTS IN TERMINAL AREAS Final Report [L'UTILIZZAZIONE DEI DATA RADAR NEL-L'AUTOMAZIONE DEL SEQUENZIAMENTO DEGLI AEREI IN AREA TERMINALE]
L. Bianco, S. Ricciardelli, G. Rinaldi, and A. Sassano *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 69-79 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

A mathematical model for aircraft sequencing is presented, and an optimizing algorithm is proposed including some tests results. The algorithm finds the optimum by progressively restricting the set of admisable sequences, and evaluating each time preset value function related to the given objectives. As a programming language FORTRAN 5 was used on a Univac 1110/22 computer for the test method. The results show satisfactory operation of the algorithm in the tested interval, especially in relation to the problem of real time operation.
Author (ESA)

N80-14072# Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. di Automatica.
TACTICAL ANALYSIS OF CONFLICTS IN AN AIR TRAFFIC CONTROL SYSTEM: DESIGN AND IMPLEMENTATION OF A PROVISIONAL MODEL Final Report [ANALISI DEI CONFLITTI IN UN SISTEMA ATC SU BASE TATTICA: COSTRUZIONE DI UN MODELLO DI PREVISIONE E SUA IMPLEMENTAZIONE]
P. Bertolazzi and M. Lucertini *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 81-89 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

An algorithm for the conflict alert automated function in an air traffic control system is described. The influence of radar errors is analyzed and the numerical results on computing time and on reliability are presented. The program conflict analysis was tested with artificial data and with experimental data from Rome and Genoa. The results show that no false alarms occured, and that the average CPU time (Univac 1100/22) for a constant load of 30 artificial trajectories is in the order of one second.
Author (ESA)

N80-14073# Consiglio Nazionale delle Ricerche, Pisa (Italy). Ist. di Elaborazione dell'Informazione.
SIMULATION OF A SURVEILLANCE AND CONTROL SYSTEM OF SURFACE TRAFFIC IN AN AIRPORT Final Report [SIMULAZIONE DI UN SISTEMA DI SORVEGLIANZA E CONTROLLO DEL TRAFFICO SUPERFICIALE DI UN AEROPORTO]
M. Mercatanti, G. Bastianini, U. Ferri, and M. Saliba *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 91-101 refs In ITALIAN
Avail: NTIS HC A21/MF A01

The main requirements of a program for the simulation of a surveillance and control system are examined for the case of a system using primary radar to control aircraft and service vehicles. Several complexity levels of the system are proposed corresponding to program modules. A minimum configuration of the program includes airfield definition data, simulation of radar signals from aircraft on the airport surface, recognition of the aircraft based upon radar signals and identification data given to the system at the landing stage, and representation on a video screen of the airport, and the aircraft identified by corresponding labels.
Author (ESA)

N80-14074# Selenia S.p.A., Rome (Italy).
TRACKING ALGORITHMS FOR MONO AND MULTIRADAR Final Report [ALGORITMI DI TRACKING MONO E MULTI RADAR]
S. Pardini, N. Del (Florence Univ.), and G. Zappa (Florence Univ.) *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 111-122 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

Some algorithms for target tracking by means of track-while-scan techniques are analyzed. Some models of target paths, matched to typical air traffic control trajectories, are shown. In the case of multiradar systems, additional causes of measurement error are discussed, and some ways to integrate information coming from different radars are compared.
Author (ESA)

N80-14075# Selenia S.p.A., Rome (Italy). Div. Radar e Sistemi Civili.
A DISTRIBUTED PROCESSING SYSTEM FOR RADAR DATA PRESENTATION Final Report [SISTEMA DI PROCESSING E PRESENTAZIONE DATI RADAR A STRUTTURA DISTRIBUITA]
G. Barale *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 123-134 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The main processing functions used for radar data handling in air traffic control automated systems are described using the example of a distributed processing system based on a minicomputer architecture in which all the system functions are performed. Another example consisting of recent studies on a multiprocessor systems for air traffic control is also given.
Author (ESA)

N80-14076# Selenia S.p.A., Rome (Italy). Div. Radar e Sistemi Civili.
FILTERING OF SYNTHETIC RADAR DATA Final Report [FILTRAGGIO DELL'INFORMAZIONE RADAR SINTETICA]
N. Iafolla and R. Petrioli (Fond. Ugo Bordoni) *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 135-142 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

Further processing of radar data coming out of the primary and secondary extractors is studied to reduce mistakes and noise level by using space and time correlations wider than those currently adopted in radar sensors and extractors. The most frequent anomalies of primary and secondary radar data are first reviewed. A detailed description of synthetic radar data filtering is presented, and then compared to a multiradar air traffic control system with distributed architecture. It includes the initial plot processing, the plot combination, the signature-plot association, the logic of signature characterization, and the multiradar combination and special processing. The aim is to simulate human operator data processing leading to a possibility of further automation of radar surveillance systems.
Author (ESA)

N80-14077# Selenia S.p.A., Rome (Italy).
VISUAL DISPLAYS FOR AIR TRAFFIC CONTROL DATA Final Report [SISTEMI DI VISUALIZZAZIONE DEI DATI ATC]
Franco Odoardi *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 143-153 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

A review of visual displays for air traffic control data is presented. Topics discussed include: raw radar data and computer generated data mixed systems, maximum displayable load and readability of synthetic data in a very bright environment, dedicated displays and requirements, and color display and digital scan converter developments.
Author (ESA)

N80-14086# Selenia S.p.A., Rome (Italy).
IMPLEMENTATION OF AIR TRAFFIC CONTROL RADAR RECEIVERS WITH FAST FOURIER TRANSFORM PROCESSORS Final Report [INTEGRAZIONE COERENTE CON FFT NEI RICEVITORI RADAR PER ATC]
In Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 249-260 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The main radar problems concerning present and future air traffic control (ATC) radars are briefly reviewed with emphasis

on moving clutter. The equivalence between a fast Fourier transform (FFT) processor and a Doppler filter bank is shown. A video FFT receiver for an ATC radar is described. Results on the performance of the FFT receiver are compared to that of the moving window receiver. It is concluded that in a clutter free environment the FFT receiver has greater losses, while in moving clutter it shows relevant advantages. Author (ESA)

N80-14087# Segnalamento Marittimo ed Aereo S.p.A., Florence (Italy).
DEVELOPMENT TRENDS OF AIRPORT SURFACE TRAFFIC CONTROL RADAR Final Report [PREVEDIBILI SVILUPPI DEL RADAR PER IL CONTROLLO DEL TRAFFICO SULLA SUPERFICIE AEROPORTUALE]
S. Betini, M. Piattelli, and G. Defina *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 261-267 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The systems in use, and development trends are examined, pointing out that surface traffic growth in airports makes economically attractive a generalized use of dedicated radar sensors. It is shown that trends at present are oriented towards the I and J band frequencies which are more reliable in rainfall, while some time ago the millimeter waves were studied because of their higher angular resolution. Some specific techniques, together with new electronic components suggest that it is possible to develop a fully operative, cost-effective device. Author (ESA)

N80-14088# Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.
AN AIR TRAFFIC CHANNEL SIMULATION BY MEANS OF RAY-TRACING TECHNIQUES Final Report [LA SIMULAZIONE DEL CANALE AERONAUTICO PER MEZZO DI TECNICHE DI RAY-TRACING]
P. Beni, F. Bertini, and P. F. Pellegrini *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 277-285 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

A three-dimensional ray tracing procedure is described which was used for propagation studies on the secondary surveillance radar (SSR) RF aeronautical channels. This procedure is based on the numerical integration of the ray canonical equations originating from the geometric optics. Phenomena such as multipath (due to the specular reflections) and shadowing, can be investigated by means of this method of numerical computer simulation. The computed ray paths of the RF energy, utilizing an environment model (whichincludes a tridimensional true model of the ground surface and of the atmosphere, constructed from experimental data) can be compared with propagation data (measured) obtained in real situations. The theoretical formulation of ray tracing is summarized. A description is given of the procedure followed for modelling the ground surface, and an example of ray tracing is presented Author (ESA)

N80-14092# Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.
L-BAND MEASUREMENTS IN THE AIR TRAFFIC CHANNEL TO CHARACTERIZE SECONDARY RADAR SYSTEMS Final Report [MISURE SUL CANALE AERONAUTICO IN BANDA L AI FINI DELLA CARATERRIZZAZIONE DI SISTEMI DI RADAR SECONDARI]
P. F. Pellegrini, R. Cappadona, R. Ruisi, M. Trambusti, and V. Venturi *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 323-332 In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The equipment used to characterize secondary radar propagation channels is described. The equipment includes a transmitting system, a receiving system, and a data processing system. Part of the apparatus was designed to be airborne, and part to be used on the ground independently, or with a radar system. Author (ESA)

N80-14100# Selenia S.p.A., Rome (Italy).
ANTIREFLECTION TECHNIQUES FOR DETECTING FALSE TRACKS IN AIR TRAFFIC SURVEILLANCE WITH SECONDARY RADAR Final Report [TECHNICHE ANTIRIFLESSIONE PER LA INDIVIDUAZIONE DELLE FALSE TRACCE NELLA SORVEGLIANZA AEREA CON RADAR SECONDARI]
G. Fraschetti, D. Giuli (Florence Univ.), and V. Sacco (Florence Univ.) *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 415-424 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

Algorithms are presented which allow the target reports to be processed for false target and false track detection in order to avoid the consequent problems in secondary surveillance radar systems. The procedure is based upon the following characteristics of false tracks due to reflections: (1) same codes for false and true reports, (2) same elevation, (3) larger distance for the false report, (4) corresponding azimuth of the false report with that of a fixed obstacle, and (5) correlation is kept between both reports of the same radar sweep. Experimental results are presented, showing that 2.74% of the reports were declared false, while 2.42% of those reports were correlated with a false track. Author (ESA)

N80-14104# Trieste Univ. (Italy). Ist. di Elettrotecnia ed Elettronica.
AUTOMATIC SYSTEMS FOR AIRPORT SURFACE MOBILE MEDIA SURVEILLANCE BASED ON THE USE OF SECONDARY MEDIA Final Report [SISTEMI AUTOMATICI PER LA SORVEGLIANZA DEI MEZZI MOBILI SU UNA SUPERFICIE AEROPORTUALE BASATI SULL'USO DEL RADAR SECONDARIO]
E. Carli, T. Corzani, G. Falciasecca (Bologne Univ.), F. Ferdani (Fond. Ugo Bordoni), L. Mania, and F. Vatalaro *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 467-476 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

The studies carried out on airport surface surveillance systems suggest the use of secondary radar for a fully automated solution. Some techniques tried in other countries are first reviewed and then an original one is advanced. It is based on the combination of the hyperbolic/azimuth interrogation and the side lobe suppression technique. The system can be implemented with free space propagation, or by means of open waveguides. The open waveguide propagation is the more promising one but its feasibility is conditioned to the design of a suitable structure. Some significant results are presented. Author (ESA)

N80-14105# Politecnico di Torino (Italy). Ist. di Elettronica e Telecommunicazioni.
ONBOARD COLLISION AVOIDANCE SYSTEM: ENVIRONMENTAL INFLUENCE ON THE TRACKING ALGORITHM REQUIREMENTS Final Report [SISTEMI DI ANTICOLLISIONE DI BORDO: INFLUENZE DELL'AMBIENTE OPERATIVO SUI REQUISITI DEGLI ALGORITMI DI TRACKING]
V. Castellani and M. Pent *In* Fond. Ugo Bordoni On Radar in Air Traffic Control Jul. 1979 p 477-486 refs In ITALIAN; ENGLISH summary

Avail: NTIS HC A21/MF A01

A simulation program was studied to assess the performance of an airborne secondary surveillance radar collision avoidance system. Some first qualitative results are given, and the implementation of tracking and prediction algorithms is discussed. The problem of preventing interference effects is discussed showing the need for the development of suitable algorithms to that effect. Author (ESA)

N80-14106# Arinc Research Corp., Santa Ana, Calif.
AVIONICS INSTALLATION (AVSTALL) COST MODEL FOR USER EQUIPMENT OF NAVSTAR GLOBAL POSITIONING SYSTEM
W. Stewart, D. Allen, and P. Orth Jun. 1979 48 p
(Contract F04701-78-C-0124)
(AD-A073681; Rept-1727-04-1-1959) Avail: NTIS HC A03/MF A01 CSCL 17/7

An avionics installation (AVSTALL) cost model developed for application to the NAVSTAR Global Positioning System (GPS) is described. The model determines the aircraft-peculiar costs of installing avionics equipment--for example. GPS user equipment--into military aircraft. It is based on cost estimating relationships (CERs) developed from an analysis of 51 previous Class V avionics modifications to Air Force aircraft. The development and application of these CERs are explained in this report. GRA

N80-14107* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACOUSTICALLY SWEPT ROTOR Patent
Fredric H. Schmitz, Donald A. Boxwell, and Rande Vause, inventors (to NASA) Issued 25 Sep. 1979 23 p Filed 8 Sep. 1977 Supersedes N77-31130 (15 - 22, p 2893)
(NASA-Case-ARC-11106-1; US-Patent-4,168,939; US-Patent-Appl-SN-831633; US-Patent-Class-416-228; US-Patent-Class-416-238; US-Patent-Class-415-199) Avail: US Patent and Trademark Office CSCL 01C

Impulsive noise reduction is provided in a rotor blade by acoustically sweeping the chord line from root to tip so that the acoustic radiation resulting from the summation of potential singularities used to model the flow about the blade tend to cancel for all times at an observation point in the acoustic far field. Official Gazette of the U.S. Patent and Trademark Office

N80-14108* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
QUIET SHORT-HAUL RESEARCH AIRCRAFT FAMILIARIZATION DOCUMENT
Robert C. McCracken Nov. 1979 96 p
(NASA-TM-81149; A-7975) Avail: NASA. Ames Res. Center, Moffett Field, Calif. 94035 CSCL 01C

The design features and general characteristics of the NASA Quiet Short-Haul Research Aircraft are described. Aerodynamic characteristics and performance are discussed based on predictions and early flight-test data. Principle airplane systems, including the airborne data-acquisition system, are also described. The aircraft was designed and built to fulfill the need for a national research facility to explore the use of upper surface-blowing propulsive-lift technology in providing short takeoff and landing capability, and perform advanced experiments in various technical disciplines such as aerodynamics, propulsion, stability and control, handling qualities, avionics and flight-control systems, trailing-vortex phenomena, acoustics, structure and loads, operating systems, human factors, and airworthiness/certification criteria. An unusually austere approach using experimental shop practices resulted in a low cost and high research capability. Author

N80-14109# Aerospace Engineering Test Establishment, Cold Lake (Alberta).
DETERMINATION OF THE REPEATABILITY OF PEC
R. D. Michas 23 Oct. 1979 37 p refs
(AETE-PR-79/36; CF-5) Avail: NTIS HC A03/MF A01

Position error calibrations conducted on four CF-5A, six CF-5 A/R, and five CF-5D aircraft using the standard tower fly by and pacing methods are discussed. The variation in position error, between individual aircraft of each type is examined. Ammendments to the position error correction charts for the CF-5A and CF-5D Aircraft Operation Instruction and redesign of the correction cam are discussed. A.W.H.

N80-14111# Dreyfuss-Pellman Corp., Stamford, Conn.
NON-CONTACTING ELECTRO-OPTICAL CONTOURING OF HELICOPTER ROTOR BLADES Final Report, Oct. 1977 Oct. 1978
Marc G. Dreyfus and Arnold Pellman 11 Dec. 1978 80 p
(Contract DAAK50-78-C-0008)
(AD-A070806; USAAVRADCOM-TR-79-30) Avail: NTIS HC A05/MF A01 CSCL 01/3

Non-contact contour measurements of helicopter rotor blades to accuracies of 0.0001 in. are possible via range finding by triangulation employing electro-optical techniques. A laboratory breadboard of such a system has been built and tested. The results of these tests indicate that the construction of a full prototype system is feasible and desirable. GRA

N80-14113*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIGITAL SYSTEM FOR DYNAMIC TURBINE ENGINE BLADE DISPLACEMENT MEASUREMENTS
Louis J. Kiraly 13 Mar. 1979 13 p refs Proposed for presentation at 25th Ann. Intern. Gas Turbine Conf. and the 22d Ann. Fluids Engr. Conf., New Orleans, 9-13 Mar. 1980; sponsored by Am. Soc. of Mech. Engr.
(NASA-TM-81382; E-288) Avail: NTIS HC A02/MF A01 CSCL 21E

An instrumentation concept for measuring blade tip displacements which employs optical probes and an array of microcomputers is presented. The system represents a hitherto unknown instrumentation capability for the acquisition and direct digitization of deflection data concurrently from all of the blade tips of an operational engine rotor undergoing flutter or forced vibration. System measurements are made using optical transducers which are fixed to the case. Measurements made in this way are the equivalent of those obtained by placing three surface-normal displacement transducers at three positions on each blade of an operational rotor. M.M.M.

N80-14114*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY TEST RESULTS OF A FLIGHT-MANAGEMENT ALGORITHM FOR FUEL CONSERVATIVE DESCENTS IN A TIME BASED METERED TRAFFIC ENVIRONMENT
Charles E. Knox and Dennis G. Cannon (Boeing Commercial Airplane Co., Seattle, Wash.) Nov. 1979 34 p refs
(NASA-TM-80194) Avail: NTIS HC A03/MF A01 CSCL 01D

A flight management algorithm designed to improve the accuracy of delivering the airplane fuel efficiently to a metering fix at a time designated by air traffic control is discussed. The algorithm provides a 3-D path with time control (4-D) for a test B 737 airplane to make an idle thrust, clean configured descent to arrive at the metering fix at a predetermined time, altitude, and airspeed. The descent path is calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard pressure and temperature effects. The flight management descent algorithms and the results of the flight tests are discussed. A.W.H.

N80-14115*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) ACOUSTIC AND AERODYNAMIC TESTS ON A SCALE MODEL OVER-THE-WING THRUST REVERSER AND FORWARD THRUST NOZZLE
D. L. Stimpert 18 Jan. 1978 85 p refs
(Contract NAS3-18021)
(NASA-CR-135254; R75AEG504) Avail: NTIS HC A05/MF A01 CSCL 21E

An acoustic and aerodynamic test program was conducted on a 1/6.25 scale model of the Quiet, Clean, Short-Haul Experimental Engine (QCSEE) forward thrust over-the-wing (OTW) nozzle and OTW thrust reverser. In reverse thrust, the effect of reverser geometry was studied by parametric variations in blocker spacing, blocker height, lip angle, and lip length. Forward thrust nozzle tests determined the jet noise levels of the cruise and takeoff nozzles, the effect of opening side doors to achieve takeoff thrust, and scrubbing noise of the cruise and takeoff jet on a

simulated wing surface. Velocity profiles are presented for both forward and reverse thrust nozzles. An estimate of the reverse thrust was made utilizing the measured centerline turning angle. Author

N80-14116*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). UNDER-THE-WING (UTW) ENGINE BOILERPLATE NACELLE TEST REPORT. VOLUME 2: AERODYNAMICS AND PERFORMANCE
31 Dec. 1977 61 p refs
(Contract NAS3-18021)
(NASA-CR-135250; R77AEG2122-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 21E

The initial phase of testing of the under the wing engine and boilerplate nacelle components is discussed. The aerodynamics and performance are outlined. M.M.M.

N80-14117*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET, CLEAN, SHORT-HAUL, EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) ENGINE ACOUSTIC DESIGN
H. D. Sowers and W. E. Coward Jan. 1978 62 p refs
(Contract NAS3-18021)
(NASA-CR-135267; R76AEG195) Avail: NTIS HC A04/MF A01 CSCL 21E

The acoustic considerations involved in the low source noise basic engine design and the design procedures followed in the development of the under-the-wing (UTW) engine boilerplate and composite nacelle acoustic treatment designs are presented. Laboratory experiments, component tests, and scale model and engine tests supporting the UTW engine acoustic design are referenced. Acoustic design features include a near-sonic inlet, low fan and core pressure ratios, low fan tip speed, high and low frequency stacked core treatment, multiple thickness treatment, and fan frame and stator vane treatment. R.E.S.

N80-14118*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET, CLEAN, SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING (OTW) ENGINE ACOUSTIC DESIGN
H. D. Sowers and W. E. Coward Jun. 1978 58 p refs
(Contract NAS3-18021)
(NASA-CR-135268; R76AEG228) Avail: NTIS HC A04/MF A01 CSCL 21E

The acoustic considerations involved in the low source noise basic engine design and the design procedures followed in the development of the over-the-wing (OTW) nacelle acoustic treatment design are presented. Laboratory experiments, component tests, and scale model and engine tests supporting the OTW engine acoustic design are referenced. Acoustic design features include a near-sonic inlet, low fan and core pressure ratios, low fan tip speed, high and low frequency stacked core treatment, multiple thickness treatment, and fan frame and stator vane treatment. R.E.S.

N80-14119*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) GRAPHITE/PMR COWL DEVELOPMENT
C. L. Ruggles Jul. 1978 75 p refs
(Contract NAS3-18021)
(NASA-CR-135279; R78AEG206) Avail: NTIS HC A04/MF A01 CSCL 21E

The PMR process development, tooling concepts, testing conducted to generate materials properties data, and the fabrication of a subscale model of the inner cowl are presented. It was concluded that the materials, processes, and tooling concepts were satisfactory for making an inner cowl with adequate structural integrity. M.M.M.

N80-14120*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING (OTW) PROPULSION SYSTEM TEST REPORT. VOLUME 2: AERODYNAMICS AND PERFORMANCE
Jul. 1978 49 p refs
(Contract NAS3-18021)
(NASA-CR-135324; R77AEG474-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 21E

The design and testing of the over the wing engine, a high bypass, geared turbofan engine, are discussed. The propulsion system performance is examined for uninstalled performance and installed performance. The fan aerodynamic performance and the D nozzle and reverser thrust performance are evaluated. A.W.H.

N80-14121*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATIC TEST-STAND PERFORMANCE OF THE YF-102 TURBOFAN ENGINE WITH SEVERAL EXHAUST CONFIGURATIONS FOR THE QUIET SHORT-HAUL RESEARCH AIRCRAFT (QSRA)
Jack G. McArdle, Leonard Homyak, and Allan S. Moore Nov. 1979 62 p
(NASA-TP-1556; E-019) Avail: NTIS HC A04/MF A01 CSCL 21E

The performance of a YF-102 turbofan engine was measured in an outdoor test stand with a bellmouth inlet and seven exhaust-system configurations. The configurations consisted of three separate-flow systems of various fan and core nozzle sizes and four confluent-flow systems of various nozzle sizes and shapes. A computer program provided good estimates of the engine performance and of thrust at maximum rating for each exhaust configuration. The internal performance of two different-shaped core nozzles for confluent-flow configurations was determined to be satisfactory. Pressure and temperature surveys were made with a traversing probe in the exhaust-nozzle flow for some confluent-flow configurations. The survey data at the mixing plane, plus the measured flow rates, were used to calculate the static-pressure variation along the exhaust nozzle length. The computed pressures compared well with experimental wall static-pressure data. External-flow surveys were made, for some confluent-flow configurations, with a large fixed rake at various locations in the exhaust plume. A.R.H.

N80-14122*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
FEASIBILITY OF SiC COMPOSITE STRUCTURES FOR 1644 K (2500 F) GAS TURBINE SEAL APPLICATION Final Report, 28 Apr. - 30 May 1979
R. Darolia Nov. 1979 120 p ref
(Contract NAS3-20082)
(NASA-CR-159597; R79AEG625) Avail: NTIS HC A06/MF A01 CSCL 21E

The silicon carbide composites evaluated consisted of Si/SiC and sintered silicon carbide as substrates, both with attached surface layers containing BN as an additive. A total of twenty-eight candidates with variations in substrate type and density, and layer chemistry, density, microstructure, and thickness were evaluated for abradability, cold particle erosion resistance, static oxidation resistance, ballistic impact resistance, and fabricability. BN-free layers with variations in density and pore size were later added for evaluation. The most promising candidates were evaluated for Mach 1.0 gas oxidation/erosion resistance from 1477 K (2200 F) to 1644 K (2500 F). The as-fabricated rub layers did not perform satisfactorily in the gas oxidation/erosion tests. However, preoxidation was found to be beneficial in improving the hot gas erosion resistance. Overall, the laboratory and rig test evaluations show that material properties are suitable for 1477 K (2200 F) gas turbine seal applications. Further improvements are needed in hot gas erosion resistance and abradability to demonstrate feasibility to 1644 K (250 F). A.R.H.

N80-14123*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC RESPONSE OF A MACH 2.5 AXISYMMETRIC INLET AND TURBOJET ENGINE WITH A POPPET-VALUE CONTROLLED INLET STABILITY BYPASS SYSTEM WHEN SUBJECTED TO INTERNAL AND EXTERNAL AIRFLOW TRANSIENTS
Bobby W. Sanders Washington Jan. 1980 102 p refs
(NASA-TP-1531; E-9467) Avail: NTIS HC A06/MF A01 CSCL 21E

The throat of a Mach 2.5 inlet that was attached to a turbojet engine was fitted with a poppet-valve-controlled stability bypass system that was designed to provide a large, stable airflow range. Propulsion system response and stability bypass performance were determined for several transient airflow disturbances, both internal and external. Internal airflow disturbances included reductions in overboard bypass airflow, power lever angle, and primary-nozzle area as well as compressor stall. For reference, data are also included for a conventional, fixed-exit bleed system. The poppet valves greatly increased inlet stability and had no adverse effects on propulsion system performance. Limited unstarted-inlet bleed performance data are presented. Author

N80-14124*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TURBOJET-EXHAUST-NOZZLE SECONDARY-AIRFLOW PUMPING AS AN EXIT CONTROL OF AN INLET-STABILITY BYPASS SYSTEM FOR A MACH 2.5 AXISYMMETRIC MIXED-COMPRESSION INLET
Bobby W. Sanders Jan. 1980 82 p refs
(NASA-TP-1532; E-9468) Avail: NTIS HC A05/MF A01 CSCL 21E

The throat of a Mach 2.5 inlet that was attached to a turbojet engine was fitted with large, porous bleed areas to provide a stability bypass system that would allow a large, stable airflow range. Exhaust-nozzle, secondary-airflow pumping was used as the exit control for the stability bypass airflow. Propulsion system response and stability bypass performance were obtained for several transient airflow disturbances, both internal and external. Internal airflow disturbances included reductions in overboard bypass airflow, power lever angle, and primary-nozzle area, as well as compressor stall. Nozzle secondary pumping as a stability bypass exit control can provide the inlet with a large stability margin with no adverse effects on propulsion system performance. Author

N80-14125*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF DEGREE OF FUEL VAPORIZATION UPON EMISSIONS FOR A PREMIXED PARTIALLY VAPORIZED COMBUSTION SYSTEM
Larry P. Cooper Jan. 1980 25 p refs
(NASA-TP-1582; E-010) Avail: NTIS HC A02/MF A01 CSCL 21E

An experimental and analytical study of the combustion of partially vaporized fuel-air mixtures was performed to assess the impact of the degree of fuel vaporization upon emissions for a premixing-prevaporizing flametube combustor. Data collected in this study showed near linear increases in nitric oxide emissions with decreasing vaporization at equivalence ratios of 0.6. For equivalence ratios of 0.72, the degree of vaporization had very little impact on nitric oxide emissions. A simple mechanism which accounts for the combustion of liquid droplets in partially vaporized mixtures was found to agree with the measured results with fair accuracy with respect to both trends and magnitudes.
Author

N80-14126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA BROAD-SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM: STATUS AND DESCRIPTION
James S. Fear 1979 14 p refs Presented at 25th Ann. Intern. Gas Turbine Conf., New Orleans, 9-13 Mar. 1980; sponsored by Am. Soc. of Mech. Engr.
(NASA-TM-79315; E-272) Avail: NTIS HC A02/MF A01 CSCL 21E

The program presented is a contracted effort to evolve and demonstrate the technology required to utilize broad-specification fuels in current and next generation commercial Conventional Takeoff and Landing aircraft engines, and to verify this technology in full-scale engine tests in 1983. The program consists of three phases: Combustor Concept Screening, Combustor Optimization Testing, and Engine Verification Testing. The development and screening of the combustion system designs for the CF6-80 engine and the JT9D-7 engine, respectively, in high-pressure sector test rigs are reported. M.M.M.

N80-14127*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
THE CF6 JET ENGINE PERFORMANCE IMPROVEMENT: NEW FRONT MOUNT
W. A. Fasching Dec. 1979 139 p refs
(Contract NAS3-20629)
(NASA-CR-159639; R79AEG366) Avail: NTIS HC A07/MF A01 CSCL 21E

The New Front Mount was evaluated in component tests including stress, deflection/distortion and fatigue tests. The test results demonstrated a performance improvement of 0.1% in cruise sfc, 16% in compressor stall margin and 10% in compressor stator angle margin. The New Front Mount hardware successfully completed 35,000 simulated flight cycles endurance testing.
Author

N80-14128*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LASER-OPTICAL BLADE TIP CLEARANCE MEASUREMENT SYSTEM
John P. Barranger and M. John Ford (Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) 13 Mar. 1979 10 p refs Proposed for presentation at 25th Ann. Intern. Gas Turbine Conf. and the 22d Ann. Fluids Engr. Conf., New Orleans, 9-13 Mar. 1980; sponsored by Am. Soc. of Mech. Engr.
(NASA-TM-81376) Avail: NTIS HC A02/MF A01 CSCL 21E

A laser-optical measurement system was developed to measure single blade tip clearances and average blade tip clearances between a rotor and its gas path seal in rotating component rigs and complete engines. The system is applicable to fan, compressor and turbine blade tip clearance measurements. The engine mounted probe is particularly suitable for operation in the extreme turbine environment. The measurement system consists of an optical subsystem, an electronic subsystem and a computing and graphic terminal. Bench tests and environmental tests were conducted to confirm operation at temperatures, pressures, and vibration levels typically encountered in an operating gas turbine engine. DOE

N80-14129*# Detroit Diesel Allison, Indianapolis, Ind.
STUDY OF TURBOPROP SYSTEMS RELIABILITY AND MAINTENANCE COSTS Final Report
Jun. 1978 304 p refs
(Contract NAS3-20057)
(NASA-CR-135192; EDR-9132) Avail: NTIS HC A14/MF A01 CSCL 21E

The overall reliability and maintenance costs (R&MC's) of past and current turboprop systems were examined. Maintenance cost drivers were found to be scheduled overhaul (40%), lack of modularity particularly in the propeller and reduction gearbox, and lack of inherent durability (reliability) of some parts. Comparisons were made between the 501-D13/54H60 turboprop system and the widely used JT8D turbofan. It was found that the total maintenance cost per flight hour of the turboprop was 75% higher than that of the JT8D turbofan. Part of this difference was due to propeller and gearbox costs being higher than those of the fan and reverser, but most of the difference was in the engine core where the older technology turboprop core maintenance costs were nearly 70 percent higher than for the turbofan. The estimated maintenance cost of both the advanced turboprop and advanced turbofan were less than the JT8D. The conclusion was that an advanced turboprop and an advanced turbofan, using similar cores, will have very competitive maintenance costs per flight hour. J.M.S.

N80-14130*# Avco Lycoming Div., Williamsport, Pa.
EXHAUST EMISSION REDUCTION FOR INTERMITTENT COMBUSTION AIRCRAFT ENGINES
R. N. Moffett Oct. 1979 114 p
(Contract NAS3-19754)
(NASA-CR-159757) Avail: NTIS HC A06/MF A01 CSCL 21E

Three concepts for optimizing the performance, increasing the fuel economy, and reducing exhaust emission of the piston aircraft engine were investigated. High energy-multiple spark discharge and spark plug tip penetration, ultrasonic fuel vaporization, and variable valve timing were evaluated individually. Ultrasonic fuel vaporization did not demonstrate sufficient improvement in distribution to offset the performance loss caused by the additional manifold restriction. High energy ignition and revised spark plug tip location provided no change in performance or emissions. Variable valve timing provided some performance benefit; however, even greater performance improvement was obtained through induction system tuning which could be accomplished with far less complexity. A.R.H.

N80-14131*# Universal Systems, Inc., Arlington, Va.
OBLIQUE DETONATION WAVE RAMJET
Richard B. Morrison Jan. 1980 87 p refs
(Contract NAS1-15344)
(NASA-CR-159192) Avail: NTIS HC A05/MF A01 CSCL 21E

Two conceptual designs of the oblique detonation wave ramjet are presented. The performance is evaluated for stoichiometric hydrogen-air equivalence ratios of phi = 1/3, 2/3 and 1 for a range of flight Mach numbers from 6 to 10. A.R.H.

N80-14132# Martin Marietta Aerospace, Denver, Colo.
PROPULSION OPTIONS FOR THE HI SPOT LONG ENDURANCE DRONE AIRSHIP Final Report, Nov. 1978 - Aug. 1979
William L. Marcy and Ralph O. Hookway 15 Sep. 1979 55 p refs
(Contract N62269-79-C-0204)
(AD-A074595; MCR-79-632; NADC-78193-60) Avail: NTIS HC A04/MF A01 CSCL 21/5

Airbreathing, monofueled, stored-energy, and solar-rechargeable propulsion systems have been studied for the HI SPOT Long Endurance Drone Airship, providing constant-level electrical power as well as variable aerodynamic thrust to maintain position in winds varying from 15 to 100 knots at high altitude. A hydrogen fueled airbreathing engine is optimum for mission lengths up to 30 days or more. GRA

N80-14133# Naval Postgraduate School, Monterey, Calif.
AN ADAPTATION AND VALIDATION OF A PRIMITIVE VARIABLE MATHEMATICAL MODEL FOR PREDICTING THE FLOWS IN TURBOJET TEST CELLS AND SOLID FUEL RAMJETS M.S. Thesis
Charles Albert Stevenson Jun. 1979 75 p refs
(AD-A074187) Avail: NTIS HC A04/MF A01 CSCL 21/5

An adaptation of a primitive variable, finite-difference computer program was accomplished in order to predict the non-reacting flow fields in turbojet test cells and the reacting flow fields in solid fuel ramjets. The study compares the predictions of the primitive variable computer model with an earlier computer model and empirical data. It was found that the new model reasonably predicted the flow fields in both geometries. In addition, the primitive variable model allowed simulation of test cell flows up to full engine throttle conditions and solid fuel ramjet flows which included an aft mixing chamber. GRA

N80-14134# ARO, Inc., Arnold Air Force Station, Tenn.
APPLICATION OF THE MULTISTAGE AXIAL-FLOW COMPRESSOR TIME-DEPENDENT MATHEMATICAL MODELING TECHNIQUE TO THE TF41-A-1 MODIFIED BLOCK 76 COMPRESSOR Final Report, Jan. 1978 - Mar. 1979
C. E. Chamblee AEDC Sep. 1979 99 p refs
(AD-A074478; AEDC-TR-79-39) Avail: NTIS HC A05/MF A01 CSCL 21/5

A one-dimensional, steady-state TF41-A-1 compressor mathematical model for stability assessment with undisturbed flow, and a three-dimensional time-dependent TF41-A-1 compressor mathematical model for analysis of distorted inflows and transient and dynamic disturbances were developed. Example problems and comparisons to experimental results are presented for both models. The problems using the one-dimensional, steady-state model consisted of determination of the steady-state stability limits (surge lines) with undisturbed flow for three distinct inlet guide vane schedules. Those problems using the three-dimensional, time-dependent model included determination of the stability limit (surge line) reduction caused by pure radial pressure inlet distortion, pure circumferential pressure, and pure circumferential temperature inlet distortion. The effects of rapid upward ramps of inlet temperature on compressor stability were also investigated. The TF41-A-1 compressor models computed the compressor stability limits with reasonable accuracy. GRA

N80-14135# Institut National des Sciences Appliquees, Lyon (France). Lab. de Mecanique de Structures.
ON THE USE OF VIBRATION SELF-DAMPING MATERIALS IN THE MANUFACTURE OF PARTS FOR ROTATING MACHINERY Final Report [UTILISATION DES MATERIAUX AMORTISSANTS POUR LA REALISATION D'ELEMENTS DE MACHINE TOURNANTE]
Michel Lalanne, Phillippe Trompette, David Jones, Johan DerHagopian, and Abdul Hommeida Oct. 1977 124 p refs In FRENCH
(Contract DGRST-75-7-0968)
Avail: NTIS HC A06/MF A01

The control of structural vibration in rotating pieces in the 400C to 600C temperature range by the utilization of damping materials was studied. The test facilities and measuring systems developed for this study are described, including the high temperature measurement of complex modes and frequencies. A computing method for rotating structures with structural damping which was developed in this study is presented, and applied to real cases, such as a stator vane (three dimensional behavior) and a motor element (axisymmetrical structure).
Author (ESA)

N80-14136*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMULATOR STUDY OF STALL/POST-STALL CHARACTERISTICS OF A FIGHTER AIRPLANE WITH RELAXED LONGITUDINAL STATIC STABILITY
Luat T. Nguyen, Marilyn E. Ogburn, William P. Gilbert, Kemper S. Kibler, Phillip W. Brown, and Perry L. Deal Washington Dec. 1979 226 p
(NASA-TP-1538; L-12854) Avail: NTIS HC A11/MF A01 CSCL 01C

A real-time simulation piloted was conducted to evaluate the high-angle-of-attack characteristics of a fighter configuration based on wind-tunnel testing of the F-16, with particular emphasis on the effects of various levels of relaxed longitudinal static stability. The aerodynamic data used in the simulation was conducted on the Langley differential maneuvering simulator, and the evaluation involved representative low-speed combat maneuvering. Results of the investigation show that the airplane with the basic control system was resistant to the classical yaw departure; however, it was susceptible to pitch departures induced by inertia coupling during rapid, large-amplitude rolls at low airspeed. The airplane also exhibited a deep-stall trim which could be flown into and from which it was difficult to recover. Control-system modifications were developed which greatly decreased the airplane susceptibility to the inertia-coupling departure and which provided a reliable means for recovering from the deep stall. Author

N80-14137*# Boeing Commercial Airplane Co., Seattle, Wash.
LINEAR SYSTEMS ANALYSIS PROGRAM, L224(QR). VOLUME 1: ENGINEERING AND USAGE Topical Report, Apr. 1978 - Oct. 1979
P. C. Shah and K. W. Heidergott Dec. 1979 180 p refs
(Contract NAS1-15346; BCS-G0061)
(NASA-CR-2861) Avail: NTIS HC A09/MF A01 CSCL 09B

The QR computer program is described as well as its use in classical control systems analysis and synthesis (root locus, time response, and frequency response). A.R.H.

N80-14138*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT CONTROL THROUGH THE TAFCOS AUTOMATIC FLIGHT CONTROL SYSTEM
William R. Wehrend, Jr. Dec. 1979 42 p refs
(NASA-TM-81152; A-7996) Avail: NTIS HC A03/MF A01 CSCL 01C

The set of flight control logic used in a recently completed flight test program to evaluate the total automatic flight control system (TAFCOS) with the controller operating in a fully automatic mode, was used to perform an unmanned simulation on an IBM 360 computer in which the TAFCOS concept was extended to provide a multilevel pilot interface. A pilot TAFCOS interface for direct pilot control by use of a velocity-control-wheel-steering mode was defined as well as a means for calling up conventional autopilot modes. It is concluded that the TAFCOS structure is easily adaptable to the addition of a pilot control through a stick-wheel-throttle control similar to conventional airplane controls. Conventional autopilot modes, such as airspeed-hold, altitude-hold, heading-hold, and flight path angle-hold, can also be included. A.R.H.

N80-14139*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ALTITUDE RESPONSE OF SEVERAL AIRPLANES DURING LANDING APPROACH
William H. Phillips Nov. 1979 39 p refs
(NASA-TM-80186) Avail: NTIS HC A03/MF A01 CSCL 01C

The response in altitude and pitching velocity of the shuttle and of four other airplanes during the landing approach is compared. The effects of airplane type, pitch damping, center-of-gravity location, lift coefficient, and cockpit position are presented. The reasons for the differences observed and the effects of these differences on control characteristics are discussed. A.R.H.

N80-14140# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
EXCITATION AND ANALYSIS TECHNIQUE FOR FLIGHT FLUTTER TESTS
G. Haidl and M. Steininger 8 Sep. 1978 27 p refs Presented at 47th SMP/AGARD Meeting, Florence, 24-29 Sep. 1978
(MBB-UF-1446(O)) Avail: NTIS HC A03/MF A01

Excitation methods applied recently for flight flutter testing are surveyed. Examples of excitation by frequency sweep, pseudo-random, harmonic oscillation, and control loop are given and their effectiveness and adaptation to digital processing is discussed. Experience gained in generating aerodynamic forces by control surfaces or additional vanes is reported. The digital analysis of flight flutter test data is then considered. Recommendations for selection of analysis parameters and how to avoid errors due to digital processing are given. For data evaluation in flight flutter tests the autopower spectrum as well as transfer and coherence functions are used. Errors and effects of digital blockwise computation with analysis procedures like block overlapping, windowing, averaging, or curve fitting are demonstrated. The filter correlation and the modal analysis technique are applied for mode separation and damping evaluation based on the above mentioned functions. Practical experience and examples from wind tunnel, flight, and laboratory tests are discussed. An online computer program is presented for realtime calculation of resonance frequencies and damping factors.
Author (ESA)

N80-14141# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
STABILITY AND CONTROL ASPECTS OF THE CCV-F104G
H. Beh, U. Korte, and G. Loebert Sep. 1978 33 p refs Presented at AGARD Flight Mech. Panel Meeting on Stability and Control, Ottawa, 25-28 Sept. 1978
(MBB-UFE-1447(O)) Avail: NTIS HC A03/MF A01

The CCV command system, its implementation, and the design of the control laws are described. The superior flight-mechanical performance of the CCV flight control system is compared with that of the basic F 104G on the basis of simulator results. The validity of these results is demonstrated by comparing the principal characteristics of longitudinal and lateral motion measured in flight with the corresponding predicted values. Author (ESA)

N80-14142# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
INVESTIGATION OF THE OSCILLATORY AND FLIGHT BEHAVIOR OF ROTOR SYSTEMS IN RELATION WITH ATMOSPHERIC TURBULENCE [UNTERSUCHUNGEN ZUM SCHWINGUNGS- UND FLUGVERHALTEN VON HUBSCHRAUBERN UNTER ATMOSPHAERISCHER TURBULENZ]
H. Dahl and D. Weger 1979 72 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(BMVG-FBWT-79-5) Avail: NTIS HC A04/MF A01; DOKZENTBw, Bonn DM 30

The effects of stochastic atmospheric disturbances on the performance of various helicopter rotor systems was investigated in order to determine their gust sensitivity. A statistical description of turbulent excitations which permits sufficiently accurate simulation of helicopter oscillatory behavior resulting from gust disturbances was developed. Results show that during low altitude flight and slow speed flight the gust vector distribution over the helicopter is very nonuniform. At any instant therefore, the individual rotor blades are affected by very different gust velocities which leads to different responses of the blades. In conclusion, the investigations pursue the important objective of elaborating and clarifying possibilities for improvement of the flight characteristics of the investigated rotor systems, in so far as the inclusion of special gust reduction systems on helicopters is possible and profitable. Author (ESA)

N80-14143# European Space Agency, Paris (France).
FLIGHT TESTING OF THE BUFFETING BEHAVIOR OF COMBAT AIRCRAFT
G. Redeker Feb. 1979 44 p refs Transl. into ENGLISH of "Flugversuche zum Buffeting-Verhalten von Kampfflugzeugen", Rep. DFVLR-FB-IB-151-78/6 DFVLR, Brunswick, 18 Dec. 1979
(ESA-TT-523; DFVLR-FB-IB-151-78/6) Avail: NTIS HC A03/MF A01

The flight testing of buffeting behavior in combat aircraft is reviewed. After a description of the buffeting phenomenon and its effects on the pilot and the performance of a combat aircraft, flight testing techniques from several American reports are discussed. Author (ESA)

N80-14144# Federal Aviation Administration, Washington, D. C.
REFLECTION CRACKING OF BITUMINOUS OVERLAYS FOR AIRPORT PAVEMENTS: A STATE OF THE ART Final Report
Aston L. McLaughlin May 1979 91 p refs
(AD-A073484; FAA-RD-79-57; ARD-430) Avail: NTIS HC A05/MF A01 CSCL 13/2

Methods and practices pursued by various pavement authorities in an effort to reduce the incidence of reflection cracking of bituminous overlays are discussed. The theoretical, analytical and laboratory efforts in this connection are presented. The mechanics of reflection cracking and criteria for design of overlay systems which are resistant to reflection cracking are examined.
A.W.H.

N80-14147# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
INVESTIGATION OF NOISE HAZARDS IN THE ENGINE TEST CELL, CFB BADEN-SOELLINGEN
S. E. Forshaw Jun. 1979 22 p refs
(AD-A074391; DCIEM-TR-79-X23) Avail: NTIS HC A02/MF A01 CSCL 21/5

Although the sound pressure levels occuring in the engine test cell, CFB Baden-Soellingen, are extremely intense (137 dBA) with a J79 engine running at military power, the attenuation provided by Canadian Forces standard-issue earmuffs is sufficient to reduce the noise at operators' ears to more tolerable levels (108 dBA). Moreover, the noise doses sustained during engine check-outs permit average work periods of up to 49 minutes per day in the test cell with engines running. GRA

N80-14199# Avco Systems Div., Wilmington, Mass.
PROTECTIVE COATINGS FOR AIRCRAFT COMPOSITES IN NUCLEAR ENVIRONMENTS Final Report, 1 Jan. - 30 Nov. 1977
J. G. Alexander and P. J. Grady 1 Apr. 1978 168 p refs
(Contract DNA001-77-C-0098)
(AD-A074889; AD-E300594; AVSD-0082-78-RR; DNA-4735F) Avail: NTIS HC A08/MF A01 CSCL 11/3

This program selected and experimentally evaluated several classes of protective coatings for nuclear flash for application on graphite epoxy and quartz polyimide composite aircraft skins. An analytical/experimental assessment was also performed to demonstrate the increased tensile capability of the two composite materials with the application of selected coatings. GRA

N80-14256# Lockheed-Georgia Co., Marietta.
AIRCRAFT FUEL SYSTEM SIMULATOR TESTS WITH ANTIMISTING KEROSENE (JET A FUEL WITH FM-9 ADDITIVE) Final Report, Oct. 1978 - May 1979
R. E. Pardue May 1979 50 p
(Contract DOT-FA78WAI-925)
(AD-A073237; FAA-RD-79-52) Avail: NTIS HC A03/MF A01 CSCL 21/4

Tests were conducted on a full-scale C-141 aircraft fuel system simulator to evaluate system and component operation using antimisting kerosene fuels (Jet A fuel with FM-9 additive). A typical aircraft flight profile was simulated with the tank-to-engine fuel feed system operating. Tests were also conducted to evaluate the tank quantity gaging system accuracy, tank refuel valve operation and fuel transfer ejector operation. Fuels tested included Jet A, .30% FM-9 AMK, .35% FM-9 AMK and .40% FM-9 AMK. Flammability tests were conducted on selected fuel samples to evaluate degradation caused by the above tests.
Author

N80-14259# Naval Research Lab., Washington, D. C.
MICROBIAL DETERIORATION OF HYDROCARBON FUELS FROM OIL SHALE, COAL, AND PETROLEUM. 1: EXPLORATORY EXPERIMENTS Interim Report
Marian E. May and Rex A. Neihof 20 Aug. 1979 28 p refs
(ZF57571004)
(AD-A073761; AD-E000316; NRL-MR-4060) Avail: NTIS HC A03/MF A01 CSCL 21/4

As part of the Navy's program on alternative sources of hydrocarbon fuel, the susceptibility to microbial deterioration of JP-5 derived from oil shale and coal (referred to as synthetic fuels) was investigated and compared with that of petroleum JP-5. Six fungi, including three strains of Cladosporium resinae, a yeast (Candida) and a bacterium (Pseudomonas) which normally grow well in association with petroleum JP-5 were used as test organisms in two-phase systems containing fuel/aqueous media. Most of the test organisms were inhibited to various extents in the presence of the synthetic fuels. An exception was a Fusarium species (fungus) which grew equally well under all three fuels. In mixtures of 75% petroleum and 25% synthetic fuels, microbial growth was generally equivalent to that in 100% petroleum JP-5. A search was made among samples of soil, creosoted wood and tree resins for microorganisms that could thrive in the presence of synthetic fuels. This endeavor produced a strain of C. resinae that grew as well with oil shale JP-5 as with petroleum JP-5. These exploratory experiments indicate that microorganisms adapted to growth with conventional petroleum fuel tend to be inhibited by synthetic fuels, but that organisms probably exist in nature which can readily adapt to and grow in the presence of synthetic fuels. GRA

N80-14303# Logicon, Inc., San Diego, Calif. Tactical and Training Systems Div.
VOCABULARY SPECIFICATION FOR AUTOMATIC SPEECH RECOGNITION IN AIRCRAFT COCKPITS Final Report, Sep. 1978 - Jun. 1979
Rohn J. Petersen, Nancey Lee, Catherine Meyn, Elaine Regelson, and William Satzer 31 Aug. 1979 92 p refs
(Contract N00014-78-C-0692)
(AD-A073703) Avail: NTIS HC A05/MF A01 CSCL 17/2

The general focus of this research was to design a communication media (a vocabulary) that is advantageous to both machine recognition and human production of speech events. The problem was analyzed from a human factors perspective that centered upon the man-computer dialogue (interaction) required for cockpit application of ASR. The results indicated that phrase familiarity and stimulus familiarity had major impact on the learning and utilization of the phrases in the paired-associate task. Phrase length and meaningfulness did not appear to differentially affect either the learning or utilization of the paired associate. In addition, pretraining of stimulus familiarity did not seem to result in improved performance. Acoustic lexical confusability also was discussed in general methodological terms. The results of the study were interpreted in terms of a contextualist viewpoint with the necessity of a broader contextual manipulation being pointed out as a requirement for further research. GRA

N80-14325# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
TARGET TRACKING USING DOPPLER-INFORMATION IN SENSOR ORIENTED COORDINATES WITH A THREE DIMENSIONAL ARRAY RADAR
G. vanKeuk Aug. 1978 33 p refs In GERMAN; ENGLISH summary
(Rept-270) Avail: NTIS HC A03/MF A01

Measurement statistics, expressed in three dimensional radar oriented coordinates, and the nonlinear equations of target motion are presented. An extended Kalman filter was developed to solve the problem of automatic target tracking. It consists of three decoupled filters, one of which processes Doppler information directly. Depending on target speed, distance, and flight direction of the object being tracked, the domain of applicability for the proposed method is derived. Doppler information is then used to improve the plot to track correlation. It is shown that this information is very sensitive for detecting target maneuvers in an adaptive tracing mechanism.
Author (ESA)

N80-14355*# Wisconsin Univ. - Milwaukee.
UNSTEADY FLOW AND DYNAMIC RESPONSE ANALYSES FOR HELICOPTER ROTOR BLADES Final Progress Report, 2 Jan. 1971 - 30 Jun. 1979
Theodore Bratanow Nov. 1979 30 p refs
(Grant NGR-50-007-001)
(NASA-CR-159190) Avail: NTIS HC A03/MF A01 CSCL 02A

Research is presented on helicopter rotor blade vibration and on two and three dimensional analyses of unsteady incompressible viscous flow past oscillating helicopter rotor blades. A summary is presented of the two international research collaborations which resulted from the NASA project: the collaboration under the auspices of NATO between the University of Wisconsin-Milwaukee, University of Brussels, Belgium and the

N80-14359*# Bionetics Corp., Hampton, Va.
THE TRANSFER OF CARBON FIBERS THROUGH A COMMERCIAL AIRCRAFT WATER SEPARATOR AND AIR CLEANER

Jerome A. Meyers Nov. 1979 22 p refs
(Contract NAS1-15238)
(NASA-CR-159183) Avail: NTIS HC A02/MF A01 CSCL 20D

The fraction of carbon fibers passing through a water separator and an air filter was determined in order to estimate the proportion of fibers outside a closed aircraft that are transmitted to the electronics through the air conditioning system. When both devices were used together and only fibers 3 mm or larger were considered, a transfer function of .001 was obtained. K.L.

N80-14377# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
US ARMY TEST AND EVALUATION COMMAND TEST OPERATIONS PROCEDURES: PHOTOGRAPHIC AND VIDEO IMAGE SUPPORT AVIATION MATERIEL Final Report

17 Aug. 1979 16 p refs
(AD-A074883; TOP-7-3-519) Avail: NTIS HC A02/MF A01 CSCL 14/5

Photographic techniques can be utilized to obtain precise data in relation to time velocity, rates and characteristics of a developmental test event or simply to document a physical defect, deficiency or shortcoming in a human factors evaluation. This document provides requirements, suggestions and techniques for incorporating photographic coverage into the developmental test of aviation materiel. GRA

N80-14400*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SURFACE CONFORMING THERMAL/PRESSURE SEAL Patent Application

Martin L. Stevens, inventor (to NASA) (Fairchild Republic Co.) Filed 12 Dec. 1979 21 p Sponsored by NASA
(NASA-Case-MSC-18422-1; US-Patent-Appl-SN-102593) Avail: NTIS HC A02/MF A01 CSCL 11A

A sealing apparatus is described which serves both pressure and thermal sealing functions between adjacent and relatively movable elements of relatively large surfaces. The sealing apparatus has the flexibility required for large movable surfaces, and can accommodate moderate variations in the gap between such surfaces which may be affected by thermal distortion. Sealing is accomplished with a nonabrasive, low frictional material, creating as little resistance as possible to movement of control members and minimal wear and damage to surface coatings. NASA

N80-14417# AiResearch Mfg. Co., Phoenix, Ariz.
CONTACT STRESS ANALYSIS OF CERAMIC-TO-METAL INTERFACES Final Report

David G. Finger 21 Sep. 1979 35 p refs
(Contract N00014-78-C-0547)
(AD-A074491; AiResearch-21-3239) Avail: NTIS HC A03/MF A01 CSCL 14/2

The objective of this proposed 8-month program was to conduct analysis, specimen testing, and data correlation to provide an improved understanding of the local contact conditions that prevail at an interface between ceramic and metal components for gas turbine engines. The program was specifically directed to study contact stresses at the interface between inserted ceramic turbine blades (hot-pressed silicon nitride) and a metal rotor, but the method of analysis, results, and conclusions also provided a better understanding of contact stresses at ceramic-to-metal and ceramic-to-ceramic interfaces for static components. A finite-element stress analysis procedure and structural evaluation technique consistent with the statistical nature of ceramic materials was generated. Specimen testing was conducted to obtain validation of these techniques and provide insight as to possible modifications of stress simulation or fracture prediction criteria. The objective was to develop a design methodology, which will improve on current design methods, thus permitting the design of interface configurations in which strengths more indicative of the inherent strength of ceramic materials can be realized. GRA

N80-14422# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
REVIEW OF INVESTIGATIONS INTO AERONAUTICS RELATED FATIGUE FEDERAL REPUBLIC OF GERMANY Status Report, May 1977 - Apr. 1979

D. Schutz and O. Buxbaum 1979 166 p refs Presented at 16th Conf. of Intern. Comm. Aeron. Fatigue, Brussels, 1979
(LBF-S-142; ICAF-CONF-1979) Avail: NTIS HC A08/MF A01

Investigations into fatigue and fatigue related disciplines, as they regard aeronautics, are reviewed. Studies treated are limited to those carried out in the Federal Republic of Germany. Subjects include measurement and analysis of operational loads, fatigue behavior of joints and notched specimens, fatigue life prediction, cyclic stress-strain behavior, and low cycle fatigue. Also considered are crack propagation, fracture mechanics, and residual static strength. Fatigue of fiber reinforced plastics and hybrid structures as well as some investigations of general interest with and without relation to aircraft are reported on. Finally, a bibliography of fatigue related documents by German authors is given. Author (ESA)

N80-14634*# Saint Cloud State Coll., Minn.
METEOROLOGICAL INPUT TO GENERAL AVIATION PILOT TRAINING

John R. Colomy *In* Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems Apr. 1979 p 30-36

Avail: NTIS HC A09/MF A01 CSCL 04B

The meteorological education of general aviation pilots is discussed in terms of the definitions and concepts of learning and good educational procedures. The effectiveness of the metoeorological program in the training of general aviations pilots is questioned. It is suggested that flight instructors provide real experience during low ceilings and visibilities, and that every pilot receiving an instrument rating should experience real instrument flight. F.O.S.

N80-14636*# National Transportation Safety Board, Washington, D. C.
ACCIDENT INVESTIGATION

Alan I. Brunstein *In* Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems Apr. 1979 p 46-57

Avail: NTIS HC A09/MF A01 CSCL 04B

Aircraft accident investigations are discussed with emphasis on those accidents that involved weather as a contributing factor. The organization of the accident investigation board for air carrier accidents is described along with the hearings, and formal report preparation. Statistical summaries of the investigations of general aviation accidents are provided. F.O.S.

N80-14638*# Port Columbus International Airport, Ohio.
EFFECT OF WEATHER CONDITIONS ON AIRPORT OPERATIONS

Daniel F. Ginty *In* Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems Apr. 1979 p 63-66

Avail: NTIS HC A09/MF A01 CSCL 04B

The effect of adverse weather on airport operations are discussed. The meteorological conditions discussed included rain and hydroplaning, snow and slush, and icing. F.O.S.

N80-14639*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF SPANWISE GUST VARIATIONS
John C. Houbolt *In* Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems Apr. 1979 p 72-79

Avail: NTIS HC A09/MF A01 CSCL 04B

The spanwise, vertical force, and rolling moment effects of random gusts encountered by aircraft are analyzed. Mathematical models are given for approximating atmospheric turbulence. F.O.S.

N80-14640*# South Dakota School of Mines and Technology, Rapid City.
THE T-28 THUNDER/HAILSTORM PENETRATION AIRCRAFT
John Prodan *In* Tennessee Univ. Space Inst. Proc., 3d Ann. Workshop on Meteorological and Environ. Inputs to Aviation Systems Apr. 1979 p 80-97

Avail: NTIS HC A09/MF A01 CSCL 04B

Modifications to the T-28 Aircraft to make it safe for penetrating hailstorms to take scientific measurements are described. F.O.S.

N80-14651*# Tennessee Univ. Space Inst., Tullahoma.
CURRENT RESEARCH ON AVIATION WEATHER (BIBLIOGRAPHY), 1979
Barry S. Turkel and Walter Frost Jan. 1980 96 p refs (Contract NAS8-32692)
(NASA-CR-3214) Avail: NTIS HC A05/MF A01 CSCL 04B

The titles, managers, supporting organizations, performing organizations, investigators and objectives of 127 current research projects in advanced meteorological instruments, forecasting, icing, lightning, visibility, low level wind shear, storm hazards/severe storms, and turbulence are tabulated and cross-referenced. A list of pertinent reference material produced through the above tabulated research activities is given. The acquired information is assembled in bibliography form to provide a readily available source of information in the area of aviation meteorology. A.R.H.

N80-14853# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THE ANALYSIS OF SOUND PROPAGATION IN JET ENGINE DUCTS USING THE FINITE DIFFERENCE METHOD Interim Report, Nov. 1975 - Nov. 1978
Dennis W. Quinn Jun. 1979 60 p refs
(AD-A074233; AFFDL-TR-79-3063) Avail: NTIS HC A04/MF A01 CSCL 20/1

In this report, the author derives the partial differential equations which describe sound propagation in jet engine ducts and then presents a finite difference approach for solving these equations. Also included is a computer program listing, sample input and sample output. The program can handle uniform rectangular and cylindrical ducts with or without uniform flow. In addition, if a mapping function which maps a nonuniform duct to a uniform duct is specified, the program can determine sound fields in nonuniform ducts in the absence of flow. GRA

N80-14870*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Aeroacoustics Branch.
APPLICATIONS OF DIFFRACTION THEORY TO AEROACOUSTICS
Donald L. Lansing, Chen-Huei Liu, and Thomas D. Norum *In* AGARD Special Course on Acoustic Wave Propagation Aug. 1979 12 p refs
Avail: NTIS HC A10/MF A01 CSCL 20A

The fundamentals of diffraction theory were reviewed and applied to several problems of aircraft noise generation, propagation, and measurement. The general acoustic diffraction problem is defined and the governing equations were set down. Diffraction phenomena are illustrated using the classical problem of the diffraction of a plane wave by a half-plane. Infinite series and geometric acoustic methods for solving diffraction problems are described. Four applications of diffraction theory are discussed: the selection of an appropriate shape for a microphone, the use of aircraft wings to shield the community from engine noise, the reflection of engine noise from an aircraft fuselage, and the radiation of trailing edge noise. K.L.

N80-14873*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Inst. for Computer Application in Science and Engineering.
EXPERIMENTAL AND NUMERICAL RESULTS OF SOUND SCATTERING BY A BODY
L. Maestrello and A. Bayliss *In* AGARD Special Course on Acoustic Wave Propagation Aug. 1979 12 p refs

Avail: NTIS HC A10/MF A01 CSCL 20A

The interaction of aerodynamic noise with a fuselage shaped body is discussed. A numerical technique is presented which permits the computation of the scattering of an acoustic source by a body at rest for frequencies of aeroacoustic interest. A parallel experiment is described which confirms the results of the computations. A numerical study of varying the geometry of the scattering is presented. In addition, the effect of forward motion on the mean velocity and static pressure profiles in the wake of such a body with a jet exiting from it is simulated. Experimental results are presented and a similarity law is given. K.L.

N80-14876# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
AEROACOUSTIC MEASURING TECHNIQUES IN OR OUTSIDE TURBULENT FLOWS
Helmut V. Fuchs *In* AGARD Special Course on Acoustic Wave Propagation Aug. 1979 27 p refs

Avail: NTIS HC A10/MF A01

The motion of aerodynamic or acoustic sources relative to the fluid and/or the measuring instrument is discussed. Some practically important effects on the pressure and velocity fields in and outside the active source region are deduced from linearized wave equations with simple source functions. Limitations on fluctuating aerodynamic and acoustic pressure measuring techniques employing special microphone probes are discussed. Applications include: (1) the pressure pulsations induced in the near fields of jet, wake, and duct flows; and (2) the effects of source convection and forward speed on the far field radiation characteristics of jets or other aeroacoustic sources in motion. K.L.

N80-15026# Department of Defence, Canberra (Australia).
AERONAUTICAL RESEARCH LABORATORIES Annual Report, 1977 - 1978
1978 95 p refs
(RM78/30107) Avail: NTIS HC A05/MF A01

Research and development in the areas of aerodynamic configurations and aeronautical engineering for design purposes and/or operational aspects of aircrafts is presented. Wind tunnel tests, materials tests, engine tests, and aircraft structural analysis are discussed. A.W.H.

N80-15028*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
LANDING APPROACH AIRFRAME NOISE MEASUREMENTS AND ANALYSIS
Paul L. Lasagna, Karen G. Mackall, Frank W. Burcham, Jr., and Terrill W. Putnam Jan. 1980 36 p refs
(NASA-TP-1602) Avail: NTIS HC A03/MF A01 CSCL 20A

Flyover measurements of the airframe noise produced by the AeroCommander, JetStar, CV-990, and B-747 airplanes are presented for various landing approach configurations. Empirical

and semiempirical techniques are presented to correlate the measured airframe noise with airplane design and aerodynamic parameters. Airframe noise for the jet-powered airplanes in the clean configuration (flaps and gear retracted) was found to be adequately represented by a function of airplane weight and the fifth power of airspeed. Results show the airframe noise for all four aircraft in the landing configuration (flaps extended and gear down) also varied with the fifth power of airspeed, but this noise level could not be represented by the addition of a constant to the equation for clean-configuration airframe noise. M.G.

N80-15029# Boeing Aerospace Co., Seattle, Wash.
FLEET HARDNESS VARIATION Final Report, Jan. - Sep. 1978
E. N. York and S. L. Strack 29 Sep. 1978 45 p refs
(Contract DNA001-78-C-0138)
(AD-A074849; AD-E300588) Avail: NTIS HC A03/MF A01 CSCL 01/3

The variation of nuclear hardness in a fleet of aircraft is considered and the potential hardness degradation mechanisms identified. These include cracks, corrosion, paint deterioration, and aging of equipment. Methods are developed whereby the variation in hardness in a fleet could be estimated for each of these degradation mechanisms. GRA

N80-15030# Technology, Inc., Dayton, Ohio. Instruments and Controls Div.
APPLICATION OF THE SIRS CONCEPT TO NAVY HELICOPTERS
1 Oct. 1979 112 p refs
(Contract N00019-77-C-0318)
(AD-A074801; TI-0798-05-02) Avail: NTIS HC A06/MF A01 CSCL 01/3

In an effort to determine the feasibility of applying the U.S. Army-developed SIRS recording system to U.S. Navy helicopters, a study was conducted into the specific application of SIRS on the RH-53D helicopter. A fatigue damage assessment model was formulated for nine fatigue-critical dynamic components of the RH-53D helicopter, and two possible flight condition monitoring systems were synthesized. Both systems were found to be technically acceptable, but only one was practical based on current recording technology. The resulting system was analyzed from a life-cycle cost viewpoint and found to be cost-effective. GRA

N80-15031*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTER PROGRAM TO PREPARE AIRFOIL CHARACTERISTIC DATA FOR USE IN HELICOPTER PERFORMANCE CALCULATIONS
Henry E. Jones Dec. 1977 57 p
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-78627; L-11608) Avail: NTIS HC A04/MF A01 CSCL 01A

A computer program developed to prepare wind tunnel generated airfoil data for input into helicopter performance prediction programs is described. The program provides for numerically cross plotting the data, plotting the data, and tabulating and punching the tabulated result into computer cards for use in the rotorcraft flight simulation model. A.W.H.

N80-15034*# National Advisory Committee for Aeronautics. Ames Aeronautical Lab., Moffett Field, Calif.
APPLICATIONS OF MODERN HYDRODYNAMICS TO AERONAUTICS. PART 1: FUNDAMENTAL CONCEPTS AND THE MOST IMPORTANT THEOREMS. PART 2: APPLICATIONS
L. Prandtl *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 1-56 refs Transl. into ENGLISH of unidentified German document

(NACA-116) Avail: NTIS HC A14/MF A01 CSCL 01A

A discussion of the principles of hydrodynamics of nonviscous fluids in the case of motion of solid bodies in a fluid is presented. Formulae are derived to demonstrate the transition from the fluid surface to a corresponding 'control surface'. The external forces are compounded of the fluid pressures on the control surface and the forces which are exercised on the fluid by any solid bodies which may be inside of the control surfaces. Illustrations of these formulae as applied to the acquisition of transformations from a known simple flow to new types of flow for other boundaries are given. Theoretical and experimental investigations of models of airship bodies are presented. M.M.M.

N80-15036*# National Advisory Committee for Aeronautics. Ames Aeronautical Lab., Moffett Field, Calif.
PRESSURE DISTRIBUTION ON JOUKOWSKI WINGS
Otto Blumenthal *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 67-83 ref Transl. into ENGLISH from Z. fuer Flugtech. und Motorluftschiffahrt (Germany), 31 May 1913 16 p
(NACA-TM-336) Avail: NTIS HC A14/MF A01 CSCL 01A

The hydrodynamics and mathematical models as applied to the potential flow about a Joukowski wing are presented. M.M.M.

N80-15038*# National Advisory Committee for Aeronautics. Ames Aeronautical Lab., Moffett Field, Calif.
THE MINIMUM INDUCED DRAG OF AEROFOILS
Max M. Munk *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 95-110

(NACA-121) Avail: NTIS HC A14/MF A01 CSCL 01A

Equations are derived to demonstrate which distribution of lifting elements result in a minimum amount of aerodynamic drag. The lifting elements were arranged (1) in one line, (2) parallel lying in a transverse plane, and (3) in any direction in a transverse plane. It was shown that the distribution of lift which causes the least drag is reduced to the solution of the problem for systems of airfoils which are situated in a plane perpendicular to the direction of flight. M.M.M.

N80-15039*# National Advisory Committee for Aeronautics. Ames Aeronautical Lab., Moffett Field, Calif.
THE AERODYNAMIC FORCES ON AIRSHIP HULLS
Max M. Munk *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 111-126 refs

(NACA-184) Avail: NTIS HC A14/MF A01 CSCL 01A

The new method for making computations in connection with the study of rigid airships, which was used in the investigation of Navy's ZR-1 by the special subcommittee of the National Advisory Committee for Aeronautics appointed for this purpose is presented. The general theory of the air forces on airship hulls of the type mentioned is described and an attempt was made to develop the results from the very fundamentals of mechanics. M.M.M.

N80-15040*# National Advisory Committee for Aeronautics. Ames Aeronautical Lab., Moffett Field, Calif.
ELEMENTS OF THE WING SECTION THEORY AND OF THE WING THEORY
Max M. Munk *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 127-149 refs

(NACA-191) Avail: NTIS HC A14/MF A01 CSCL 01A

Results are presented of the theory of wings and of wing sections which are of immediate practical value. They are proven and demonstrated by the use of the simple conceptions of kinetic energy and momentum only. M.M.M.

N80-15046*# National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, Va.
GENERAL POTENTIAL THEORY OF ARBITRARY WING SECTIONS
Theodore Theodorsen and I. E. Garrick *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 257-289 refs
(NACA-452) Avail: NTIS HC A14/MF A01 CSCL 01A

The problem of determining the two dimensional potential flow around wing sections of any shape is examined. The problem is condensed into the compact form of an integral equation capable of yielding numerical solutions by a direct process. An attempt is made to analyze and coordinate the results of earlier studies relating to properties of wing sections. The existing approximate theory of thin wing sections and the Joukowski theory with its numerous generalizations are reduced to special cases of the general theory of arbitrary sections, permitting a clearer perspective of the entire field. The method which permits the determination of the velocity at any point of an arbitrary section and the associated lift and moments is described. The method is also discussed in terms for developing new shapes of preassigned aerodynamical properties. A.W.H.

N80-15047*# National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, Va.
GENERAL THEORY OF AERODYNAMIC INSTABILITY AND THE MECHANISM OF FLUTTER
Theodore Theodorsen *In* NASA. Ames Res. Center Classical Aerodyn. Theory Dec. 1979 p 291-311

(NACA-496) Avail: NTIS HC A14/MF A01 CSCL 01A

The aerodynamic forces on an oscillating airfoil or airfoil-aileron combination of three independent degrees of freedom were determined. The problem resolves itself into the solution of certain definite integrals, which were identified as Bessel functions of the first and second kind, and of zero and first order. The theory, based on potential flow and the Kutta condition, is fundamentally equivalent to the conventional wing section theory relating to the steady case. The air forces being known, the mechanism of aerodynamic instability was analyzed. An exact solution, involving potential flow and the adoption of the Kutta condition, was derived. The solution is of a simple form and is expressed by means of an auxiliary parameter k. The flutter velocity, treated as the unknown quantity, was determined as a function of a certain ratio of the frequencies in the separate degrees of freedom for any magnitudes and combinations of the airfoil-aileron parameters. A.W.H.

N80-15050*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PARAMETRIC WING DESIGN STUDY FOR A MODERN LAMINAR FLOW WING
John A. Koegler, Jr. Dec. 1979 44 p refs
(NASA-TM-80154) Avail: NTIS HC A03/MF A01 CSCL 01A

The results of a parametric wing design study using a modern laminar flow airfoil designed to exhibit desirable stall characteristics while maintaining high cruise performance are presented. It was found that little is sacrificed in cruise performance when satisfying the stall margin requirements if a taper ratio of 0.65 or greater is used. M.G.

N80-15051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF ADVANCED METHODS FOR PREDICTING HIGH SPEED PROPELLER PERFORMANCE
L. A. Bober 1980 14 p refs Presented at 18th Aerospace Sci. Meeting, Pasadena, Calif., 14-16 Jan. 1980; sponsored by AIAA
(NASA-TM-81409) Avail: NTIS HC A02/MF A01 CSCL 01A

Three advanced analyses for predicting aircraft propeller performance at high subsonic speeds are described. Two of these analyses use a lifting line representation for the propeller blades and vortex filaments for the blade wakes but differ in the details of the solution. The third analysis is a finite difference solution of the unsteady, three dimensional Euler equations for the flow between adjacent blades. Analysis results are compared to data for a high speed propeller having eight swept blades integrally designed with the spinner and nacelle. Author

N80-15052*# Boeing Commercial Airplane Co., Seattle, Wash.
A USERS GUIDE FOR A344: A PROGRAM USING A FINITE DIFFERENCE METHOD TO ANALYZE TRANSONIC FLOW OVER OSCILLATING AIRFOILS Final Report
Warren H. Weatherill and F. Edward Ehlers Nov. 1979 65 p refs
(Contract NAS1-15128)
(NASA-CR-159141; D6-48837) Avail: NTIS HC A04/MF A01 CSCL 01A

The design and usage of a pilot program for calculating the pressure distributions over harmonically oscillating airfoils in transonic flow are described. The procedure used is based on separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady differential equations for small disturbances. The steady velocity potential which must be obtained from some other program, was required for input. The unsteady equation, as solved, is linear with spatially varying coefficients. Since sinusoidal motion was assumed, time was not a variable. The numerical solution was obtained through a finite difference formulation and either a line relaxation or an out of core direct solution method. R.C.T.

N80-15055# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF THE AERODYNAMIC CHARACTERISTICS OF A 1/20-SCALE A-10 MODEL AT MACH NUMBERS FROM 0.30 TO 0.75 Final Report
Phillip L. Yeakley AEDC Sep. 1979 90 p refs
(AF Proj. 329A)
(AD-A074867; AEDC-TR-78-66; AFATL-TR-78-103) Avail: NTIS HC A05/MF A01 CSCL 20/4

A 1/20-scale model of the A-10 aircraft was tested to determine the aerodynamic and control characteristics of the basic aircraft, evaluate the effect of external store configurations on the static stability and drag characteristics of the aircraft, and investigate the effects of Reynolds number, boundary layer transition grit, and aerodynamic hysteresis on the data. Data were obtained at angles of attack from -4 to 20 deg and at sideslip angles from -10 to 10 deg. The Mach number range was from 0.30 to 0.75, and the Reynolds number range was from 0.7 to 4.9 million per foot. GRA

N80-15058*# Dayton Univ. Research Inst., Ohio.
A FIRST LOOK AT THE EFFECT OF SEVERE RAINFALL UPON AN AIRCRAFT
Jan. 1980 34 p refs
(Grant NsG-6026)
(NASA-CR-162569) Avail: NTIS HC A03/MF A01 CSCL 01C

An aircraft penetrating heavy rain can be affected aerodynamically in at least four ways: (1) raindrops striking the fuselage and wings of the aircraft impart a downward momentum to the aircraft; (2) increased aircraft drag results from the aircraft striking the raindrops head on; (3) at any instant of time the aircraft will contain a thin layer of water over most of its surfaces which will give additional mass to the aircraft; and (4) the water on the airfoil will result in a roughened airfoil surface that could produce significant aerodynamic penalties. An order of magnitude calculation was made for the penalty associated with the factors one two and three. The roughness factor required detailed modeling and boundary layer calculations and was studied using the 'aerodynamic effects of frost model'. The results achieved on each of the penalty factors are described and the factors most likely to cause significant performance degradation are indicated. R.E.S.

N80-15059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SIMULTANEOUS CABIN AND AMBIENT OZONE MEASUREMENTS ON TWO BOEING 747 AIRPLANES, VOLUME 1

Porter J. Perkins, J. D. Holdeman, and G. D. Nastrom (Control Data Corp., Minneapolis, Minn.) Jul. 1979 826 p refs
(NASA-TM-79166; FAA-EE-79-05; E-196) Avail: NTIS HC A99/MF A01 CSCL 01C

Measurements of zone concentrations both outside and in the cabin of an airline operated Boeing 747SP and Boeing 747-100 airliner are presented. Plotted data and the corresponding tables of observations taken at altitude between the departure and destination airports of each flight are arranged chronologically for the two aircraft. Data were taken at five or ten minute intervals by automated instrumentation used in the NACA Global Atmospheric Sampling Program. M.M.M.

N80-15060*# National Aeronautics and Space Administration, Washington, D. C.

NASA TECHNICAL ADVANCES IN AIRCRAFT OCCUPANT SAFETY

John H. Enders 1978 28 p refs Presented at the SAE Congr. and Exposition, Detroit, 27 Feb. - 3 Mar. 1978
(NASA-TM-80851; ISSN-0148-7191) Avail: NTIS HC A03/MF A01 CSCL 01C

NASA's aviation safety technology program examines specific safety problems associated with atmospheric hazards, crash-fire survival, control of aircraft on runways, human factors, terminal area operations hazards, and accident factors simulation. While aircraft occupants are ultimately affected by any of these hazards, their well-being is immediately impacted by three specific events: unexpected turbulence encounters, fire and its effects, and crash impact. NASA research in the application of laser technology to the problem of clear air turbulence detection, the development of fire resistant materials for aircraft construction, and to the improvement of seats and restraint systems to reduce crash injuries are reviewed. A.R.H.

N80-15061# General Accounting Office, Washington, D. C. Community and Economic Development Div.

AIRCRAFT DELAYS AT MAJOR US AIRPORTS CAN BE REDUCED

4 Sep. 1979 36 p refs
(PB-299442/4; CED-79-102) Avail: NTIS HC A03/MF A01 CSCL 01E

In 1977, aircraft delays cost U.S. airlines over $800 million; detained the traveling public over 60 million hours; and caused the airlines to use an additional 700 million gallons of fuel, over 8 percent of their total consumption. Generally, aircraft delays result from excessive air traffic and bad weather. Many major U.S. airports have peak, congested periods when air traffic exceeds runway capacity and aircraft delays occur. To reduce delays at major airports, the Congress and Secretary of Transportation should take actions to shift traffic from peak to off-peak periods or to other airports by amending the Airport and Airway Development Act of 1970. GRA

N80-15062*# Magnavox Government and Industrial Electronics Co., Torrance, Calif. Advanced Products Div.

DESIGN STUDY OF A LOW COST CIVIL AVIATION GPS RECEIVER SYSTEM Final Report

R. Cnossen and G. Gilbert (GAC Assoc.) Dec. 1979 150 p refs
(Contract NAS1-15343)
(NASA-CR-159176; R-6132) Avail: NTIS HC A07/MF A01 CSCL 17G

A low cost Navstar receiver system for civil aviation applications was defined. User objectives and constraints were established. Alternative navigation processing design trades were evaluated. Receiver hardware was synthesized by comparing technology projections with various candidate system designs. A control display unit design was recommended as the result of field test experience with Phase I GPS sets and a review of special human factors for general aviation users. Areas requiring technology development to ensure a low cost Navstar Set in the 1985 timeframe were identified. R.C.T.

N80-15063*# Ohio Univ., Athens. Avionics Engineering Center.

EXPERIMENTAL LOOP ANTENNAS FOR 60 KHz TO 200 KHz

Ralph W. Burhans Dec. 1979 9 p refs
(Grant NGR-36-009-017)
(NASA-CR-162729; TM-71) Avail: NTIS HC A02/MF A01 CSCL 17G

The design and design data for broadband loop antenna systems are presented. An investigation of some simple systems for possible Loran C receivers which require a bandwidth of greater than 20 KHz is discussed. Designs are presented for a 60 KHz WWVB antenna, several Loran C variations, and some 1750 meter band antennas. Signals received on all these, including one airborne experiment where a Loran C receiver gave the correct time difference reading within 1 microsecond while flying on a straightline course are examined. The phase reversal in the Loran C when the direction of travel changes 180 degrees is discussed and possible corrections are studied. A.W.H.

N80-15064*# Ohio Univ., Athens. Avionics Engineering Center.

DATA REDUCTION SOFTWARE FOR LORAN-C FLIGHT TEST EVALUATION

Joseph P. Fischer Dec. 1979 43 p refs
(Grant NGR-36-009-017)
(NASA-CR-162730; TM-72) Avail: NTIS HC A03/MF A01 CSCL 17G

A set of programs designed to be run on an IBM 370/158 computer to read the recorded time differences from the tape produced by the LORAN data collection system, convert them to latitude/longitude and produce various plotting input files are described The programs were written so they may be tailored easily to meet the demands of a particular data reduction job. The tape reader program is written in 370 assembler language and the remaining programs are written in standard IBM FORTRAN-IV language. The tape reader program is dependent upon the recording format used by the data collection system and on the I/O macros used at the computing facility. The other programs are generally device-independent, although the plotting routines are dependent upon the plotting method used. The data reduction programs convert the recorded data to a more readily usable form; convert the time difference (TD) numbers to latitude/longitude (lat/long), to format a printed listing of the TDs, lat/long, reference times, and other information derived from the data, and produce data files which may be used for subsequent plotting. M.M.M.

N80-15065*# Ohio Univ., Athens. Avionics Engineering Center.
LORAN DIGITAL PHASE-LOCKED LOOP AND RF FRONT-END SYSTEM ERROR ANALYSIS
Daryl L. McCall Dec. 1979 19 p
(Grant NGR-39-009-017)
(NASA-CR-162731; TM-73) Avail: NTIS HC A02/MF A01 CSCL 17G

An analysis of the system performance of the digital phase locked loops (DPLL) and RF front end that are implemented in the MINI-L4 Loran receiver is presented. Three of the four experiments deal with the performance of the digital phase locked loops. The other experiment deals with the RF front end and DPLL system error which arise in the front end due to poor signal to noise ratios. The ability of the DPLLs to track the offsets is studied.

N80-15067*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA/ARMY XV-15 TILT ROTOR RESEARCH AIRCRAFT WIND-TUNNEL TEST PROGRAM PLAN
James A. Weiberg and Martin D. Maisel (AVRADCOM Res. and Technol. Labs.) Mar. 1979 73 p refs
(NASA-TM-78562; A-7740; AVRADCOM-TR-79-7(AM)) Avail: NASA. Ames Research Center, Moffett Field, Calif. 94035 CSCL 01C

To ensure that the XV-15 tilt rotor research aircraft will meet the requirements of the program plan and the contract model specification and statement of work, one of the two aircraft will be tested in the Ames 40 x 80 foot wind tunnel to provide an initial assessment of the aerodynamic characteristics, structural loads, and rotor/pylon/wing dynamics in a simulated flight environment for correlation with estimated values. The tests will also serve to verify the functional operation of the aircraft systems and on-board instrumentation in a flight environment. The management structure, operational plan, support requirements and responsibilities, safety provisions and reporting requirements for conduct of the wind tunnel tests are defined and related to other phases of the program. A.R.H.

N80-15068*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
LOADING TESTS OF A WING STRUCTURE FOR A HYPERSONIC AIRCRAFT
Roger A. Fields, Lawrence F. Reardon, and William H. Siegel Jan. 1980 72 p refs
(NASA-TP-1596; H-1046) Avail: NTIS HC A04/MF A01 CSCL 01C

Room-temperature loading tests were conducted on a wing structure designed with a beaded panel concept for a Mach 8 hypersonic research airplane. Strain, stress, and deflection data were compared with the results of three finite-element structural analysis computer programs and with design data. The test program data were used to evaluate the structural concept and the methods of analysis used in the design. A force stiffness technique was utilized in conjunction with load conditions which produced various combinations of panel shear and compression loading to determine the failure envelope of the buckling critical beaded panels. The force-stiffness data did not result in any predictions of buckling failure. It was, therefore, concluded that the panels were conservatively designed as a result of design constraints and assumptions of panel eccentricities. The analysis programs calculated strains and stresses competently. Comparisons between calculated and measured structural deflections showed good agreement. The test program offered a positive demonstration of the beaded panel concept subjected to room-temperature load conditions. Author

N80-15069*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF MOTION AND g-SEAT CUES ON PILOT SIMULATOR PERFORMANCE OF THREE PILOTING TASKS
Thomas W. Showalter and Benton L. Parris Jan. 1980 45 p refs
(NASA-TP-1601; A-7875) Avail: NTIS HC A03/MF A01 CSCL 01C

Data are presented that show the effects of motion system cues, g-seat cues, and pilot experience on pilot performance during takeoffs with engine failures, during in-flight precision turns, and during landings with wind shear. Eight groups of USAF pilots flew a simulated KC-135 using four different cueing systems. The basic cueing system was a fixed-base type (no-motion cueing) with visual cueing. The other three systems were produced by the presence of either a motion system or a g-seat, or both. Extensive statistical analysis of the data was performed and representative performance means were examined. These data show that the addition of motion system cueing results in significant improvement in pilot performance for all three tasks; however, the use of g-seat cueing, either alone or in conjunction with the motion system, provides little if any performance improvement for these tasks and for this aircraft type. Author

N80-15070*# Lockheed-Georgia Co., Marietta.
EXPLORATORY STUDIES OF THE CRUISE PERFORMANCE OF UPPER SURFACE BLOWN CONFIGURATION: EXPERIMENTAL PROGRAM, HIGH-SPEED FORCE TESTS
J. A. Braden, J. P. Hancock, K. P. Burdges, and J. E. Hackett Langley Res. Center, Hampton, Va. NASA Oct. 1979 231 p refs
(Contract NAS1-13871)
(NASA-CR-159134; LG77ER0028) Avail: NTIS HC A11/MF A01 CSCL 01C

The work to develop a wing-nacelle arrangement to accommodate a wide range of upper surface blown configuration is reported. Pertinent model and installation details are described. Data of the effects of a wide range of nozzle geometric variations are presented. Nozzle aspect ratio, boattail angle, and chordwise position are among the parameters investigated. Straight and swept wing configurations were tested across a range of nozzle pressure ratios, lift coefficients, and Mach numbers. F.O.S.

N80-15071*# Lockheed-Georgia Co., Marietta.
EXPLORATORY STUDIES OF THE CRUISE PERFORMANCE OF UPPER SURFACE BLOWN CONFIGURATIONS: EXPERIMENTAL PROGRAM, HIGH-SPEED PRESSURE TESTS
J. A. Braden, J. P. Hancock, K. P. Burdges, and J. E. Hackett Langley Res. Center, Hampton, Va. NASA Oct. 1979 226 p refs
(Contract NAS1-13871)
(NASA-CR-159135; LG77ER0028) Avail: NTIS HC A11/MF A01 CSCL 01C

Basic pressure data are presented which was obtained from an experimental study of upper-surface blown configurations at cruise. The high-speed (subsonic) experimental work, studying the aerodynamic effects of wing-nacelle geometric variations, was conducted around semi-span model configurations composed of diversified, interchangeable components. Power simulation was provided by high-pressure air ducted through closed forebody nacelles. Nozzle geometry was varied across size, exit aspect ratio, exit position and boattail angle. Both 3-D force and 2-D pressure measurements were obtained at cruise Mach numbers from 0.5 to 0.8 and at nozzle pressure ratios up to about 3.0. The experimental investigation was supported by an analytical synthesis of the system using a vortex lattice representation with first-order power effects. Results are also presented from a compatibility study in which a short-haul transport is designed on the basis of the aerodynamic findings in the experimental study as well as acoustical data obtained in a concurrent program. High-lift test data are used to substantiate the projected performance of the selected transport design. Author

N80-15072*# Lockheed-Georgia Co., Marietta.
EXPLORATORY STUDIES OF THE CRUISE PERFORMANCE OF UPPER SURFACE BLOWN CONFIGURATIONS: PROGRAM ANALYSIS AND CONCLUSIONS

J. A. Braden, J. P. Hancock, J. E. Hackett, and V. Lyman Langley Res. Center, Hampton, Va. NASA Oct. 1979 349 p refs (Contract NAS1-13871)
(NASA-CR-159136; LG77ER0028) Avail: NTIS HC A15/MF A01 CSCL 01C

The experimental data encompassing surface pressure measurements, and wake surveys at static and wind-on conditions are analyzed. Cruise performance trends reflecting nacelle geometric variations, and nozzle operating conditions are presented. Details of the modeling process are included. F.O.S.

N80-15073*# Rockwell International Corp., El Segundo, Calif.
ANALYSES AND TESTS OF THE B-1 AIRCRAFT STRUCTURAL MODE CONTROL SYSTEM Final Report
John H. Wykes, Thomas R. Byar, Cary J. MacMiller, and David C. Greek Jan. 1980 268 p refs
(Contract NAS4-2519)
(NASA-CR-144887; H-1109; NA-79-405) Avail: NTIS HC A12/MF A01 CSCL 01C

Analyses and flight tests of the B-1 structural mode control system (SMCS) are presented. Improvements in the total dynamic response of a flexible aircraft and the benefits to ride qualities, handling qualities, crew efficiency, and reduced dynamic loads on the primary structures, were investigated. The effectiveness and the performance of the SMCS, which uses small aerodynamic surfaces at the vehicle nose to provide damping to the structural modes, were evaluated. R.E.S.

N80-15074*# Lockheed-California Co., Burbank.
HYPERSONIC CRUISE AIRCRAFT PROPULSION INTEGRATION STUDY, VOLUME 1 Final Report, Jun. 1978 - Sep. 1979
R. E. Morris and G. D. Brewer Sep. 1979 96 p ref
(Contract NAS1-15057)
(NASA-CR-158926-Vol-1; LR-28651-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 01C

A hypersonic cruise transport conceptual design is described. The integration of the subsonic, supersonic, and hypersonic propulsion systems with the aerodynamic design of the airframe is emphasized. An evaluation of various configurations of aircraft and propulsion integration concepts, and selection and refinement of a final design are given. This configuration was used as a baseline to compare two propulsion concepts - one using a fixed geometry dual combustion mode scramjet and the other a variable geometry ramjet engine. Both concepts used turbojet engines for takeoff, landing and acceleration to supersonic speed. R.C.T.

N80-15075*# Lockheed-California Co., Burbank.
HYPERSONIC CRUISE AIRCRAFT PROPULSION INTEGRATION STUDY, VOLUME 2 Final Report, Jun. 1978 - Sep. 1979
R. E. Morris and G. D. Brewer Sep. 1979 244 p refs
(Contract NAS1-15057)
(NASA-CR-158926-Vol-2; LR-28651-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 01C

Conceptual vehicle configuration and propulsion approach for a Mach 6 transport aircraft capable of carring 200 passengers 9260 km was investigated. Wind tunnel test data for various hypersonic transport configurations were examined. Canidates for baseline reference vehicles were selected. An explanation of technical methods which were used and configuration details which were significant in the final vehicle concept are given. R.C.T.

N80-15076*# Rensselaer Polytechnic Inst., Troy, N. Y.
COMPOSITE STRUCTURAL MATERIALS Semiannual Report, Apr. - Sep. 1979
George S. Ansell, Robert G. Loewy, and Stephen E. Wiberly Dec. 1979 107 p refs Sponsored in part by AFOSR
(Grant NGL-33-018-003)
(NASA-CR-162578; SAR-37) Avail: NTIS HC A06/MF A01 CSCL 01C

A multifaceted program is described in which aeronautical, mechanical, and materials engineers interact to develop composite aircraft structures. Topics covered include: (1) the design of an advanced composite elevator and a proposed spar and rib assembly; (2) optimizing fiber orientation in the vicinity of heavily loaded joints; (3) failure mechanisms and delamination; (4) the construction of an ultralight sailplane; (5) computer-aided design; finite element analysis programs, preprocessor development, and array preprocessor for SPAR; (6) advanced analysis methods for composite structures; (7) ultrasonic nondestructive testing; (8) physical properties of epoxy resins and composites; (9) fatigue in composite materials, and (10) transverse thermal expansion of carbon/epoxy composites. A.R.H.

N80-15077# Boeing Vertol Co., Philadelphia, Pa.
CH-46 COMPOSITE ROTOR BLADE FLIGHT STRESS SURVEY DATA. VOLUME 3: PLOTTED FORWARD ROTOR BLADE CHORD, TORSION AND ABSOLUTE LOADS
R. Aiello and J. Bendo 1978 324 p refs
(Contract N00019-75-C-0396)
(AD-A075612; D210-11168-3-Vol-3) Avail: NTIS HC A14/MF A01 CSCL 01/3

Data plots are presented of flight stress tests performed on the CH-46 aircraft composite rotor blades. M.M.M.

N80-15078# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
AIRCRAFT ANTI-ICING/DE-ICING Final Report
31 Aug. 1979 21 p
(AD-A074128; TOP-7-3-528) Avail: NTIS HC A02/MF A01 CSCL 01/3

This document provides information, methodology and techniques necessary to plan, conduct and document a development test of an aircraft anti-icing/de-icing system. A development test of an aircraft anti-icing/de-icing system will determine the degree to which a subject system and its associated documentation, tools and auxiliary equipment meets the requirements of the Army Materiel Needs documents. GRA

N80-15079# Textron Bell Helicopter, Fort Worth, Tex.
ANALYSIS OF LOW-SPEED HELICOPTER FLIGHT TEST DATA Final Report, Mar. 1977 - Mar. 1979
James L. Tangler Aug. 1979 145 p refs
(Contract DAAJ02-77-C-0022; DA Proj. 1L2-62209-AH-76)
(AD-A074141; BHT-699-099-103; USARTL-TR-79-19) Avail: NTIS HC A07/MF A01 CSCL 01/3

The purpose of this study was to investigate the aerodynamic behavior of a helicopter rotor operating in the low-speed flight regime, particularly in the nap-of-the-Earth (NOE) evasive mode. The effort consisted of reducing and analyzing existing AH-1G flight test response data acquired for simulated NOE flight under contract DAAJ02-73-C-0105. Specific areas of interest analyzed in this study include blade/vortex interaction at 50 knots and angle-of-attack data derived from hot-wire measurements taken in hover. GRA

N80-15080# Naval Air Test Center, Patuxent River, Md.
JA-6A CIRCULATION CONTROL WING CONTRACTOR FLIGHT DEMONSTRATION
R. W. Boyd 28 Aug. 1979 25 p refs
(AD-A074888; NATC-TM-79-2-SA) Avail: NTIS HC A02/MF A01 CSCL 01/3

A Circulation Control Wing (CCW) Flight Demonstrator was designed and built by Grumman Aerospace Corporation (GAC) using a modified A-6A airplane. The design was a joint effort by David Taylor Naval Ship Research and Development Center (DTNSRDC) and GAC based on research originated by DTNSRDC. The airplane demonstrated significant STOL potential. Compared to the basic A-6A airplane, takeoff and landing roll distances were improved by 36% and 43%, respectively. Maximum CL was increased by 80%. Some Handling Qualities problems are discussed. The CCW concept was shown to be a viable, simple, and powerful STOL tool for use in future designs. GRA

N80-15081# Army Research and Technology Labs., Fort Eustis, Va.
MODEL 540 ROTOR BLADE CRACK PROPAGATION INVESTIGATION Final Report, Jan. - Feb. 1978

Danny E. Good Aug. 1979 35 p refs
(DA Proj. 1F2-62209-AH-76)
(AD-A074734; USARTL-TR-79-26) Avail: NTIS
HC A03/MF A01 CSCL 01/3

The rate of crack propagation from an induced defect in a metal Bell Helicopter 540 main rotor blade was investigated. A controlled crack front was introduced into the top surface of the blade spar. Fatigue testing was conducted at maximum level flight loads and the crack growth was monitored. Experimental data was then compared with analytical predictions to measure the ability to predict crack growth characteristics. GRA

N80-15082# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
VISUAL ACCOMMODATION RESPONSES IN A VIRTUAL IMAGE ENVIRONMENT Phase Report
Gloria Twine Chisum and Phyllis E. Morway 1979 15 p refs
(WR041010101)
(AD-A074415; NADC-79213-60) Avail: NTIS
HC A02/MF A01 CSCL 05/5

The virtual images generated for helmet mounted displays and head-up displays are reflected by beam splitters to the eyes of a user. The influence of the beam splitters, with and without images reflected, on the accommodation responses of observers was measured utilizing an eyetracker which continuosly monitored the accommodation response. The results indicate that the presence of the beam splitter aids in maintaining accommodation at or near infinity. GRA

N80-15083*# General Electric Co., Washington, D. C. Aircraft Engine Group.
DEMONSTRATION OF SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES ON A TWENTY INCH (50.8 cm) DIAMETER FAN, VOLUME 1
D. L. Stimpert and R. A. McFalls May 1975 131 p refs
3 Vol.
(Contract NAS3-18021)
(NASA-CR-134849; R75AEG252-Vol-1) Avail: NTIS
HC A07/MF A01 CSCL 21E

Tests of a 20 inch diameter, low tip speed, low pressure ratio fan which investigated aft fan noise reduction techniques are reported. These techniques included source noise reduction features of selection of vane-blade ratio to reduce second harmonic noise, spacing effects, and lowering the Mach number through a vane row. Aft suppression features investigated included porosity effects, variable depth treatment, and treatment regenerated flow noise. Initial results and selected comparisons are presented.
J.M.S.

N80-15084*# General Electric Co., Washington, D. C. Aircraft Engine Group.
DEMONSTRATION OF SHORT-HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES ON A TWENTY INCH (50.8) DIAMETER FAN, VOLUME 2
D. L. Stimpert Apr. 1975 307 p 3 Vol.
(Contract NAS3-18021)
(NASA-CR-134850; R75AEG252-Vol-2) Avail: NTIS
HC A14/MF A01 CSCL 21E

Aft fan noise reduction techniques were investigated. The 1/3 octave band sound data were plotted with the following plots included: perceived noise level vs acoustic angle at 2 fan speeds; PWL vs frequency at 2 fan speeds; and sound pressure level vs frequency at 2 aft angles and 2 fan speeds. The source noise plots included: band pass filter sound pressure level vs acoustic angle at 2 fan speeds; and 2nd harmonic SPL acoustic angle at 2 fan speeds. R.C.T.

N80-15085*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
DEMONSTRATION OF SHORT HAUL AIRCRAFT AFT NOISE REDUCTION TECHNIQUES ON A TWENTY INCH (50.8 cm) DIAMETER FAN, VOLUME 3
D. L. Stimpert Apr. 1975 725 p 3 Vol.
(Contract NAS3-18021)
(NASA-CR-134851; R75AEG252-Vol-3) Avail: NTIS
HC A99/MF A01 CSCL 21E

Tests of a twenty inch diameter, low tip speed, low pressure ratio fan which investigated aft fan noise reduction techniques are reported. The 1/3 octave band sound data are presented for all the configurations tested. The model data are presented on 17 foot arc and extrapolated to 200 foot sideline. J.M.S.

N80-15086*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER THE WING (OTW) DESIGN REPORT Final Report
Jun. 1977 530 p
(Contract NAS3-18021)
(NASA-CR-134848; R75AEG443) Avail: NTIS
HC A23/MF A01 CSCL 21E

The design, fabrication, and testing of two experimental high bypass geared turbofan engines and propulsion systems for short haul passenger aircraft are described. The propulsion technology required for future externally blown flap aircraft with engines located both under the wing and over the wing is demonstrated. Composite structures and digital engine controls are among the topics included. R.C.T.

N80-15087*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). AERODYNAMIC AND AEROMECHANICAL PERFORMANCE OF A 50.8 cm (20 INCH) DIAMETER 1.34 PR VARIABLE PITCH FAN WITH CORE FLOW
R. G. Giffin, R. A. McFalls, and B. F. Beacher Aug. 1977 133 p refs
(Contract NAS3-18021)
(NASA-CR-135017; R75AEG445) Avail: NTIS
HC A07/MF A01 CSCL 21E

The fan aerodynamic and aeromechanical performance tests of the quiet clean short haul experimental engine under the wing fan and inlet with a simulated core flow are described. Overall forward mode fan performance is presented at each rotor pitch angle setting with conventional flow pressure ratio efficiency fan maps, distinguishing the performance characteristics of the fan bypass and fan core regions. Effects of off design bypass ratio, hybrid inlet geometry, and tip radial inlet distortion on fan performance are determined. The nonaxisymmetric bypass OGV and pylon configuration is assessed relative to both total pressure loss and induced circumferential flow distortion. Reverse mode performance, obtained by resetting the rotor blades through both the stall pitch and flat pitch directions, is discussed in terms of the conventional flow pressure ratio relationship and its implications upon achievable reverse thrust. Core performance in reverse mode operation is presented in terms of overall recovery levels and radial profiles existing at the simulated core inlet plane. Observations of the starting phenomena associated with the initiation of stable rotor flow during acceleration in the reverse mode are briefly discussed. Aeromechanical response characteristics of the fan blades are presented as a separate appendix, along with a description of the vehicle instrumentation and method of data reduction. R.C.T.

N80-15088*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) PRELIMINARY UNDER THE WING FLIGHT PROPULSION SYSTEM ANALYSIS REPORT
D. F. Howard Feb. 1976 261 p refs
(Contract NAS3-18021)
(NASA-CR-134868; R75AEG349) Avail: NTIS
HC A12/MF A01 CSCL 21E

The preliminary design and installation of high bypass, geared turbofan engine with a composite nacelle forming the propulsion system for a short haul passenger aircraft are described. The technology required for externally blown flap aircraft with under the wing (UTW) propulsion system installations for introduction into passenger service in the mid 1980's is included. The design, fabrication, and testing of this UTW experimental engine containing the required technology items for low noise, fuel economy, with composite structure for reduced weight and digital engine control are provided. R.C.T.

N80-15089*# General Electric Co., Cincinnati, Ohio. Group Engineering Div.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). THE AERODYNAMIC AND MECHANICAL DESIGN OF THE QCSEE OVER-THE-WING FAN
Apr. 1976 98 p
(Contract NAS3-18021)
(NASA-CR-134915) Avail: NTIS HC A05/MF A01 CSCL 21E

The aerodynamic and mechanical design of a fixed-pitch 1.36 pressure ratio fan for the over-the-wing (OTW) engine is presented. The fan has 28 blades. Aerodynamically, the fan blades were designed for a composite blade, but titanium blades were used in the experimental fan as a cost savings measure. R.E.S.

N80-15090*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING ENGINE DIGITAL CONTROL SYSTEM DESIGN REPORT
Jan. 1978 321 p refs
(Contract NAS3-18021)
(NASA-CR-134920; R75AEG483) Avail: NTIS HC A14/MF A01 CSCL 21E

A digital electronic control was combined with conventional hydromechanical components to operate the four controlled variables on the under-the-wing engine: fuel flow, fan blade pitch, fan exhaust area, and core compressor stator angles. The engine and control combination offers improvements in noise, pollution, thrust response, operational monitoring, and pilot workload relative to current engines. R.E.S.

N80-15091*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING ENGINE SIMULATION REPORT
Jul. 1977 103 p refs
(Contract NAS3-18021)
(NASA-CR-134914; R75AEG444) Avail: NTIS HC A06/MF A01 CSCL 21E

Hybrid computer simulations of the under-the-wing engine were constructed to develop the dynamic design of the controls. The engine and control system includes a variable pitch fan and a digital electronic control. Simulation results for throttle bursts from 62 to 100 percent net thrust predict that the engine will accelerate 62 to 95 percent net thrust in one second. R.E.S.

N80-15092*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING CONTROL SYSTEM DESIGN REPORT
Dec. 1977 249 p refs
(Contract NAS3-18021)
(NASA-CR-135337; R77AEG664) Avail: NTIS HC A11/MF A01 CSCL 21E

A control system incorporating a digital electronic control was designed for the over-the-wing engine. The digital electronic control serves as the primary controlling element for engine fuel flow and core compressor stator position. It also includes data monitoring capability, a unique failure indication and corrective action feature, and optional provisions for operating with a new type of servovalve designed to operate in response to a digital-type signal and to fail with its output device hydraulically locked into position. R.E.S.

N80-15093*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). CORE ENGINE NOISE MEASUREMENTS
H. D. Sowers and W. E. Coward Dec. 1977 52 p ref
(Contract NAS3-18021)
(NASA-CR-135160; R75AEG511) Avail: NTIS HC A04/MF A01 CSCL 21E

Noise measurements were taken on a turbofan engine which uses the same core, with minor modifications, employed on the quiet clean short-haul experimental engine (QCSEE) propulsion systems. Both nearfield and farfield noise measurements were taken in order to determine the core internally generated noise levels. The resulting noise measurements were compared to predicted combustor and turbine noise levels, to verify or improve the predicted QCSEE combustor and turbine noise levels. Author

N80-15094*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Engineering Div.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) ENGINE COMPOSITE NACELLE TEST REPORT. VOLUME 1: SUMMARY, AERODYNAMIC AND MECHANICAL PERFORMANCE
Apr. 1979 214 p refs
(Contract NAS3-18021)
(NASA-CR-159471; R78AEG573-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 21E

The performance test results of the final under-the-wing engine configuration are presented. One hundred and six hours of engine operation were completed, including mechanical and performance checkout, baseline acoustic testing with a bellmouth inlet, reverse thrust testing, acoustic technology tests, and limited controls testing. The engine includes a variable pitch fan having advanced composite fan blades and using a ball-spline pitch actuation system. R.E.S.

N80-15095*# General Electric Co., Cincinnati, Ohio. Group Engineering Div.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) PRELIMINARY OVER-THE-WING FLIGHT PROPULSION SYSTEM ANALYSIS REPORT
D. F. Howard Jun. 1977 174 p refs
(Contract NAS3-18021)
(NASA-CR-135296; R77AEG305) Avail: NTIS HC A08/MF A01 CSCL 21E

The preliminary design of the over-the-wing flight propulsion system installation and nacelle component and systems design features of a short-haul, powered lift aircraft are presented. Economic studies are also presented and show that high bypass, low pressure ratio turbofan engines have the potential of providing an economical propulsion system for achieving the very quiet aircraft noise level of 95 EPNdB on a 152.4 m sideline. R.E.S.

N80-15096*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). UNDER-THE-WING (UTW) ENGINE BOILERPLATE NACELLE TEST REPORT, VOLUME 1 Summary Report
31 Dec. 1977 65 p 3 Vol.
(Contract NAS3-18021)
(NASA-CR-135249; R77AEG2121-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 21E

The design and testing of high bypass geared turbofan engines with nacelles forming the propulsion systems for short haul passenger aircraft are considered. The test results demonstrate the technology required for externally blown flap aircraft for introduction into passenger service in the 1980's. The equipment tested is described along with the test facility and instrumentation. A chronological history of the test and a summary of results are given. J.M.S.

N80-15097*# General Electric Co., Cincinnati, Ohio. Advanced Engneering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). UNDER-THE-WING (UTW) ENGINE BOILERPLATE NACELLE TEST REPORT. VOLUME 3: MECHANICAL PERFORMANCE
31 Dec. 1977 128 p refs 3 Vol.
(Contract NAS3-18021)
(NASA-CR-135251; R77AEG212-Vol-3) Avail: NTIS HC A07/MF A01 CSCL 21E

Results of initial tests of the under the wing experimental engine and boilerplate nacelle are presented. The mechanical performance of the engine is reported with emphasis on the advanced technology components. Technology elements of the propulsion system covered include: system dynamics, composite fan blades, reduction gear, lube and accessory drive system, fan frame, inlet, core cowl cooling, fan exhaust nozzle, and digital control system. J.M.S.

N80-15098*# General Electric Co., Cincinnati, Ohio.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). COMPOSITE FAN FRAME SUBSYSTEM TEST REPORT
C. L. Stotler, Jr. and J. H. Bowden Sep. 1977 71 p
(Contract NAS3-18021)
(NASA-CR-135010; R76AEG233) Avail: NTIS
HC A04/MF A01 CSCL 21E

The element and subcomponent testing conducted to verify the composite fan frame design of two experimental high bypass geared turbofan engines and propulsion systems for short haul passenger aircraft is described. Emphasis is placed on the propulsion technology required for future externally blown flap aircraft with engines located both under the wing and over the wing, including technology in composite structures and digital engine controls. The element tests confirmed that the processes used in the frame design would produce the predicted mechanical properties. The subcomponent tests verified that the detail structural components of the frame had adequate structural integrity. J.M.S.

N80-15099*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING (OTW) BOILERPLATE NACELLE DESIGN REPORT
May 1977 78 p
(Contract NAS3-18021)
(NASA-CR-135168; R77AEG300) Avail: NTIS
HC A05/MF A01 CSCL 21E

A summary of the mechanical design of the boiler plate nacelle for the QCSEE over the wing (OTW) engine is presented. The nacelle, which features a D-shaped nozzle/thrust reverser and interchangeable hard wall and acoustic panels, is utilized in the engine testing to establish the aerodynamic and acoustic requirements for nozzles and reversers of this type. J.M.S.

N80-15100*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) COMPOSITE NACELLE SUBSYSTEM TEST REPORT
C. L. Stotler, Jr., E. A. Johnston, and D. S. Freeman Jul. 1977 83 p refs
(Contract NAS3-18021)
(NASA-CR-135075; R76AEG420) Avail: NTIS
HC A05/MF A01 CSCL 21E

The element and subcomponent testing conducted to verify the under the wing composite nacelle design is reported. This composite nacelle consists of an inlet, outer cowl doors, inner cowl doors, and a variable fan nozzle. The element tests provided the mechanical properties used in the nacelle design. The subcomponent tests verified that the critical panel and joint areas of the nacelle had adequate structural integrity. J.M.S.

N80-15101*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). BALL SPLINE PITCH CHANGE MECHANISM DESIGN REPORT
Apr. 1978 73 p refs
(Contract NAS3-18021)
(NASA-CR-134873; R77AEG327) Avail: NTIS
HC A04/MF A01 CSCL 21E

Detailed design parameters are presented for a variable-pitch change mechanism. The mechanism is a mechanical system containing a ball screw/spline driving two counteracting master bevel gears meshing pinion gears attached to each of 18 fan blades. R.E.S.

N80-15102*# General Electric Co., Cincinnati, Ohio.
ACOUSTIC ANALYSIS OF AFT NOISE REDUCTION TECHNIQUES MEASURED ON A SUBSONIC TIP SPEED 50.8 cm (TWENTY INCH) DIAMETER FAN
D. L. Stimpert and A. Clemons Jan. 1977 149 p refs
(Contract NAS3-18021)
(NASA-CR-134891; R75AEG368) Avail: NTIS
HC A07/MF A01 CSCL 21E

Sound data which were obtained during tests of a 50.8 cm diameter, subsonic tip speed, low pressure ratio fan were analyzed. The test matrix was divided into two major investigations: (1) source noise reduction techniques; and (2) aft duct noise reduction with acoustic treatment. Source noise reduction techniques were investigated which include minimizing second harmonic noise by varying vane/blade ratio, variation in spacing, and lowering the Mach number through the vane row to lower fan broadband noise. Treatment in the aft duct which includes flow noise effects, faceplate porosity, rotor OGV treatment, slant cell treatment, and splitter simulation with variable depth on the outer wall and constant thickness treatment on the inner wall was investigated. Variable boundary conditions such as variation in treatment panel thickness and orientation, and mixed porosity combined with variable thickness were examined. Significant results are reported. R.C.T.

N80-15103*# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) MAIN REDUCTION GEARS TEST PROGRAM Final Report
O. W. Misel Mar. 1977 220 p refs
(Contract NAS3-18021)
(NASA-CR-134669; CW-WR-77-008) Avail: NTIS
HC A10/MF A01 CSCL 21E

Sets of under the wing (UTW) engine reduction gears and sets of over the wing (OTW) engine reduction gears were fabricated for rig testing and subsequent installation in engines. The UTW engine reduction gears which have a ratio of 2.465:1 and a design rating of 9712 kW at 3157 rpm fan speed were operated at up to 105% s feed at 60% torque and 100% speed at 125% torque. The OTW engine reduction gears which have a ratio of 2.062:1 and a design rating of 12,615 kW at 3861 rpm fan speed were operated at up to 95% speed at 50% torque and 80% speed at 109% torque. Satisfactory operation was demonstrated at powers up to 12,172 kW, mechanical efficiency up to 99.1% UTW, and a maximum gear pitch line velocity of 112 m/s (22,300 fpm) with a corresponding star gear spherical roller bearing DN of 850,00 OTW. Oil and star gear bearing temperatures, oil churning, heat rejection, and vibratory characteristics were acceptable for engine installation. R.C.T.

N80-15104*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) CLEAN COMBUSTOR TEST REPORT
Oct. 1975 66 p refs
(Contract NAS3-18021)
(NASA-CR-134916; R75AEG449) Avail: NTIS
HC A04/MF A01 CSCL 21E

A component pressure test was conducted on a F101 PFRT combustor to evaluate the emissions levels of this combustor design at selected under the wing and over the wing operating conditions for the quiet clean short haul experimental engine (QCSEE). Emissions reduction techniques were evaluated which included compressor discharge bleed and sector burning in the combustor. The results of this test were utilized to compare the expected QCSEE emissions levels with the emission goals of the QCSEE engine program. R.C.T.

N80-15105*# Curtiss-Wright Corp., Wood-Ridge, N.J.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) MAIN REDUCTION GEARS BEARING DEVELOPMENT PROGRAM Final Report
Dec. 1975 40 p
(Contract NAS3-18021)
(NASA-CR-134890) Avail: NTIS HC A03/MF A01 CSCL 21E

The viability of proposed bearing designs to operate at application conditions is described. Heat rejection variables were defined for the test conditions. Results indicate that there is potential for satisfactory operation of spherical roller bearing in the QCSEE main reduction gear application. R.C.T.

N80-15106*# Curtiss-Wright Corp., Wood-Ridge, N.J.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) MAIN REDUCTION GEARS DETAILED DESIGN REPORT Final Report
A. Defeo and M. Kulina Jul. 1977 221 p
(Contract NAS3-18021)
(NASA-CR-134872; CW-WR-77-024) Avail: NTIS HC A10/MF A01 CSCL 21E

Lightweight turbine engines with geared slower speed fans are considered. The design of two similar but different gear ratio, minimum weight, epicyclic star configuration main reduction gears for the under the wing (UTW) and over the wing (OTW) engines is discussed. The UTW engine reduction gear has a ratio of 2.465:1 and a 100% power design rating of 9885 kW (13,256 hp) at 3143 rpm fan speed. The OTW engine reduction gear has a ratio of 2.062:1 and a 100% power design rating of 12813 kW (17183 hp) at 3861 rpm fan speed. Details of configuration, stresses, deflections, and lubrication are presented. J.M.S.

N80-15107*# Hamilton Standard, Windsor Locks, Conn. Aircraft Systems Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE): HAMILTON STANDARD CAM/HARMONIC DRIVE VARIABLE PITCH FAN ACTUATION SYSTEM DETAIL DESIGN REPORT
Mar. 1976 159 p
(Contract NAS3-18021)
(NASA-CR-134852; HSER-7001) Avail: NTIS HC A08/MF A01 CSCL 21E

A variable pitch fan actuation system was designed which incorporates a remote nacelle-mounted blade angle regulator. The regulator drives a rotating fan-mounted mechanical actuator through a flexible shaft and differential gear train. The actuator incorporates a high ratio harmonic drive attached to a multitrack spherical cam which changes blade pitch through individual cam follower arms attached to each blade trunnion. Detail design parameters of the actuation system are presented. These include the following: design philosophies, operating limits, mechanical, hydraulic and thermal characteristics, mechanical efficiencies, materials, weights, lubrication, stress analyses, reliability and failure analyses. Author

N80-15108*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING ENGINE COMPOSITE FAN BLADE DESIGN REPORT Final Report
R. Ravenhall and C. T. Salemme Feb. 1977 61 p refs
(Contract NAS3-18021)
(NASA-CR-135046; R77AEG177) Avail: NTIS HC A04/MF A01 CSCL 21E

A total of 38 quiet clean short haul experimental engine under the wing composite fan blades were manufactured for various component tests, process and tooling, checkout, and use in the QCSEE UTW engine. The component tests included frequency characterization, strain distribution, bench fatigue, platform static load, whirligig high cycle fatigue, whirligig low cycle fatigue, whirligig strain distribution, and whirligig overspeed. All tests were successfully completed. All blades planned for use in the engine were subjected to and passed a whirligig proof spin test. R.C.T.

N80-15109*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE): THE AERODYNAMIC AND MECHANICAL DESIGN OF THE QCSEE UNDER-THE-WING FAN
Mar. 1977 144 p
(Contract NAS3-18021)
(NASA-CR-135009; R75AEG484) Avail: NTIS HC A07/MF A01 CSCL 21E

The design, fabrication, and testing of two experimental high bypass geared turbofan engines and propulsion systems for short haul passenger aircraft are described. The aerodynamic and mechanical design of a variable pitch 1.34 pressure ratio fan for the under the wing (UTW) engine are included. The UTW fan was designed to permit rotation of the 18 composite fan blades into the reverse thrust mode of operation through both flat pitch and stall pitch directions. R.C.T.

N80-15110*# General Electric Co., Cincinnati, Ohio.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) COMPOSITE FAN FRAME DESIGN REPORT
S. C. Mitchell Sep. 1978 97 p refs
(Contract NAS3-18021)
(NASA-CR-135278; R77AEG439) Avail: NTIS HC A04/MF A01 CSCL 21E

An advanced composite frame which is flight-weight and integrates the functions of several structures was developed for the over the wing (OTW) engine and for the under the wing (UTW) engine. The composite material system selected as the basic material for the frame is Type AS graphite fiber in a Hercules 3501 epoxy resin matrix. The frame was analyzed using a finite element digital computer program. This program was used in an iterative fashion to arrive at practical thicknesses and ply orientations to achieve a final design that met all strength and stiffness requirements for critical conditions. Using this information, the detail design of each of the individual parts of the frame was completed and released. On the basis of these designs, the required tooling was designed to fabricate the various component parts of the frame. To verify the structural integrity of the critical joint areas, a full-scale test was conducted on the frame before engine testing. The testing of the frame established critical spring constants and subjected the frame to three critical load cases. The successful static load test was followed by 153 and 58 hours respectively of successful running on the UTW and OTW engines. J.M.S.

N80-15111*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UTW FAN PRELIMINARY DESIGN
Feb. 1975 107 p
(Contract NAS3-18021)
(NASA-CR-134842; R75AEG213) Avail: NTIS HC A06/MF A01 CSCL 21E

High bypass geared turbofan engines and propulsion systems designed for short-haul passenger aircraft are described. The propulsion technology required for future externally blown flap aircraft with engines located both under the wing and over the wing is emphasized. The aerodynamic and mechanical preliminary design of the QCSEE under the wing 1.34 pressure ratio fan with variable blade pitch is presented. Design information is given for two pitch change actuation systems which will provide reverse thrust. J.M.S.

N80-15112*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE): THE AERODYNAMIC AND PRELIMINARY MECHANICAL DESIGN OF THE QCSEE OTW FAN
Feb. 1975 80 p
(Contract NAS3-18021)
(NASA-CR-134841; R75AEG381) Avail: NTIS HC A05/MF A01 CSCL 21E

The aerodynamic and mechanical preliminary design of the QCSEE over the wing 1.36 pressure ratio fan is presented. Design information is given for both the experimental and flight designs. J.M.S.

N80-15113*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING ENGINE COMPOSITE FAN BLADE DESIGN
May 1975 57 p
(Contract NAS3-18021)
(NASA-CR-134840; R75AEG278) Avail: NTIS HC A04/MF A01 CSCL 21E

The design and analysis of a composite fan blade for the under the wing (UTW) QCSEE is presented. The blade is designed for a variable pitch, 18 bladed rotor and is constructed from a hybrid composite combination of materials consisting of Kevlar-49, type AS graphite, boron, and S-glass fibers in a PR288 epoxy resin matrix. The blade has an attached platform which is constructed of AS-graphite, PR278 epoxy resin matrix and aluminum honeycomb. The blade is designed to satisfy aerostability and cyclic life and strength requirements with a light weight construction. The attached platform is designed for a fail-safe condition in that it is retainable by the blade, under centrifugal force loading, even in the event of blade to platform bond separation. Details of the blade design and the results of stress, vibration, and impact analysis are included. J.M.S.

N80-15114*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING ENGINE AND CONTROL SIMULATION RESULTS
Oct. 1978 107 p refs
(Contract NAS3-18021)
(NASA-CR-135049; R76AEG218) Avail: NTIS HC A06/MF A01 CSCL 21E

A hybrid-computer simulation of the over the wing turbofan engine was constructed to develop the dynamic design of the control. This engine and control system includes a full authority digital electronic control using compressor stator reset to achieve fast thrust response and a modified Kalman filter to correct for sensor failures. Fast thrust response for powered-lift operations and accurate, fast responding, steady state control of the engine is provided. Simulation results for throttle bursts from 62 to 100 percent takeoff thrust predict that the engine will accelerate from 62 to 95 percent takeoff thrust in one second. J.M.S.

N80-15115*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) BALL SPLINE PITCH-CHANGE MECHANISM WHIRLIGIG TEST REPORT
Sep. 1978 64 p refs
(Contract NAS3-18021)
(NASA-CR-135354; R77AEG394) Avail: NTIS HC A04/MF A01 CSCL 21E

The component testing of a ball spline variable pitch mechanism is described including a whirligig test. The variable pitch actuator successfully completed all planned whirligig tests including a fifty cycle endurance test at actuation rates up to 125 deg per second at up to 102 percent fan speed (3400 rpm). J.M.S.

N80-15116*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) BOILER PLATE NACELLE AND CORE EXHAUST NOZZLE DESIGN REPORT
Oct. 1976 104 p
(Contract NAS3-18021)
(NASA-CR-135008; R76AEG222) Avail: NTIS HC A06/MF A01 CSCL 21E

The mechanical design of the boiler plate nacelle and core exhaust nozzle for the QCSEE under the wing engine is presented. The nacelle, which features interchangeable hard-wall and acoustic panels, is to be utilized in the initial engine testing to establish acoustic requirements for the subsequent composite nacelle as well as in the QCSEE over the wing engine configuration. J.M.S.

N80-15117*# Hamilton Standard, Windsor Locks, Conn.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) WHIRL TEST OF CAM/HARMONIC PITCH CHANGE ACTUATION SYSTEM Contractor Report, 10 Nov. 1975 - 16 Feb. 1976
Apr. 1976 208 p refs
(Contract NAS3-18021)
(NASA-CR-135140; HSER-7002) Avail: NTIS HC A10/MF A01 CSCL 21E

A variable pitch fan actuation system, which incorporates a remote nacelle mounted blade angle regulator, was tested. The regulator drives a rotating fan mounted mechanical actuator through a flexible shaft and differential gear train. The actuator incorporates a high ratio harmonic drive attached to a multitrack spherical cam which changes blade pitch through individual cam follower arms attached to each blade trunnion. Testing of the actuator on a whirl rig, is reported. Results of tests conducted to verify that the unit satisfied the design requirements and was structurally adequate for use in an engine test are presented. J.M.S.

N80-15118*# General Electric Co., Cincinnati, Ohio.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING (OTW) PROPULSION SYSTEMS TEST REPORT. VOLUME 4: ACOUSTIC PERFORMANCE
D. L. Stimpert Feb. 1979 144 p refs
(Contract NAS3-18021)
(NASA-CR-135326; R77AEG476-Vol-4) Avail: NTIS HC A07/MF A01 CSCL 21E

A series of acoustic tests were conducted on the over the wing engine. These tests evaluated the fully suppressed noise levels in forward and reverse thrust operation and provided insight into the component noise sources of the engine plus the suppression achieved by various components. System noise levels using the contract specified calculation procedure indicate that the in-flight noise level on a 152 m sideline at takeoff and approach are 97.2 and 94.6 EPNdB, respectively, compared to a goal of 95.0 EPNdB. In reverse thrust, the system noise level was 106.1 PNdB compared to a goal of 100 PNdB. Baseline source noise levels agreed very well with pretest predictions. Inlet-radiated noise suppression of 14 PNdB was demonstrated with the high throat Mach number inlet at 0.79 throat Mach number. R.E.S.

N80-15119*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) UNDER-THE-WING (UTW) COMPOSITE NACELLE Final Design Report
E. A. Johnston Aug. 1978 128 p
(Contract NAS3-18021)
(NASA-CR-135352; R77AEG588) Avail: NTIS HC A07/MF A01 CSCL 21E

The detail design of the under the wing experimental composite nacelle components is summarized. Analysis of an inlet, fan bypass duct doors, core cowl doors, and variable fan nozzle are given. The required technology to meet propulsion system performance, weight, and operational characteristics is discussed. The materials, design, and fabrication technology for quiet propulsion systems which will yield installed thrust to weight ratios greater than 3.5 to 1 are described. R.C.T.

N80-15120*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) Final Report

William S. Willis Aug. 1979 408 p refs
(Contract NAS3-18021)
(NASA-CR-159473; R79AEG478) Avail: NTIS HC A18/MF A01 CSCL 21E

The design, fabrication, and testing of two experimental propulsion systems for powered lift transport aircraft are given. The under the wing (UTW) engine was intended for installation in an externally blown flap configuration and the over the wing (OTW) engine for use in an upper surface blowing aircraft. The UTW engine included variable pitch composite fan blades, main reduction gear, composite fan frame and nacelle, and a digital control system. The OTW engine included a fixed pitch fan, composite fan frame, boilerplate nacelle, and a full authority digital control. Many acoustic, pollution, performance, and weight goals were demonstrated. R.C.T.

N80-15121*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). DOUBLE-ANNULAR CLEAN COMBUSTOR TECHNOLOGY DEVELOPMENT REPORT
D. W. Bahr, D. L. Burrus, and P. E. Sabla May 1979 149 p refs
(Contract NAS3-18021)
(NASA-CR-159483; R79AEG397) Avail: NTIS HC A07/MF A01 CSCL 21E

A sector combustor technology development program was conducted to define an advanced double annular dome combustor sized for use in the quiet clean short haul experimental engine (QCSEE). A design which meets the emission goals, and combustor performance goals of the QCSEE engine program was developed. Key design features were identified which resulted in substantial reduction in carbon monoxide and unburned hydrocarbon emission levels at ground idle operating conditions, in addition to very low nitric oxide emission levels at high power operating conditions. Their significant results are reported. R.C.T.

N80-15122*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE): ACOUSTIC TREATMENT DEVELOPMENT AND DESIGN
Art Clemons May 1979 353 p refs
(Contract NAS3-18021)
(NASA-CR-135266; R76AEG379-1) Avail: NTIS HC A16/MF A01 CSCL 21E

Acoustic treatment designs for the quiet clean short-haul experimental engines are defined. The procedures used in the development of each noise-source suppressor device are presented and discussed in detail. A complete description of all treatment concepts considered and the test facilities utilized in obtaining background data used in treatment development are also described. Additional supporting investigations that are complementary to the treatment development work are presented. The expected suppression results for each treatment configuration are given in terms of delta SPL versus frequency and in terms of delta PNdB. R.E.S.

N80-15123*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QSCEE). PRELIMINARY ANALYSES AND DESIGN REPORT, VOLUME 1
Oct. 1974 372 p
(Contract NAS3-18021)
(NASA-CR-134838; R74AEG479-Vol-1) Avail: NTIS HC A16/MF A01 CSCL 21E

The experimental propulsion systems to be built and tested in the 'quiet, clean, short-haul experimental engine' program are presented. The flight propulsion systems are also presented. The following areas are discussed: acoustic design; emissions control; engine cycle and performance; fan aerodynamic design; variable-pitch actuation systems; fan rotor mechanical design; fan frame mechanical design; and reduction gear design. R.E.S.

N80-15124*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE). PRELIMINARY ANALYSES AND DESIGN REPORT, VOLUME 2
Oct. 1974 330 p
(Contract NAS3-18021)
(NASA-CR-134839; R74AEG479-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 21E

The experimental and flight propulsion systems are presented. The following areas are discussed: engine core and low pressure turbine design; bearings and seals design; controls and accessories design; nacelle aerodynamic design; nacelle mechanical design; weight; and aircraft systems design. R.E.S.

N80-15125*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE-WING (OTW) PROPULSION SYSTEM TEST REPORT. VOLUME 1: SUMMARY REPORT
Jan. 1978 67 p
(Contract NAS3-18021)
(NASA-CR-135323; R77AEG473-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 21E

Sea level, static, ground testing of the over-the-wing engine and boilerplate nacelle components was performed. The equipment tested and the test facility are described. Summaries of the instrumentations, the chronological history of the tests, and the test results are presented. R.E.S.

N80-15126*# General Electric Co., Cincinnati, Ohio. Advanced Engineering and Technology Programs Dept.
QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) OVER-THE WING (OTW) PROPULSION SYSTEM TEST REPORT. VOLUME 3: MECHANICAL PERFORMANCE
Feb. 1978 121 p
(Contract NAS3-18021)
(NASA-CR-135325; R77AEG475-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 21E

The mechanical performance of the over-the-wing engine is described with emphasis on the advanced technology components. The overall dynamic response of the engine was excellent. R.E.S.

N80-15127*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUIET POWERED-LIFT PROPULSION
1979 426 p refs Conf. held at Cleveland, Ohio, 14-15 Nov. 1978
(NASA-CP-2077; E-9906) Avail: NTIS HC A19/MF A01 CSCL 21E

Latest results of programs exploring new propulsion technology for powered-lift aircraft systems are presented. Topics discussed include results from the 'quiet clean short-haul experimental engine' program and progress reports on the 'quiet short-haul research aircraft' and 'tilt-rotor research aircraft' programs. In addition to these NASA programs, the Air Force AMST YC 14 and YC 15 programs were reviewed. R.E.S.

N80-15128*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIRECT INTEGRATION OF TRANSIENT ROTOR DYNAMICS
Albert F. Kascak Washington Jan. 1980 23 p refs
(NASA-TP-1597; AVRADCOM-TR-79-42; E-101) Avail: NTIS HC A02/MF A01 CSCL 21E

An implicit method was developed for integrating the equations of motion for a lumped mass model of a rotor dynamics system. As an aside, a closed form solution to the short bearing theory was also developed for a damper with arbitrary motion. The major conclusions are that the method is numerically stable and that the computation time is proportional to the number of elements in the rotor dynamics model rather than to the cube of the number. This computer code allowed the simulation of a complex rotor bearing system experiencing nonlinear transient

motion and displayed the vast amount of results in an easily understood motion picture format - a 10 minute, 16 millimeter, color, sound motion picture supplement. An example problem with 19 mass elements in the rotor dynamics model took 0.7 second of central processing unit time per time step on an IBM 360-67 computer in a time sharing mode. R.C.T.

N80-15129*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EVALUATION OF APPROXIMATE METHODS FOR THE PREDICTION OF NOISE SHIELDING BY AIRFRAME COMPONENTS

Warren F. Ahtye and Geraldine McCulley (Informatics, Inc., Palo Alto, Calif.) Washington Jan. 1980 105 p refs
(NASA-TP-1004; A-6961) Avail: NTIS HC A06/MF A01 CSCL 21E

An evaluation of some approximate methods for the prediction of shielding of monochromatic sound and broadband noise by aircraft components is reported. Anechoic-chamber measurements of the shielding of a point source by various simple geometric shapes were made and the measured values compared with those calculated by the superposition of asymptotic closed-form solutions for the shielding by a semi-infinite plane barrier. The shields used in the measurements consisted of rectangular plates, a circular cylinder, and a rectangular plate attached to the cylinder to simulate a wing-body combination. The normalized frequency, defined as a product of the acoustic wave number and either the plate width or cylinder diameter, ranged from 4.6 to 114. Microphone traverses in front of the rectangular plates and cylinders generally showed a series of diffraction bands that matched those predicted by the approximate methods, except for differences in the magnitudes of the attenuation minima which can be attributed to experimental inaccuracies. The shielding of wing-body combinations was predicted by modifications of the approximations used for rectangular and cylindrical shielding. Although the approximations failed to predict diffraction patterns in certain regions, they did predict the average level of wing-body shielding with an average deviation of less than 3 dB. M.M.M.

N80-15132*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER SIMULATION OF ENGINE SYSTEMS

L. H. Fishback 1980 26 p refs Presented at the 18th Aerospace Sci. Meeting, Pasadena, Calif., 14-16 Jan. 1980; sponsored by AIAA
(NASA-TM-79290; E-234) Avail: NTIS HC A03/MF A01 CSCL 21E

The use of computerized simulations of the steady state and transient performance of jet engines throughout the flight regime is discussed. In addition, installation effects on thrust and specific fuel consumption is accounted for as well as engine weight, dimensions and cost. The availability throughout the government and industry of analytical methods for calculating these quantities are pointed out. M.M.M.

N80-15133*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IMPACT OF NEW INSTRUMENTATION ON ADVANCED TURBINE RESEARCH

Robert W. Graham Mar 1980 25 p refs Proposed for presentation at the 1980 Spring Ann. Meeting, New Orleans, 5-13 Mar. 1980; sponsored by ASME
(NASA-TM-79301; E-251) Avail: NTIS HC A02/MF A01 CSCL 21E

A description is presented of an orderly test program that progresses from the simplest stationary geometry to the more complex, three dimensional, rotating turbine stage. The instrumentation requirements for this evolution of testing are described. The heat transfer instrumentation is emphasized. Recent progress made in devising new measurement techniques has greatly improved the development and confirmation of more accurate analytical methods for the prediction of turbine performance and heat transfer. However, there remain challenging requirements for novel measurement techniques that could advance the future research to be done in rotating blade rows of turbomachines. M.M.M.

N80-15134*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN ANALYTICAL AND EXPERIMENTAL STUDY OF A SHORT S-SHAPED SUBSONIC DIFFUSER OF A SUPERSONIC INLET

Harvey E. Neumann, Louis A. Povinelli, and Robert E. Coltrin 1980 14 p refs Presented at 18th Aerospace Sci. Meeting, Pasadena, Calif., 14-16 Jan 1980; sponsored by AIAA
(NASA-TM-81406; E-320) Avail: NTIS HC A02/MF A01 CSCL 21E

A subscale HiMAT forebody and inlet was investigated over a range of Mach numbers to 1.4. The inlet exhibited a transitory separation within the diffuser but steady state data indicated reattachment at the diffuser exit. A finite difference procedure for turbulent compressible flow in axisymmetric ducts was used to successfully model the HiMAT duct flow. The analysis technique was further used to estimate the initiation of separation and delineate the steady and unsteady flow regimes in similar S-shaped ducts. R.C.T.

N80-15135# Boeing Aerospace Co., Seattle, Wash.

AN EXTENSION OF ENGINE WEIGHT ESTIMATION TECHNIQUES TO COMPUTE ENGINE PRODUCTION COST Final Report

E. Onat and F. F. Tolle 31 Aug. 1979 38 p refs
(Contract N62269-78-C-0286)
(AD-A074454; NADC-78103-60) Avail: NTIS HC A03/MF A01 CSCL 05/1

As a follow-on to previously developed engine weight estimation work, a preliminary design engine cost estimating code has been produced. The code relies on engine thermodynamic characteristics and weight as computed by earlier developed codes to select raw material types and quantities required to produce the engine. An existing Navy technique is then used to convert this data into engine cost. The code was used to predict the cost of three existing engines; errors ranged form 1 to 8% of actual costs as reported to NADC. GRA

N80-15136# Kentucky Univ., Lexington. Dept. of Engineering Mechanics.

THERMO-MECHANICAL STRESS ANALYSIS OF ADVANCED TURBINE BLADE COOLING CONFIGURATION Final Report, 1 May 1975 - 15 Jul. 1979

F. J. Rizzo and D. J. Shippy Jul. 1974 68 p refs
(Grant AF-AFOSR-2824-79; AF Proj. 2307)
(AD-A074098; UKY-TR111-79-EM17; AFOSR-79-0953TR) Avail: NTIS HC A04/MF A01 CSCL 20/11

A thermo-mechanical stress analysis capability, based on the Boundary Integral Equation Method (BIE) is developed and described. The capability is used to provide a thermoelastic analysis of stress in the vicinity of cooling holes in turbojet blades with transpiration or film cooling. Details involved in the formulation, numerical procedures, mathematical modelling, and data from solved problems are presented. GRA

N80-15137# TRW Equipment Labs., Cleveland, Ohio. Materials Technology Dept.

FRS COMPOSITES FOR ADVANCED GAS TURBINE ENGINE COMPONENTS Final Report

D. M. Essock May 1979 46 p refs
(Contract N62269-77-C-0217; SF54592201)
(AD-A074287; ER-7969-F; NADC-77015-30) Avail: NTIS HC A03/MF A01 CSCL 20/5

A number of FRS design concepts involve use of varying volume fraction of fiber, varying fiber diameter, and cross-ply construction. Key properties of such composites were evaluated to determine whether there are any adverse effects. Based upon elevated temperature tensile, creep, and thermal fatigue testing, equivalent mechanical properties are obtained if placement of plies is varied in a symmetrical layup. GRA

N80-15138*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF PRIMARY ROTOR PARAMETERS ON FLAPPING DYNAMICS

Robert T. N. Chen Jan. 1980 63 p refs
(NASA-TP-1431; A-7777) Avail: NTIS HC A04/MF A01 CSCL 01A

The effects of flapping dynamics of four main rotor design features that influence the agility, stability, and operational safety of helicopters are studied. The parameters include flapping hinge offset, flapping hinge restraint, pitch-flap coupling, and blade lock number. First, the flapping equations of motion are derived that explicitly contain the design parameters. The dynamic equations are then developed for the tip-path plane, and the influence of individual and combined variations in the design parameters determined. The steady state flapping response is examined with respect to control input and aircraft angular rate which leads to a feedforward control law for control decoupling through cross feed, and a feedback control law to decouple the steady state flapping response. The condition for achieving perfect decoupling of the flapping response due to aircraft pitch and roll rates without using feedback control is also found for the hover case. It is indicated that the frequency of the regressing flapping mode of the rotor system can become low enough to require consideration in the assessment of handling characteristics. J.M.S.

N80-15139# Calspan Advanced Technology Center, Buffalo, N.Y.
DESIGN CRITERIA FOR OPTIMAL FLIGHT CONTROL SYSTEMS Final Report, Jan. - Nov. 1978
K. S. Govindara, E. G. Rynaski, and A. T. Fam 7 Sep. 1979 95 p refs Prepared in cooperation with the State Univ. of New York at Buffalo
(Contract N00014-78-C-0155)
(AD-A074092; CALSPAN-6248-F-1; ONR-CR-215-259-1F) Avail: NTIS HC A05/MF A01 CSCL 01/3

Discussed is the application of linear optimal control to the design of a multicontroller feedback system to satisfy aircraft flying qualities criteria. The problem addressed is that of relating the performance index weighting matrices to the poles and zeros of the closed-loop transfer functions. Two sequential design procedures, one computing the Riccati solution from a set of linear equations and the other computing the closed-loop eigenvectors, are presented that determine, at each step, the pole-zero movements of the closed-loop transfer functions as the weighting matrix on the states is varied for a given weighting matrix on the controls. The performance index matrix constructed at each step to move the poles and zeros is added to get a final performance index matrix that moves the open-loop poles and zeros to more desirable locations. A control system design example with the X-22A V/STOL aircraft as the model, and using the first sequential design procedures, is presented. Two alternative design techniques are also presented. The first is based upon the Riccati equation solution and the control weighting matrix rather than on the weighting matrices on the states and control, and in the second design technique, the change in the pole-zero locations is determined under perturbations in the performance index matrices. GRA

N80-15140# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT ON THE 28TH GUIDANCE AND CONTROL PANEL SYMPOSIUM ON ADVANCES IN GUIDANCE AND CONTROL SYSTEMS USING DIGITAL TECHNIQUES
Morris A. Ostgaard (AFFDL, Wright-Patterson AFB, Ohio) Nov. 1979 14 p Symp. held at Ottawa, 8-11 May 1979
(AGARD-AR-148; ISBN-92-835-1314-X) Avail: NTIS HC A02/MF A01

A summary of the conclusions and recommendations resulting from audience comments and participation and technical assessment of the papers and the meeting is presented. Some of the conclusions are as follows: (1) there is a rapid emergence of digital processor application to guidance and control that represent integration opportunities heretofore unavailable in analog systems; (2) there appears to be a proliferation of microprocessor device application and architectures that, by themselves, limit potential for generalized application; (3) with the availability of more information from the data buss and the power of the computational capability, the multi-variable design techniques are offering significant potential for improving system performance and reducing equipment complexity; and (4) there is a strong need for fundamental studies in functional architecture that can employ microprocessors and still retain standards that permit the application of emerging electronic technology without restructuring the total system. R.E.S.

N80-15141# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
LOW COST AIRCRAFT FLUTTER CLEARANCE
Sep. 1979 110 p Papers presented at the 48th Meeting of the Structures and Mater. Panel, Williamsburg, Va., 4 Apr. 1979
(AGARD-CP-278; ISBN-92-835-0245-0) Avail: NTIS HC A06/MF A01

An evaluation of the usage of low cost aircraft flutter clearance procedures is presented. Some results occurring from such procedures (weight efficiency, safety, flight incidents, and overall costs) were discussed relative to those from methods using advanced state of the art. The relative technological-financial position of the small light weight aircraft manufacturer was also discussed.

N80-15142# Lockheed-Georgia Co., Marietta.
COMPARISON OF INTERNATIONAL FLUTTER REQUIREMENTS AND FLUTTER FREEDOM SUBSTANTIATION OF LIGHT AIRCRAFT IN THE USA
H. F. Hunter and G. E. Goodblood (FAA) *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 10 p refs

Avail: NTIS HC A06/MF A01

A comparison of current flutter specification requirements for light aircraft produced by NATO and other free-world countries is presented as well as an overview of flutter substantiation procedures presently used in the USA by the Federal Aviation Administration. Current flutter assessment procedures for light aircraft parallel very nearly those for transport-type aircraft. Significant deviations could occur because specific requirements for follow-on flight verification are lacking. The lack of such requirements has not created a great problem, since certain elements of the flight structure call for flight demonstration, in most cases. The body of data acquired may be something less than that derived for a transport program. The attempt is made, however, to acquire sufficient data to validate the analysis from a safety standpoint. M.M.M.

N80-15143# Beech Aircraft Corp., Wichita, Kans. Structural Dynamics Dept.
THE STATE-OF-THE-ART OF FLUTTER SUBSTANTIATION PROCEDURES AMONG US GENERAL AVIATION MANUFACTURERS
E. H. Hooper *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 19 p ref

Avail: NTIS HC A06/MF A01

An overview is presented of the state of the art of flutter substantiation procedures among U.S. general aviation manufacturers to serve as a guide to the small plane designer in the prevention of flutter, aileron reversal, and wing divergence. The material presented relies upon: (1) a statistical study of the geometric, inertia, and elastic properties of those airplanes which had experienced flutter in flight, and the methods used to eliminate the flutter; (2) limited wind-tunnel tests conducted with semi-rigid models. These were solid models of high rigidity with motion controlled at the root by springs to simulate wing bending and torsion. Springs at the control surface were used to simulate rotation; and (3) analytic studies based on the two dimensional study of a representative section of an airfoil. M.M.M.

N80-15144# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
AN EMPIRICAL APPROACH FOR CHECKING FLUTTER STABILITY OF GLIDERS AND LIGHT AIRCRAFT
F. Kiessling *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 17 p refs

Avail: NTIS HC A06/MF A01

Data of flutter accidents and computations of gliders and light aircraft are presented, and the empirical rules of a simplified flutter investigation are applied. A procedure for checking the flutter stability of small airplanes is proposed, which takes into account the varying levels of knowledge with conventional and unconventional designs. M.M.M.

N80-15145# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DYNAMIC IDENTIFICATION OF LIGHT AIRCRAFT STRUCTURES AND THEIR FLUTTER CERTIFICATION
Gerard Piazzoli and Jean-Louis Meurzec *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 19 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A06/MF A01

Within the framework of the general orientation of the treatment of the light aircraft structures, and with a view to determining specifications for their aeroelastic certification, the following points are discussed: (1) application of fast identification methods and of technological means to be implemented during the tests; (2) exploitation of flutter onset calculations, coupled on the computer with the experimental data, making it possible, in most cases, to define in situ a remedy (such as a new mass balance of the control surface) and to check its efficiency; (3) development of mixed methods, based on the theoretical definition of the participation of the control surfaces in the structural modes revealed by the test, with a view to palliating the possible orthogonally defects of the experimental modal basis on which the definitive flutter prediction calculations are established; and (4) methods and techniques used during the aeroelastic flight test, carried out in the particular cases where flutter certification cannot be based only on the calculation file because of insufficient safety margins. M.M.M.

N80-15146# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
A SIMPLIFIED GROUND VIBRATION TEST PROCEDURE FOR SAILPLANES AND LIGHT AIRCRAFT
N. Niedbal *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 11 p refs

Avail: NTIS HC A06/MF A01

A test procedure to obtain all characteristic modal data for an aeroelastic analysis is presented. It is shown that by taking into consideration the beam-like structural behaviour of such aircraft, and the comparatively small bandwidth of the design variables, substantial simplifications are possible when the dynamic behavior of similar aircraft structures is known. The mechanical steering mechanism of the control surfaces causes high damping and nonlinear effects, which require a separate examination and analysis of the control surfaces. M.M.M.

N80-15147# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
A FLUTTER-SPEED FORMULA FOR WINGS OF HIGH ASPECT RATIO
Ll. T. Niblett *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 14 p refs

Avail: NTIS HC A06/MF A01

Flutter-speed formulae for unswept wings of high aspect ratio and not carrying concentrated masses are derived. A high aspect ratio wing was defined as one whose fundamental torsional frequency is well above its first overtone flexural frequency. Because of the comparative fewness of the factors governing the flutter of such wings, flutter-speed formulae aimed at giving a lower bound for the flutter speed is of simple form. M.M.M.

N80-15148# British Aerospace Aircraft Group, Weybridge (England). Weybridge-Bristol Div.
THE MINIMUM COST APPROACH TO FLUTTER CLEARANCE
B. W. Payne and R. E. J. Brazier *In* AGARD Low Cost Aircraft Flutter Clearance Sep. 1979 11 p

Avail: NTIS HC A06/MF A01

Flutter prediction methods are assessed using criteria and simple flutter analyses. The difference in cost of these alternative approaches is no longer great, and the better data, available from the flutter analysis, answer far more of the questions which arise when obtaining a flutter clearance. Current regulations, although not making flutter calculations mandatory, do insist on ground and flight resonance testing. Data from a flutter analysis can allow a substantial saving in flight test time. It is concluded that flutter calculations provide the swiftest, surest and safest route to flutter clearance of the orthodox design and the only route for the unorthodox. Author

N80-15149# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AERODYNAMIC CHARACTERISTICS OF CONTROLS
Sep. 1979 510 p Presented at the Fluid Dyn. Panel Symp., Pozzuoli, Italy, 14-17 May 1979
(AGARD-CP-262; ISBN-92-835-0252-3) Avail: NTIS HC A22/MF A01

The rapidly expanding flight envelopes of aircraft, the growing applications of active control technology (ACT) and the associated development of control configured vehicles (CCV) are considered. Conventional and novel methods of control, prediction methods, experimental data derived from wind tunnel and flight measurements, and flight experience of ACT and CCV are included.

N80-15150# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Design Aerodynamics.
THEORETICAL AERODYNAMIC METHODS FOR ACTIVE CONTROL DEVICES
Horst Koerner *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 28 p refs

Avail: NTIS HC A22/MF A01

The theoretical aerodynamic aspects of active control devices are surveyed. Various calculation methods for subsonic, transonic, and supersonic attached flow are reviewed followed by comments on separated flow. Typical correlations between theoretical and experimental results for steady and unsteady characteristics of control are presented along with the shortcomings of the theoretical approaches and some recommendations for future efforts. J.M.S.

N80-15151# Royal Aircraft Establishment, Farnborough (England).
A SURVEY OF EXPERIMENTAL DATA ON THE AERODYNAMICS OF CONTROLS, IN THE LIGHT OF FUTURE NEEDS
A. Jean Ross and H. H. B. M. Thomas *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 48 p refs

Avail: NTIS HC A22/MF A01

Control data for current aircraft are used to provide material for discussion, principally to describe trends and to highlight gaps in knowledge. Both direct and indirect effects for a range of conventional and unconventional motivators are included. Maximum control power at the extremes of the flight envelope is particularly emphasized, since that available at high angle of attack and high subsonic speed is likely to be the critical design case. The indirect and coupling effects are also more marked at high angle of attack and/or high control deflection, and are of importance in the control system design. Hinge moment characteristics are described, although experimental data published recently are sparse. Some thought is given to the means of

generating required control powers for aircraft configurations made possible by Active Control Technology, and to the integration of the motivators in the control system. J.M.S.

N80-15152# McDonnell Aircraft Co., St. Louis, Mo.
CORRELATION OF F-15 FLIGHT AND WIND TUNNEL TEST CONTROL EFFECTIVENESS
J. W. Agnew and J. F. Mello *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 11 p refs

Avail: NTIS HC A22/MF A01

The F-15 aerodynamic configuration and control system development relied on data obtained in an extensive wind tunnel test program. Subsequently, a large body of flight test data was obtained. Control surface effectiveness characteristics were derived from flight test data and were compared with the data obtained in the wind tunnel test program. Data correlations are available for the ailerons, rudders, and stabilators. The latter surfaces are deflected symmetrically for longitudinal control and are deflected differentially for roll control. Primary axis effectiveness is addressed for each of these control surfaces. Significant secondary axis contributions (e.g., yawing moments due to aileron deflection) are also addressed. In addition to the conventional control surfaces, the longitudinal control effectiveness of the F-15 movable inlet ramp is discussed. As a result of the excellent resistance to departure from controlled flight, the spin resistance and spin recovery characteristics of the F-15, it was possible to flight test and to obtain control effectiveness data to 90 deg angle of attack at low speeds and to approximately 40 deg at transonic speeds. Thus, the correlation of control effectiveness is addressed for a large range of conditions. J.M.S.

N80-15153# Royal Aircraft Establishment, Farnborough (England).
SOME WIND TUNNEL MEASUREMENTS OF THE EFFECTIVENESS AT LOW SPEEDS OF COMBINED LIFT AND ROLL CONTROLS
D. S. Woodward, R. F. A. Keating, and C. S. Barnes *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 36 p refs

Avail: NTIS HC A22/MF A01

Using a half-model technique, measurements were made, at low speeds, of the effectiveness of spoilers for direct lift or roll control, with high lift devices deployed. The wing planform was representative of that of a transport aircraft outboard of the trailing edge crank. Results are presented which show that appropriate venting beneath the leading edge of hinged plate spoilers, together with venting through the flap shroud, achieved acceptably linear spoiler characteristics. Similarly, linear characteristics were obtained for a vented spoiler formed by moving the rear of the flap shroud. No reversal of spoiler effectiveness was found at any test condition within the normal operating range of incidence. In the same way, measurements were made of the maximum lift and roll performance of a typical swing wing fighter aircraft, for which the design of the leading and trailing edge controls was totally determined by the need to maximize the maneuverability at high speed. The maximum lift performance is compared with that obtainable from conventional slate and slotted flaps. Somewhat surprisingly, it is found that adequate rolling moments can be obtained by using full-span plain flaps differentially about a basic drooped position of 30 deg. J.M.S.

N80-15154# Boeing Military Airplane Development, Seattle, Wash. Flight Control Technology.
FLIGHT CONTROL AND CONFIGURATION DESIGN CONSIDERATIONS FOR HIGHLY MANEUVERABLE AIRCRAFT
William T. Kehrer *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 11 p
Avail: NTIS HC A22/MF A01

Working within wing geometry and other design constraints, the controllable limits of instability and the maneuver capabilities of various design approaches were investigated. Preliminary studies conducted to evaluate competitive configuration arrangements indicate that an aft-tail controller concept will be superior to canard and tailless delta configurations. The latter configurations suffer controllability limitations that compromise the ability to achieve design goals for maneuverability and efficient supersonic cruise. Thrust vectoring was explored as a means of improving maneuver load factor capability. R.E.S.

N80-15155# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
WIND TUNNEL MEASUREMENTS AND ANALYSIS OF SOME UNUSUAL CONTROL SURFACES ON TWO SWEPT WING FIGHTER CONFIGURATIONS
D. Welte and S. Ehekircher *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 10 p

Avail: NTIS HC A22/MF A01

Force measurements were made in a low speed and in a high speed wind tunnel with a 1:20 scale, 35 deg swept wing fighter configuration model. Surfaces which are deflected for longitudinal trim are: horizontal tail, leading- and trailing-edge flaps, a strake and a strake leading-edge flap. For lateral control the following surfaces are deflected: ailerons, tiperons, flaperons and a strake leading-edge flap. The main conclusions are: (1) trailing edge flaps are very useful to trim an unstable configuration and have minimum drag; (2) tiperons are very effective means for roll-yaw control up to very high angles of attack; and (3) differentially deflected leading edge flaps and a vortex fin, positioned on the wing upper surface, decrease the directional instability at high angles of attack. In addition, low speed tests were made with a new wing concept for a future fighter configuration, so called supersonic biplane, to investigate the effectiveness of the upper- and lower-wing trailing edge flaps. As supplement to the wind tunnel measurements some flight mechanical maneuver calculations were made to check the suitability and to compare the effectiveness of the different controls. R.E.S.

N80-15156# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
ROLL CONTROL BY DIGITALLY CONTROLLED SEGMENT SPOILERS
Klaus Jonas (Dornier-Werke G.m.b.H.), Horst Wuennenberg (Dornier-Werke G.m.b.H.), and Karl-Heinz Horstmann *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 8 p refs

Avail: NTIS HC A22/MF A01

To realize total wing span flaps for improving the maneuvering and landing performances of a combat aircraft the roll control has to be realized by spoilers. To overcome the nonlinearity and control reversal problems at low deflections, the continuously deflected spoiler is replaced by a certain set of digitally controlled single spoilers, which provide only three discrete deflections. It was found by simulator tests that by a proper combination of these segment spoilers it is possible to provide a roll control, which is judged as continuous by the pilot, with a relatively low number of single spoilers. Wind tunnel programs were performed to investigate system efficiency and aerodynamic effectiveness. Several roll spoiler configurations were tested in two and three dimensional configurations with and without landing flaps at different spanwise positions, spoiler deflections and -spans. It is shown that the effectiveness related to the deflection is linear for flaps-up and highly nonlinear for flaps-down configurations. The spoiler span is of no more influence at a certain value and the optimum spanwise location is about 0.8 of the semispan. Furthermore the effectiveness and the influence on lift and pitching moment for a possible test aircraft are shown. The practical application within an intended flight test program is discussed. R.E.S.

N80-15157# Boeing Aerospace Co., Seattle, Wash.
THE YC-14 UPPER SURFACE BLOWN FLAP: A UNIQUE CONTROL SURFACE
Alan H. Lee *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 8 p refs

Avail: NTIS HC A22/MF A01

The application of powered-lift technology applied to the Boeing YC-14 is assessed. The YC-14 can be controlled during short takeoff landings using conventional pilot techniques. That capability stems from the use of its upper surface blown (USB) flaps as control surfaces. The USB flaps are used to help control aircraft lift and airspeed. They are positioned automatically by the flight control system to eliminate undesired lift changes caused by thrust changes or external disturbances and to work with the autothrottle to attain and hold a selected airspeed. The aerodynamic and physical characteristics of USB flaps are described. R.E.S.

N80-15158# Northrop Corp., Los Angeles, Calif.
FLAPERON CONTROL: THE VERSATILE SURFACE FOR FIGHTER AIRCRAFT
John F. Moynes and Wallace E. Nelson, Jr. *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 18 p refs

Avail: NTIS HC A22/MF A01

The versatility of a flaperon is presented for roll performance and for several longitudinal active control modes. Particular emphasis is given to the advantages of a segmented flaperon over a full span for a YF-17 type aircraft. The areas of ride smoothing, direct lift, pitch pointing, vertical flight path control and flight control system reconfiguration are addressed for the active longitudinal control modes. The effect of flaperon pitching moment on the implementation of these modes is discussed. Author

N80-15159# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
AFFDL EXPERIENCE IN ACTIVE CONTROL TECHNOLOGY
Robert P. Johannes and Robert A. Whitmoyer *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 20 p refs

Avail: NTIS HC A22/MF A01

The evolution of active control technology (ACT) from the viewpoint of the Air Force Flight Dynamics Laboratory (AFFDL) is presented. Emphasis is placed on the aerodynamic control forces necessary to exploit ACT and in describing AFFDL development programs which merge these two disciplines and transition technology into operational flight equipment. Specific ACT programs described are: (1) the LAMS program; (2) the CCV B-52 program; (3) the SFCS F-4 program; (4) the CCV/PACT F-4 programs; (5) the Variable Stability NT-33 program; (6) the CCV YF-16 program; (7) the A-7D Digital Multimode program; (8) the IFFC I/FIREFLY III program; and (9) the AFTI-16 program. Experiences indicating areas of need for extension of fluid dynamics technology are also discussed. M.M.M.

N80-15160*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONTROL CONSIDERATIONS FOR CCV FIGHTERS AT HIGH ANGLES OF ATTACK
Luat T. Nguyen, William P. Gilbert, and Sue B. Grafton *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 10 p ref

Avail: NTIS HC A22/MF A01 CSCL 01C

Wind tunnel and piloted simulation studies were conducted to investigate the potential high angle of attack control problems that are introduced by the use of the CCV concept of relaxed static pitch stability (RSS) on fighter aircraft. A conventional wing/aft tail design incorporating modest levels of static instability and a close-coupled canard/wing design exhibiting very high levels of instability was investigated. Two types of high angle of attack control problems can result from the use of RSS: pitch departures caused by coupling and deep stall trim. Avoidance of these problems requires that the airplane have sufficient nose-down pitch control at high angles of attack. The effectiveness of several pitch control configurations were investigated including conventional aft-mounted stabilators, wing-mounted elevators, canard-mounted flaps, and all-moveable canards. Varying the incidence of the canards was the most effective scheme; however, very large deflections may be required on highly unstable configurations to prevent pitch departure without sacrificing roll performance and to avoid deep stall trim. For situations where the high angle of attack pitch control requirement is not met, control laws were developed to inhibit the departure and to allow deep stall recovery. However, these schemes involve limiting airplane roll capability and therefore can potentially compromise maneuverability. M.M.M.

N80-15161# British Aerospace Aircraft Group, Brough (England).
FIN DESIGN WITH ACT IN THE PRESENCE OF STRAKES
D. J. Walker *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 6 p
Avail: NTIS HC A22/MF A01

Wind tunnel tests on a combat aircraft model are reported in which the effect of fin size and various types of fin controls were investigated. It was shown that a rudder (rather than an all moving fin) using active control technology is probably the best solution for incidences of up to about 50 deg. Also the use of such a system would allow a 20% reduction in the size of the basic fin. M.M.M.

N80-15162# McDonnell Aircraft Co., St. Louis, Mo.
CONTROL INTEGRATION TECHNOLOGY IMPACT
Charles A. Scolatti *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 6 p refs

Avail: NTIS HC A22/MF A01

Some of the essential elements of an integrated technology development program are presented. The integrated flight and fire control system programs, called IFFC I/FIREFLY III, is used as an example. The operational relevance of the example is discussed. The major problems in air-to-ground attack, and the introduction of maneuvering weapon delivery (with IFFC mechanization required to achieve bombing solutions), are covered. The impact of this IFFC technology, and its extension on other areas of technology, such as aerodynamics, is indicated. M.M.M.

N80-15163# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DIRECT SIDE FORCE AND DRAG CONTROL WITH THE AID OF PYLON SPLIT FLAPS
Peter Esch and Horst Wuennenberg *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 9 p refs

Avail: NTIS HC A22/MF A01

Two configurations of split flaps are examined, a long one with small deflections and a short one with large deflections. The short one led to the same effectiveness at reduced values of hinge moments and cross coupling effects. Due to high interference effects it was not possible to get the effects of all flaps by superposition of the single flap results. The angle of attack, the landing flap setting and the lateral projection area of the external stores have a significant influence on the effectiveness whereas the Mach number is less important. The examination of the wind tunnel results led to the necessary control laws for the operation of the flaps and the compensation equipment. The flight test program with an Alpha Jet preproduction aircraft is expected to start in 1980. M.M.M.

N80-15164*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONTROL OF FOREBODY THREE-DIMENSIONAL FLOW SEPARATIONS
David J. Peake and F. Kevin Owen (Owen Intern., Inc., Palo Alto, Calif.) *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 49 p refs

Avail: NTIS HC A22/MF A01 CSCL 01C

The development of the turbulent symmetric and asymmetric vortex flow about the lee side of a 5 deg semiangle conical forebody at high relative incidence was investigated. The cone was immersed in a Mach 0.6 airstream at a Reynolds number of 13.5 x 10 to the 6th power based on the 1.4 m axial length of the cone. Small amounts of air injected normally or tangentially to the cone surface, but on one side of the leeward meridian

and beneath the vortex farthest from the wall, were effective in biasing the asymmetry. With this reorientation of the forebody vortices, the amplitude of the side force could be reduced to the point where its direction was reversed. This phenomenon was obtained either by changing the blowing rate at constant incidence or by changing incidence at constant blowing rate. Normal injection appeared more effective than tangential injection. The contrarotating vortices in the penetrating jet flow were of opposite hand to the rotational directions of the forebody vortices. A distinctively organized and stable flow structure emerged with the jet vortices positioned above the forebody vortices. K.L.

N80-15165# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
IN-FLIGHT MEASURED CHARACTERISTICS OF COMBINED FLAP-SPOILER DIRECT LIFT CONTROLS
O. Rix and D. Hanke *In* AGARD Aerodyn. characteristics of Controls Sep. 1979 22 p refs

Avail: NTIS HC A22/MF A01

The influence of direct lift control on longitudinal aircraft dynamics and the requirements for the characteristics of direct lift controls for large transport aircraft in the landing approach phase are discussed. The characteristics of flaps, spoilers, and the influence of surface rate on aircraft behavior are also described. Flight tests were carried out with the DFVLR HFB 320 In-Flight Simulator to determine in-flight flap and spoiler characteristics and the characteristics of simultaneously deflected flaps and spoilers as a DLC device. The results show that flap and spoiler characteristics can be described by linear models for flap and spoiler inputs up to + or - 10 deg and + or - 30 deg, respectively, and relatively high surface rates of 10 deg/sec and 62 deg/sec. In addition, combined flap-spoiler deflections show no nonlinear or unsteady effects and the aircraft response is described by simple linear modelling. The spoiler derivatives valid for combined flap-spoiler deflections are identified. K.L.

N80-15166# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
WIND TUNNEL INVESTIGATION OF CONTROLS FOR DF ON A FIGHTER-TYPE CONFIGURATION OF HIGHER ANGLES OF ATTACK
Wolfgang Sonnleitner *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 11 p refs

Avail: NTIS HC A22/MF A01

Stability and control characteristics of a fighter-type model were investigated at incidences up to 40 deg. Isolated and combined effects of different control shapes and control in different positions were demonstrated. K.L.

N80-15167# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PROBLEMS OF UNSTEADY AERODYNAMICS RAISED BY THE USE OF CONTROL SURFACES AS ACTIVE CONTROLS [PROBLEMES D'AERODYNAMIQUE INSTATIONNAIRE POSES PAR L'UTILISATION DES GOUVERNES DANS LE CONTROLE ACTIF]
Roger Destuynder *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 17 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A22/MF A01

The unsteady aerodynamic forces created by spoilers or auxiliary surfaces are investigated. Control problems concerning turbulence, gust control, and flutter phenomena are studied considering both subcritical and supercritical flows. Theoretical and mixed methods based on corrections defined after wind tunnel tests are applied. K.L.

N80-15168# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
UNSTEADY EFFECTS OF A CONTROL SURFACE IN TWO DIMENSIONAL, SUBSONIC AND TRANSONIC FLOW [EFFETS INSTATIONNAIRES D'UNE GOUVERNE EN ECOULEMENT BIDIMENSIONNEL SUBSONIQUE ET TRANSSONIQUE]
Richard Grenon, Andre Desopper, and Jacques Sides *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 14 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A22/MF A01

The unsteady effects of an oscillating surface are studied. The experimental results of steady and unsteady pressure measurements carried out in subsonic and transonic flow on a 16% relative thickness supercritical airfoil, equipped with a trailing edge flap, are compared with those obtained by various methods of steady and unsteady inviscid flow calculations. Calculation results are presented in which viscous effects have been taken into account, for both steady and unsteady flows. K.L.

N80-15169# Royal Aircraft Establishment, Bedford (England). Structures Dept.
AERODYNAMIC CHARACTERISTICS OF MOVING TRAILING-EDGE CONTROLS AT SUBSONIC AND TRANSONIC SPEEDS
D. G. Mabey, D. M. McOwat, and B. L. Welsh *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 26 p refs

Avail: NTIS HC A22/MF A01

Oscillatory pressures calculated and measured at high subsonic speeds for a swept back wing of aspect ratio 6 with a part span trailing edge flap were compared. The flap was driven at frequencies of 1 Hz (quasi-steady) and 90 Hz at Mach numbers from 0.40 to 0.95 with both fixed and free transition over a range of Reynolds numbers from 1 million to 4 million. The measured oscillatory pressures depended strongly on the boundary layer displacement thickness at the hinge line. Extrapolation from model to full scale required great care. In subsonic flow, tests with free transition gave the thinnest turbulent boundary layer at the hinge line and come nearest to full scale. At transonic speeds, transition was fixed at a safe distance upstream of the most forward excursion of the shock wave to obtain results appropriate to higher Reynolds number. Tests with flap driven simultaneously at two frequencies (90 Hz and 131 Hz) at subsonic and transonic speeds produced the same oscillatory pressures at 131 Hz as when driven independently. The principle of superposition applies, at least for small amplitude motions with attached flows. R.C.T.

N80-15170# Queen Mary Coll., London (England). Dept. of Aeronautical Engineering.
UNSTEADY AERODYNAMICS OF TWO-DIMENSIONAL SPOILERS AT LOW SPEEDS
S. R. Siddalingappa and G. J. Hancock *In* AGARD Aerodynam. Characteristics of Controls Sep. 1979 13 p refs

Avail: NTIS HC A22/MF A01

Complementary aspects of spoiler behavior are reviewed. The emphasis is on the understanding of the local flow about a spoiler. A two dimensional spoiler on the floor of a small blower tunnel (solid floor, and side walls but open at the top) was investigated. Steady pressures were measured along the tunnel floor for various steady spoiler angles and gap sizes between the bottom of the spoiler and the tunnel floor. Transient pressures were recorded following sudden changes in spoiler angle and for oscillating spoilers. A two dimensional spoiler attached to a two dimensional airfoil was investigated. The manner in which the spoiler affects the overall pressure distribution on the airfoil plus spoiler combination was emphasized. Both the airfoil and the spoiler were pressure plotted. The results of steady pressures, transient pressures following rapid and slower ramp changes in spoiler angle, and transient pressures when the spoiler is moving in simple harmonic motion are included. R.C.T.

N80-15171# Rome Univ. (Italy). School of Aerospace Engineering.
TRAJECTORY BEHAVIOUR OF A CONTROL CONFIGURATED AIRCRAFT SUBJECTED TO RANDOM DISTURBANCES

Achille Danesi, Scott Smolka (Boston Univ.), and Francesco Borrini *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 17 p refs

Avail: NTIS HC A22/MF A01

The longitudinal behavior of a Boeing V-747 aircraft with some of its original aerodynamic effectors operating as active controllers in addition to the conventional elevators were studied. The ailerons were collectively used as outboard active flaps and the inboard section of the high lift triple slotted flaps was employed as inboard active flaps. The flight control system structure was implemented as an optimal model following system in which the optimal feedback gains were computed to minimize the integral performance index. Errors in dynamical response, in wing root bending moment, and in aerodynamic drag computed as deviations from the same quantities related to a specified model responding satisfactorily to disturbances with zero increments in wing root bending moment and aerodynamic drag in flight maneuver at given load factor, were considered. At the same time the minimum effectors activity was included as a design objective. A lighter wing structure was realized as the result of wing loads reduction and further weight saving (reduced tail size) was obtained by taking advantage of the beneficial effect of the active controller activity in reducing the elevator deflections required in the pull up maneuver. R.C.T.

N80-15172# Northrop Corp., Hawthorne, Calif. Aircraft Group.

FOREBODY VORTEX BLOWING: A NOVEL CONTROL CONCEPT TO ENHANCE DEPARTURE/SPIN RECOVERY CHARACTERISTICS OF FIGHTER AND TRAINER AIRCRAFT

Andrew M. Skow, William A. Moore, and Dale J. Lorincz *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 17 p refs

Avail: NTIS HC A22/MF A01

Active blowing concepts which control the asymmetric orientation of the vortex system emanating from an aircraft forebody at high angles of attack are described. The side force generated by the asymmetric nature of the vortices was utilized. The choice between these two preferred positions was influenced strongly by very small geometric imperfections in an otherwise symmetric model and by small asymmetries in the upstream flow such as are caused by flow angularity or turbulent eddies in the free stream. The magnitude of the side force was very large due to the fluid amplification afforded by the vortex growth. The results of water tunnel flow visualization studies and a wind tunnel test program are presented which bear out this assumption and show that tangential blowing can effectively alter the forebody vortex system at angles of attack between 25 and 55 deg. and can generate yawing moments comparable to those produced by a conventional rudder at low angles of attack. The results of a six deg of freedom digital simulation are presented which show that this concept can substantially enhance departure recovery characteristics and could have potential as a departure inhibitor for some aircraft. The results of a preliminary system design indicate that such a system could be applied to aircraft. R.C.T.

N80-15173# Neilsen Engineering and Research, Inc., Mountain View, Calif.

NONLINEAR AERODYNAMICS OF ALL-MOVABLE CONTROLS

Charles A. Smith and Jack N. Nielsen *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 20 p refs

(Contract N00014-74-C-0050)

Avail: NTIS HC A22/MF A01

The nonlinear effects and their consequences on control effectiveness are described. Both independent control effectiveness (e.g., pitch control) as well as control cross coupling (e.g., pitch control in the presence of yaw control) are discussed. It is shown that, at sufficiently high angles of attack, the presence of these nonlinearities can completely dominate control effectiveness. The current status of techniques to predict control effects using both analytical and data correlation techniques are reviewed. R.C.T.

N80-15174# Ruhr Univ., Bochum (West Germany).

ON THE EFFECT OF WING WAKE ON TAIL CHARACTERISTICS

K. Gersten and D. Glueck *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 8 p refs

Avail: NTIS HC A22/MF A01

A nonlinear theory was developed to calculate lift and moment forces for airfoils in a two dimensional flow field. The oncoming velocity distribution is approximated by a series of step functions which results in a flow field composed of a number of potential flow fields. The potential flow fields are matched properly at several dividing streamlines where the total pressure changes discontinuously. The solution of the problem is determined by using vortex distributions on both the contour of the airfoil and the dividing streamlines. A special approach makes it possible to calculate the flow field when one of the dividing streamlines merges with the profile. A comparison between theoretical and experimental results for the aerodynamic characteristics of a tail unit placed in the wake of a wing is presented. A prediction method for the tail characteristics at high angles of attack (super stall) is discussed. A.W.H.

N80-15175# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AERODYNAMIC INTERACTION ON A CLOSE-COUPLED CANARD WING CONFIGURATION [INTERACTION AERODYNAMIQUE ENTRE UN CANARD PROCHE ET UNE VOILURE]

Yves Brocard and Volker Schmitt *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 11 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A22/MF A01

Half model tests performed on a close coupled canard wing configuration in a low speed, pressurized wind tunnel are discussed. Results are presented in terms of longitudinal aerodynamic characteristics and pressure distribution on the main wing. The effects of canard deflection and of Reynolds number variation are investigated. Surface oil flow pattern on the wind tunnel model and water tunnel visualization on a smaller model are examined. Comparisons between the experimental results and theoretical predictions are presented. A.W.H.

N80-15176# Queen Mary Coll., London (England). Dept. of Aeronautical Engineering.

ON THE EFFECTS OF GAPS ON CONTROL SURFACE CHARACTERISTICS

C. Michael and G. J. Hancock *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 13 p ref

Avail: NTIS HC A22/MF A01

A two dimensional airfoil comprising an elliptic nose, parallel section of 5% t/c ratio, and a 20% trailing edge control surface was investigated at low speeds. Three different geometries of the rear of the main airfoil were investigated. Gaps were created by moving the control surface aft of the main airfoil. Extensive pressure plotting is presented for the above range of gaps and control surface angular deflections up to 8 degrees and a range of measurements of mean boundary layer profiles in the neighborhood of the gap are discussed. The variations of the overall lift coefficient with control angle and gap size for the three geometries are reported. A.W.H.

N80-15178# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany). Commercial Aircraft Div.

SOME INVESTIGATIONS CONCERNING THE EFFECTS OF GAPS AND VORTEX GENERATORS ON ELEVATOR EFFICIENCY AND OF LANDING FLAP SWEEP ON AERODYNAMIC CHARACTERISTICS

Herbert Neppert and Richard Sanderson *In* AGARD Aerodyn. Characteristics of Controls Sep. 1979 12 p refs

Avail: NTIS HC A22/MF A01

The effect of gaps and vortex generators on elevator effectiveness and drag is examined. The effect of single rudder deflection on the effectiveness of a split rudder is discussed. Wind tunnel results and proposals for improving the aerodynamic characteristics of a tailplane by means of a reduction in the sweep on the landing flap hinge line are described. A.W.H.

N80-15179*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LOX/GOX MECHANICAL IMPACT TESTER ASSESSMENT
J. W. Bransford (NASA, Marshall Space Flight Center), C. J. Bryan, G. W. Frye (NASA, Johnson Space Center), and S. L. Stohler (Rocketdyne, Canoga Park, Calif.) Feb. 1980 103 p refs
(NASA-TM-74106) Avail: NTIS HC A06/MF A01 CSCL 14B

The performances of three existing high pressure oxygen mechanical impact test systems were tested at two different test sites. The systems from one test site were fabricated from the same design drawing, whereas the system tested at the other site was of different design. Energy delivered to the test sample for each test system was evaluated and compared. Results were compared to the reaction rates obtained. R.C.T.

N80-15180# Air Force Human Resources Lab., Brooks AFB, Tex.
EFFECTS OF VARYING VISUAL DISPLAY CHARACTERISTICS OF THE T-4G, A T-37 FLIGHT SIMULATOR Final Report, Aug. 1974 - Dec. 1977
Robert R. Woodruff Jun. 1979 17 p refs
(AF Proj. 1123)
(AD-A071410; AFHRL-TR-79-17) Avail: NTIS HC A02/MF A01 CSCL 05/9

Two experiments were conducted using the T-4G, a T-37 flight simulator, to investigate the benefit to simulation of visual displays which have color or are collimated. Thirty-two Air Force undergraduate pilots learned approach and landing in the T-4G using either black and white or colored imagery. Thirty-eight instructor pilots performed approach and landing with visual displays that had collimation or reduced collimation. No statistically significant differences were found in either experiment. Power analysis shows that each of these experiments would have detected a practically significant difference, if one existed, with a probability of more than .75. There are no psychophysical reasons to use either color or collimation. User acceptance is another thing, and if color and collimation improve acceptance, they should be used. GRA

N80-15181# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
CLIMATIC CHAMBER TESTING AIRCRAFT, ENGINES ARMAMENT AND AVIONICS; TEST OPERATIONS PROCEDURE Final Report
31 Aug. 1979 35 p Supersedes MTP-7-3-521
(AD-A074049; TOP-7-3-521; MTP-7-3-521) Avail: NTIS HC A03/MF A01 CSCL 01/3

This document provides information, guidance and methodology for planning and conducting an environmental climatic chamber developmental test of aviation materiel. Environmental climatic chamber developmental testing in general, determines the degree to which aviation materiel meets the developmental requirements of the US Army Materiel Needs (MN) documents, when subjected to the environmental conditions developed in the climatic chamber. GRA

N80-15182# Avco-Everett Research Lab., Mass.
DESIGN STUDY FOR ATA VACUUM SYSTEM APERTURE
S. Hibbs 26 Jul. 1979 24 p refs
(Contract W-7405-eng-48)
(UCRL-15050) Avail: NTIS HC A02/MF A01

A vacuum system aperture for the advanced test accelerator is analyzed. An axial aerowindow, a suction type aerowindow, and a combination suction/axial aerowindow are examined. The combination suction/axial aerowindow is recommended due to the estimated leakage rate and the projected cost. DOE

N80-15183# General Applied Science Labs., Inc., Westbury, N. Y.
CONCEPTUAL DESIGN AND PERFORMANCE ESTIMATES FOR A SUPERSONIC AERODYNAMIC WINDOW FOR THE ATA VACUUM SYSTEM APERTURE Final Report
J. I. Erdos Jun. 1979 39 p refs
(Contract W-7405-eng-48)
(UCRL-15051) Avail: NTIS HC A03/MF A01

The design of an aerodynamic window for the aperture in a system of interconnecting cavities is discussed. Two types of windows are considered and evaluated for the system. They are a supersonic jet operating transverse to the aperture axis and a supersonic jet operating coaxially about the aperture. A.W.H.

N80-15265# Southwest Research Inst., San Antonio, Tex Army Fuels and Lubricants Research Lab.
THE PHYSICAL AND CHEMICAL CHARACTERIZATION OF TEN MILITARY TURBINE ENGINE LUBRICANTS Final Report, Jul. - Sep. 1979
Frank M. Newman and Leo L. Stavinoha Sep. 1979 32 p refs
(Contract DAAK70-79-C-0142)
(AD-A074073; AFLRL-115) Avail: NTIS HC A03/MF A01 CSCL 11/8

Four MIL-L-23699B and six MIL-L-7808G turbine engine lubricants have been characterized from the physical properties and chemical composition of their basestocks. The four MIL-L-23699 lubricants were found to be 100% polyol esters. Of the six MIL-L-7808 lubricants, four were mixtures of polyol esters and diesters, one was 100% polyol ester, and one was 100% diester. Correlation of the chemical data is made to some of the physical properties wherever possible. GRA

N80-15299*# Old Dominion Univ. Research Foundation, Norfolk, Va.
SOIL ANALYSES AND EVALUATIONS AT THE IMPACT DYNAMICS RESEARCH FACILITY FOR TWO FULL-SCALE AIRCRAFT CRASH TESTS Final Report, 24 May - 31 Aug. 1977
Robert Y. K. Cheng Dec. 1977 36 p refs
(Contract NAS1-14193)
(NASA-CR-159199) Avail: NTIS HC A03/MF A01 CSCL 08M

The aircraft structural crash behavior and occupant survivability for aircraft crashes on a soil surface was studied. The results of placement, compaction, and maintenance of two soil test beds are presented. The craters formed by the aircraft after each test are described. J.M.S.

N80-15364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTATION OF THREE-DIMENSIONAL FLOW IN TURBOFAN MIXERS AND COMPARISON WITH EXPERIMENTAL DATA
L. A. Povinelli, B. H. Anderson, and W. Gerstenmaier Jan. 1980 12 p refs Presented at the AIAA Aerospace Sciences Meeting, Pasadena, Calif., 14-16 Jan. 1980
(NASA-TM-81410; E-324) Avail: NTIS HC A02/MF A01 CSCL 20D

A three dimensional, viscous computer code was used to calculate the mixing downstream of a typical turbofan mixer geometry. Experimental data obtained using pressure and temperature rakes at the lobe and nozzle exit stations were used to validate the computer results. The relative importance of turbulence in the mixing phenomenon as compared with the

streamwise vorticity set up by the secondary flows was determined. The observations suggest that the generation of streamwise vorticity plays a significant role in determining the temperature distribution at the nozzle exit plane. K.L.

N80-15871*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

AN EXPERIMENTAL STUDY OF THE STRUCTURE AND ACOUSTIC FIELD OF A JET IN A CROSS STREAM

Ivan Camelier and K. Karamcheti Jan. 1976 134 p refs (Grants NGL-05-020-526; NsG-2007) (NASA-CR-162464; SU-JIAA-TR-2) Avail: NTIS HC A07/MF A01 CSCL 20A

The plane of symmetry of a high speed circular jet was surveyed to measure the mean and turbulent velocity fields by using constant temperature hot wire anemometry. The intensity of the noise radiated from the jet was determined in the tunnel test section by utilizing the cross-correlation at a particular time delay between the signals of two microphones suitably located along a given direction. Experimental results indicate that the turbulent intensity inside the crossflow jet increases by a factor of (1. + 1/2) as compared to the turbulent intensity of the same jet under free conditions, with r indicating the ratio of the jet velocity by the cross stream velocity. The peak observed in the turbulence spectra obtained inside the potential core of the jet has a frequency that increases by the same factor with respect to the corresponding frequency measured in the case of the free jet. The noise radiated by the jet becomes more intense as the crossflow velocity increases. The measured acoustic intensity of the crossflow jet is higher than the value which would be expected from the increase of the turbulent intensity only. A.R.H.

N80-15874*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A STUDY OF PARTIAL COHERENCE FOR IDENTIFYING INTERIOR NOISE SOURCES AND PATHS ON GENERAL AVIATION AIRCRAFT

James T. Howlett Dec. 1979 17 p refs Presented at 98th Acoust. Soc. of Am. Meeting, Salt Lake City, 26-30 Nov. 1979 (NASA-TM-80197) Avail: NTIS HC A02/MF A01 CSCL 20A

The partial coherence analysis method for noise source/path determination is summarized and the application to a two input, single output system with coherence between the inputs is illustrated. The augmentation of the calculations on a digital computer interfaced with a two channel, real time analyzer is also discussed. The results indicate possible sources of error in the computations and suggest procedures for avoiding these errors. M.G.

N80-15983# Army Missile Research and Development Command, Redstone Arsenal, Ala. Technology Lab.

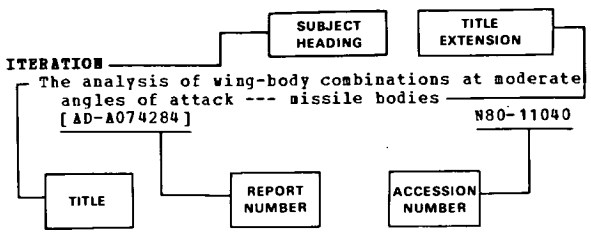
AERODYNAMIC DATA BASE USERS GUIDE

George M. Landingham 5 Jun. 1979 27 p (AD-A074448; DRDMI-T-79-62) Avail: NTIS HC A03/MF A01 CSCL 05/2

A data base system has been developed for storage and interactive analysis of data. This report is intended as a description of the system and as a user's guide. The equipment on which the data base system is implemented is detailed. A description of the data base structure and detailed instructions for using the system are included. GRA

SUBJECT INDEX

Typical Subject Index Listing



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A

A-10 AIRCRAFT
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
Evaluation of the aerodynamic characteristics of a 1/20-scale A-10 model at Mach numbers from 0.30 to 0.75
[AD-A074867] N80-15055
ACCELERATION (PHYSICS)
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15069
ACCELEROMETERS
Methods for strap-down attitude estimation and navigation with accelerometers
N80-14034
ACOUSTIC ATTENUATION
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
ACOUSTIC FATIGUE
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
ACOUSTIC MEASUREMENTS
Aeroacoustic measuring techniques in or outside turbulent flows
N80-14876
An experimental study of the structure and acoustic field of a jet in a cross stream --- Ames 7-ft by 10-ft wind tunnel tests
[NASA-CR-162464] N80-15871
ACOUSTIC RETROFITTING
Quiet Clean Short-Haul Experimental Engine (QCSEE): Acoustic treatment development and design
[NASA-CR-135266] N80-15122
ACOUSTIC SCATTERING
Experimental and numerical results of sound scattering by a body --- interaction of aerodynamic noise and fuselage
N80-14873
ACOUSTICS
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion systems test report. Volume 4: Acoustic performance
[NASA-CR-135326] N80-15118
ACTUATORS
Quiet Clean Short-haul Experimental Engine (QCSEE). Ball spline pitch change mechanism design report
[NASA-CR-134873] N80-15101
Quiet Clean Short-haul Experimental Engine (QCSEE) whirl test of cam/harmonic pitch change actuation system
[NASA-CR-135140] N80-15117
ADAPTIVE CONTROL
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations
A80-18022
ADDITIVES
Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256
ADHESIVE BONDING
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
Fatigue life prediction of a bonded splice joint
[AIAA PAPER 80-0305] A80-18306
AERIAL RUDDERS
Fin design with ACT in the presence of strakes
N80-15161
AEROACOUSTICS
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics
A80-20952
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965
Acoustically swept rotor --- helicopter noise reduction
[NASA-CASE-ARC-11106-1] N80-14107
Applications of diffraction theory to aeroacoustics --- aircraft noise
N80-14870
Experimental and numerical results of sound scattering by a body --- interaction of aerodynamic noise and fuselage
N80-14873
Aeroacoustic measuring techniques in or outside turbulent flows
N80-14876
AERODYNAMIC CHARACTERISTICS
Concerning the information efficiency of aerodynamic experiments
A80-17671
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow
A80-17697
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699
Engine aerodynamic installation by numerical simulation
[AIAA PAPER 80-0108] A80-18271
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308

Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
Designing light airplanes --- Russian book A80-19414
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052
Theoretical study of aerodynamic characteristics of wings having vortex flow
[NASA-CR-159184] N80-14053
Quiet short-haul research aircraft familiarization document --- STOL
[NASA-TM-81149] N80-14108
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
Aerodynamic characteristics of controls --- conferences
[AGARD-CP-262] N80-15149
In-flight measured characteristics of combined flap-spoiler direct lift controls N80-15165
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds N80-15169
Unsteady aerodynamics of two-dimensional spoilers at low speeds N80-15170
Aerodynamic interaction on a close-coupled canard wing configuration N80-15175
On the effects of gaps on control surface characteristics N80-15176

AERODYNAMIC COEFFICIENTS
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700

AERODYNAMIC CONFIGURATIONS
Theoretical study of aerodynamic characteristics of wings having vortex flow
[NASA-CR-159184] N80-14053
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and mechanical design of the QCSEE under-the-wing fan
[NASA-CR-135009] N80-15109
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations N80-15155
Roll control by digitally controlled segment spoilers N80-15156
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack N80-15166
Nonlinear aerodynamics of all-movable controls N80-15173
Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperture
[UCRL-15051] N80-15183

AERODYNAMIC DRAG
The minimum induced drag of aerofoils
[NACA-121] N80-15038

AERODYNAMIC FORCES
The aerodynamic forces on airship hulls
[NACA-184] N80-15039
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040
General theory of aerodynamic instability and the mechanism of flutter
[NACA-496] N80-15047
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072
AFFDL experience in active control technology N80-15159
Problems of unsteady aerodynamics raised by the use of control surfaces as active controls N80-15167

AERODYNAMIC INTERFERENCE
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047

AERODYNAMIC LOADS
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads
[AD-A075612] N80-15077
Analysis of low-speed helicopter flight test data
[AD-A074141] N80-15079

AERODYNAMIC NOISE
Sound generation in a flow near a compliant wall A80-20153
Acoustically swept rotor --- helicopter noise reduction
[NASA-CASE-ARC-11106-1] N80-14107
Experimental and numerical results of sound scattering by a body --- interaction of aerodynamic noise and fuselage N80-14873

AERODYNAMIC STABILITY
Formulation of coupled rotor/fuselage equations of motion A80-17717
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book A80-19374
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123
Flight testing of the buffeting behavior of combat aircraft
[ESA-TT-523] N80-14143
General theory of aerodynamic instability and the mechanism of flutter
[NACA-496] N80-15047
Control considerations for CCV fighters at high angles of attack N80-15160
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics N80-15178

AERODYNAMIC STALLING
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238

Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(O)] N80-14058
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability --- F-16
[NASA-TP-1538] N80-14136
A parametric wing design study for a modern laminar flow wing
[NASA-TM-80154] N80-15050

AERODYNAMICS
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088
Modification of axial compressor streamline program for analysis of engine test data
[NASA-TM-79312] N80-14051
Aeronautical Research Laboratories
[RM78/30107] N80-15026
Theoretical aerodynamic methods for active control devices
N80-15150
A survey of experimental data on the aerodynamics of controls, in the light of future needs
N80-15151

AEROELASTICITY
Formulation of coupled rotor/fuselage equations of motion
A80-17717
An empirical approach for checking flutter stability of gliders and light aircraft
N80-15144

AERONAUTICAL ENGINEERING
AEROPP - Message and data switching systems for aeronautical operations
A80-19579
Aeronautical Research Laboratories
[RM78/30107] N80-15026

AFTERBODIES
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088

AIR CARGO
Analog aircraft weight and balance computer
[SAWE PAPER 1283] A80-20631
Computer simulation of an air cargo small package sorting system
A80-20866
Shipping by air - Is the value of your time worth it
A80-20868
Models for freight access to air terminals
A80-20869
Air cargo container utilization optimization through modeling
A80-20870

AIR COOLING
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299] A80-19316

AIR DUCTS
Experimental investigation of the characteristics of pneumatic transfer lines
A80-19052
The analysis of sound propagation in jet engine ducts using the finite difference method
[AD-A074233] N80-14853

AIR FILTERS
The transfer of carbon fibers through a commercial aircraft water separator and air cleaner
[NASA-CR-159183] N80-14359

AIR FLOW
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124

AIR NAVIGATION
Performance evaluation of image correlation techniques --- for aircraft inertial navigation systems
A80-17534
A strapdown inertial reference system for commercial airline use in navigation and flight control
A80-17558
Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017

AIR POLLUTION
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104

AIR TO SURFACE MISSILES
Control integration technology impact --- as a basis for improving the combat effectiveness of all tactical aircraft
N80-15162

AIR TRAFFIC
Air traffic density and distribution measurements
[AD-A073229] N80-14064

AIR TRAFFIC CONTROL
Automation and air traffic control
A80-18722
The economics of air traffic control
A80-18723
ATC and the airborne traffic-situation display
A80-18724
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867
State of the art for digital avionics and controls, 1978
N80-14018
Air traffic density and distribution measurements
[AD-A073229] N80-14064
On radar in air traffic control --- conference, Rome, Jul. 1979
[FUB-11-1979] N80-14065
Problems related to the design and construction of a radar network
N80-14066
Methodology for the evaluation of a radar site
N80-14067
Performance evaluation methods of a secondary radar network
N80-14068
Organization of an integrated global maintenance service --- Radar Networks
N80-14069
Automation of flight on-line strategic control: The case of speed control on pre-established routes
N80-14070
Radar data utilization in automating the sequencing of aircrafts in terminal areas
N80-14071
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
Tracking algorithms for mono and multiradar
N80-14074
A distributed processing system for radar data presentation
N80-14075
Filtering of synthetic radar data
N80-14076
Visual displays for air traffic control data
N80-14077
Implementation of air traffic control radar receivers with fast Fourier transform processors
N80-14086
An air traffic channel simulation by means of ray-tracing techniques
N80-14088

L-band measurements in the air traffic channel to characterize secondary radar systems N80-14092
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar N80-14100
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements N80-14105
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time
[NASA-TM-80194] N80-14114

AIR TRANSPORTATION
Aircraft delays at major US airports can be reduced
[PB-299442/4] N80-15061

AIRBORNE EQUIPMENT
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects A80-17402
ATC and the airborne traffic-situation display A80-18724
A light aircraft camera Pod - The Enviro-Pod A80-20251
Infrared sensor system performance simulations A80-20900

AIRBORNE/SPACEBORNE COMPUTERS
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system N80-14026
The integrity of onboard computer programs: A solution N80-14028
An assessment of and approach to the validation of digital flight control systems N80-14036
The avionics computer program: Practical experiences with a methodology --- Mirage F1 and Mirage 200 aircraft N80-14037

AIRCRAFT ACCIDENT INVESTIGATION
Accident investigation N80-14636
A first look at the effect of severe rainfall upon an aircraft
[NASA-CR-162569] N80-15058

AIRCRAFT COMMUNICATION
AEROPP - Message and data switching systems for aeronautical operations A80-19579

AIRCRAFT COMPARTMENTS
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874

AIRCRAFT CONFIGURATIONS
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
Small ship-based VTOL aircraft - A design exercise
[SAWE PAPER 1296] A80-20639
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071
Hypersonic cruise aircraft propulsion integration study, volume 1
[NASA-CR-158926-VOL-1] N80-15074
Hypersonic cruise aircraft propulsion integration study, volume 2
[NASA-CR-158926-VOL-2] N80-15075
Flight control and configuration design considerations for highly maneuverable aircraft N80-15154

AIRCRAFT CONSTRUCTION MATERIALS
Determination of the stress intensity factor of composite structural members A80-17958
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
Composite structural materials
[NASA-CR-162578] N80-15076
Climatic chamber testing aircraft, engines armament and avionics; Test operations procedure --- environmental test chambers and facility for testing aircraft construction materials and engines
[AD-A074049] N80-15181

AIRCRAFT CONTROL
Comment on 'Handling quality criterion for heading control' A80-17698
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700
Controllers for aircraft motion simulators
[AIAA PAPER 80-0050] A80-18252
A statistical method applied to pilot behavior analysis in multiloop systems A80-18537
Constrained optimum trajectories with specified range A80-18538
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book A80-19374
Recent developments in flight simulation techniques A80-20907
Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017
State of the art for digital avionics and controls, 1978 N80-14018
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
Aerodynamic characteristics of controls --- conferences
[AGARD-CP-262] N80-15149
Theoretical aerodynamic methods for active control devices N80-15150
A survey of experimental data on the aerodynamics of controls, in the light of future needs N80-15151
Correlation of F-15 flight and wind tunnel test control effectiveness N80-15152
Flight control and configuration design considerations for highly maneuverable aircraft N80-15154
Direct side force and drag control with the aid of pylon split flaps N80-15163
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack N80-15166
Problems of unsteady aerodynamics raised by the use of control surfaces as active controls N80-15167
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft N80-15172
Nonlinear aerodynamics of all-movable controls N80-15173

AIRCRAFT DESIGN
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow A80-17697
Computer simulation of engine systems --- for aircraft design
[AIAA PAPER 80-0051] A80-18253

Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
An inverse transonic wing design method
[AIAA PAPER 80-0330] A80-18319
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
Designing light airplanes --- Russian book A80-19414
The next supersonic transport A80-20214
Application of RCS guidelines to weight effective aircraft design --- Radar Cross Section
[SAWE PAPER 1270] A80-20626
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638
Small ship-based VTOL aircraft - A design exercise
[SAWE PAPER 1296] A80-20639
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
Navy V/STOL - A continuing initiative
[SAWE PAPER 1325] A80-20655
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656
Quiet short-haul research aircraft familiarization document --- STOL
[NASA-TM-81149] N80-14108
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072
JA-6A circulation control wing contractor flight demonstration
[AD-A074888] N80-15080

AIRCRAFT ENGINES

Preparing aircraft propulsion for a new era in energy and the environment A80-17737
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255
Engine aerodynamic installation by numerical simulation
[AIAA PAPER 80-0108] A80-18271
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303
Engine component improvement program - Performance improvement
[AIAA PAPER 80-0223] A80-19300
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301
Thermal state of structural members of aircraft engines --- Russian book A80-19412
Damping capacity of plastic compressor blades A80-19868
Integrated circuit characteristics at 260 C for aircraft engine-control applications A80-20112
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
Unification of oils for aircraft gas-turbine engines A80-20690
Exhaust emission reduction for intermittent combustion aircraft engines
[NASA-CR-159757] N80-14130
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery N80-14135
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
Computer simulation of engine systems
[NASA-TM-79290] N80-15132
Climatic chamber testing aircraft, engines armament and avionics; Test operations procedure --- environmental test chambers and facility for testing aircraft construction materials and engines
[AD-A074049] N80-15181

AIRCRAFT EQUIPMENT

An overvoltage safety system for direct current aircraft generators A80-19051
Aircraft torque motors --- Russian book A80-19199
A high accuracy flight profile determining system --- systems analysis of inertial navigation system for aircraft position determination N80-14042
Aircraft anti-icing/de-icing
[AD-A074128] N80-15078

AIRCRAFT FUEL SYSTEMS

Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256

AIRCRAFT FUELS

Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time
[NASA-TM-80194] N80-14114

AIRCRAFT GUIDANCE

Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017

AIRCRAFT HAZARDS

An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC)
[AD-A074390] N80-14063
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059

AIRCRAFT INSTRUMENTS

Some practical aspects of the calibration of air data systems A80-18865
Experimental investigation of the characteristics of pneumatic transfer lines A80-19052
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles A80-19990

AIRCRAFT LANDING

The loads at landing impact --- for aircraft A80-17723
What brings us down tomorrow - Landing guidance systems for the 1980s A80-18725
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028

AIRCRAFT MAINTENANCE

Study of turboprop systems reliability and maintenance costs
[NASA-CR-135192] N80-14129
Fleet hardness variation --- to determine aircraft survivability due to blast loads
[AD-A074849] N80-15029

AIRCRAFT MANEUVERS

Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045

AIRCRAFT MODELS

The criticality of engine exhaust simulations on VSTOL model-measured ground effects
[AIAA PAPER 80-0230] A80-18276

Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115
Evaluation of the aerodynamic characteristics of a 1/20-scale A-10 model at Mach numbers from 0.30 to 0.75
[AD-A074867] N80-15055

AIRCRAFT NOISE
Rotational noise of helicopter rotors
A80-17718
Airport noise, location rent, and the market for residential amenities
A80-17720
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics
A80-20952
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
Applications of diffraction theory to aeroacoustics --- aircraft noise
N80-14870
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan --- quiet engine program
[NASA-CR-134891] N80-15102
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874

AIRCRAFT PERFORMANCE
Flight certification of the Cessna TU206G amphibious floatplane
A80-18186
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656
A first look at the effect of severe rainfall upon an aircraft
[NASA-CR-162569] N80-15059

AIRCRAFT RELIABILITY
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638
Automatic recovery after sensor failure onboard
N80-14024

AIRCRAFT SAFETY
Covariance simulation of BCAS - An aircraft collision avoidance system
A80-20915
Effect of weather conditions on airport operations
N80-14638
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060

AIRCRAFT SPECIFICATIONS
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
Low cost aircraft flutter clearance --- conference
[AGARD-CP-278] N80-15141
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA
N80-15142
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers
N80-15143
Dynamic identification of light aircraft structures and their flutter certification
N80-15145
The minimum cost approach to flutter clearance
N80-15148

AIRCRAFT SPIN
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351

AIRCRAFT STABILITY
Comment on 'Handling quality criterion for heading control'
A80-17698
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response
A80-17716
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book
A80-19374

AIRCRAFT STRUCTURES
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
Code optimization for solving large 3D EMP problems --- electromagnetic scattering by aircraft structures
A80-19764
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
Review of investigations into aeronautics related fatigue Federal Republic of Germany
[LBF-S-142] N80-14422
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034
The aerodynamic forces on airship hulls
[NACA-184] N80-15039
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
Dynamic identification of light aircraft structures and their flutter certification
N80-15145

AIRCRAFT SURVIVABILITY
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
Fleet hardness variation --- to determine aircraft survivability due to blast loads
[AD-A074849] N80-15029

AIRFIELD SURFACE MOVEMENTS
Simulation of a surveillance and control system of surface traffic in an airport
N80-14073
Effect of weather conditions on airport operations
N80-14638

AIRFOIL PROFILES
Experimental and computational study of transonic flow about swept wings
[AIAA PAPER 80-0005] A80-18235
Conformal mapping analysis of multielement airfoils with boundary-layer corrections
[AIAA PAPER 80-0069] A80-18261
Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317
An inverse transonic wing design method
[AIAA PAPER 80-0330] A80-18319

Pressure distribution on Joukowski wings
[NACA-TM-336] N80-15036
The minimum induced drag of aerofoils
[NACA-121] N80-15038
AIRFOILS
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
Computer program to prepare airfoil characteristic data for use in helicopter performance calculations
[NASA-TM-78627] N80-15031
The minimum induced drag of aerofoils
[NACA-121] N80-15038
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils
[NASA-CR-159141] N80-15052
AIRFRAMES
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028
AIRLINE OPERATIONS
Shipping by air - Is the value of your time worth it
A80-20868
AIRPLANE PRODUCTION COSTS
Application of parametric weight and cost estimating relationships to future transport aircraft
[SAWE PAPER 1292] A80-20637
AIRPORT PLANNING
An analytical method of testing pavement strength
A80-17998
Marseilles - Metamorphosis of an airport
A80-17999
Computer simulation of an air cargo small package sorting system
A80-20866
Methodology for the evaluation of a radar site
N80-14067
AIRPORT SURFACE DETECTION EQUIPMENT
On radar in air traffic control --- conference, Rome, Jul. 1979
[FUB-11-1979] N80-14065
Simulation of a surveillance and control system of surface traffic in an airport
N80-14073
Development trends of airport surface traffic control radar
N80-14087
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104
AIRPORTS
Airport noise, location rent, and the market for residential amenities
A80-17720
Centralized ground power systems conserve energy
A80-18000
Models for freight access to air terminals
A80-20869
An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC)
[AD-A074390] N80-14063
Reflection cracking of bituminous overlays for airport pavements: A state of the art
[AD-A073484] N80-14144
Effect of weather conditions on airport operations
N80-14638
Aircraft delays at major US airports can be reduced
[PB-299442/4] N80-15061
AIRSHIPS
Propulsion options for the HI SHOT long endurance drone airship
[AD-A074595] N80-14132
The aerodynamic forces on airship hulls
[NACA-184] N80-15039
AIRSPACE
Air traffic density and distribution measurements
[AD-A073229] N80-14064
AIRSPEED
A flutter-speed formula for wings of high aspect ratio
N80-15147
ALGORITHMS
Automation of flight on-line strategic control: The case of speed control on pre-established routes
N80-14070
Radar data utilization in automating the sequencing of aircrafts in terminal areas
N80-14071
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
Tracking algorithms for mono and multiradar
N80-14074
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar
N80-14100
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements
N80-14105
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time
[NASA-TM-80194] N80-14114
ALL-WEATHER LANDING SYSTEMS
What brings us down tomorrow - Landing guidance systems for the 1980s
A80-18725
ALPHA JET AIRCRAFT
Roll control by digitally controlled segment spoilers
N80-15156
Direct side force and drag control with the aid of pylon split flaps
N80-15163
ALTITUDE CONTROL
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
ALUMINUM ALLOYS
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632
AMPHIBIOUS AIRCRAFT
Flight certification of the Cessna TU206G amphibious floatplane
A80-18186
ANALOG COMPUTERS
Analog aircraft weight and balance computer
[SAWE PAPER 1283] A80-20631
ANECHOIC CHAMBERS
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
ANGLE OF ATTACK
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(O)] N80-14058
Control considerations for CCV fighters at high angles of attack
N80-15160
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack
N80-15166
Nonlinear aerodynamics of all-movable controls
N80-15173
ANTENNA DESIGN
Experimental loop antennas for 60 KHz to 200 KHz
[NASA-CR-162729] N80-15063

ANTIICING ADDITIVES
Aircraft anti-icing/de-icing
[AD-A074128] N80-15078
APPROACH
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
APPROXIMATION
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
ARCHITECTURE (COMPUTERS)
A flight control system using the DAIS architecture N80-14019
Trends in digital data processing and system architecture --- avionics applications N80-14020
AROMATIC COMPOUNDS
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel --- jet engine fuels A80-17675
ATLIT PROJECT
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
ATMOSPHERIC EFFECTS
Atmospheric effects on Martian ejecta emplacement A80-20192
ATMOSPHERIC TURBULENCE
Effect of spanwise gust variations N80-14639
ATTITUDE INDICATORS
Methods for strap-down attitude estimation and navigation with accelerometers N80-14034
AUTOMATIC CONTROL
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book A80-19374
Failure detection, isolation and indication in highly integrated digital guidance and control system N80-14027
Radar data utilization in automating the sequencing of aircrafts in terminal areas N80-14071
Automatic systems for airport surface mobile media surveillance based on the use of secondary media N80-14104
AUTOMATIC FLIGHT CONTROL
An assessment of and approach to the validation of digital flight control systems N80-14036
Pilot control through the TAFCOS automatic flight control system
[NASA-TM-81152] N80-14138
AUTOMATIC PILOTS
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
Pilot control through the TAFCOS automatic flight control system
[NASA-TM-81152] N80-14138
AUTOMATION
Automation and air traffic control A80-18722
AVIONICS
Modular strapdown guidance unit with embedded microprocessors
[AIAA PAPER 78-1239] A80-18534
Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017
State of the art for digital avionics and controls, 1978 N80-14018
A flight control system using the DAIS architecture N80-14019
Trends in digital data processing and system architecture --- avionics applications N80-14020
The avionics computer program: Practical experiences with a methodology --- Mirage F1 and Mirage 200 aircraft N80-14037
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106
AXISYMMETRIC BODIES
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088
AXISYMMETRIC FLOW
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311

B

B-1 AIRCRAFT
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
BALANCE
A method of simplifying weight and balance for small aircraft
[SAWE PAPER 1278] A80-20630
BASE FLOW
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
BEAT FREQUENCIES
Evaluation of the intensity of beat-induced vibrations A80-17965
BIBLIOGRAPHIES
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651
BIRD-AIRCRAFT COLLISIONS
An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC)
[AD-A074390] N80-14063
BLADE TIPS
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128
BLAST LOADS
Fleet hardness variation --- to determine aircraft survivability due to blast loads
[AD-A074849] N80-15029
BODY-WING AND TAIL CONFIGURATIONS
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(O)] N80-14058
On the effect of wing wake on tail characteristics N80-15174
BODY-WING CONFIGURATIONS
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
BOEING 747 AIRCRAFT
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059
BOILER PLATE
Quiet Clean Short-Haul Experimental Engine (QCSEE). Under-the-wing (UTW) engine boilerplate Nacelle test report. Volume 2: Aerodynamics and performance
[NASA-CR-135250] N80-14116
BORON REINFORCED MATERIALS
Determination of the stress intensity factor of composite structural members A80-17958

BOUNDARY LAYER CONTROL
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Control of forebody three-dimensional flow separations N80-15164

BOUNDARY LAYER FLOW
Conformal mapping analysis of multielement airfoils with boundary-layer corrections
[AIAA PAPER 80-0069] A80-18261
The aerodynamic forces on airship hulls
[NACA-184] N80-15039

BOUNDARY LAYER SEPARATION
A numerical approach to subsonic viscous-inviscid interaction A80-19070
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083

BOUNDARY LAYER TRANSITION
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034

BOUNDARY VALUE PROBLEMS
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696

BOXES (CONTAINERS)
Air cargo container utilization optimization through modeling A80-20870

BUFFETING
Flight testing of the buffeting behavior of combat aircraft
[ESA-TT-523] N80-14143

BYPASSES
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123

C

C-15 AIRCRAFT
Quiet powered-lift propulsion
[NASA-CR-2077] N80-15127

C-135 AIRCRAFT
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15069

CABINS
Recent developments in flight simulation techniques A80-20907

CALIBRATING
Some practical aspects of the calibration of air data systems A80-18865
Determination of the repeatability of PFC --- flight tests for position error calibrating
[AETE-PR-79/36] N80-14109

CANARD CONFIGURATIONS
Aerodynamic interaction on a close-coupled canard wing configuration N80-15175

CARBON FIBERS
The transfer of carbon fibers through a commercial aircraft water separator and air cleaner
[NASA-CR-159183] N80-14359

CARGO AIRCRAFT
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
Air cargo container utilization optimization through modeling A80-20870

CASCADE CONTROL
A statistical method applied to pilot behavior analysis in multiloop systems A80-18537

CELESTIAL REFERENCE SYSTEMS
Navigation error using rate of change of signal time of arrival from space vehicles A80-20904

CENTER OF GRAVITY
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648

CENTRIFUGAL COMPRESSORS
On the dynamics of compressor surge A80-17900

CERAMIC COATINGS
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303

CERAMICS
Technologies conceived for the utilization of ceramics in turboengines
[ONERA, TP NO. 1979-132] A80-20076
Contact stress analysis of ceramic-to-metal interfaces --- in gas turbine engines
[AD-A074491] N80-14417

CERTIFICATION
Flight certification of the Cessna TU206G amphibious floatplane A80-18186

CESSNA AIRCRAFT
Flight certification of the Cessna TU206G amphibious floatplane A80-18186

CH-46 HELICOPTER
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads
[AD-A075612] N80-15077

CHANNEL FLOW
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083

CHANNELS (DATA TRANSMISSION)
An air traffic channel simulation by means of ray-tracing techniques N80-14088
L-band measurements in the air traffic channel to characterize secondary radar systems N80-14092

CHEMICAL ATTACK
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack A80-18062

CHEMICAL PROPERTIES
The physical and chemical characterization of ten military turbine engine lubricants
[AD-A074073] N80-15265

CIRCUIT PROTECTION
An overvoltage safety system for direct current aircraft generators A80-19051

CIVIL AVIATION
AEROPP - Message and data switching systems for aeronautical operations A80-19579
Shipping by air - Is the value of your time worth it A80-20868
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062

CLEAR AIR TURBULENCE
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060

COAL
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259

COCKPITS
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303

COHERENT ACOUSTIC RADIATION
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874

COLLISION AVOIDANCE
Covariance simulation of BCAS - An aircraft collision avoidance system A80-20915
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements N80-14105

COMBAT
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
COMBUSTIBLE FLOW
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953
COMBUSTION CHAMBERS
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines
[NASA-TP-1582] N80-14125
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
COMBUSTION PHYSICS
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
COMBUSTION PRODUCTS
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104
COMMAND AND CONTROL
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design
A80-20879
COMMERCIAL AIRCRAFT
A strapdown inertial reference system for commercial airline use in navigation and flight control
A80-17558
The transfer of carbon fibers through a commercial aircraft water separator and air cleaner
[NASA-CR-159183] N80-14359
Aircraft delays at major US airports can be reduced
[PB-299442/4] N80-15061
COMMUNICATION CABLES
Recent advances in fibre optics for high integrity digital control systems
N80-14025
COMMUNICATION NETWORKS
AEROPP - Message and data switching systems for aeronautical operations
A80-19579
COMPARISON
Implementation of air traffic control radar receivers with fast Fourier transform processors
N80-14086
COMPLEX SYSTEMS
A method of evaluation of gas turbine engines
A80-20064
COMPONENT RELIABILITY
The CF6 jet engine performance improvement: New front mount
[NASA-CR-159639] N80-14127
COMPOSITE MATERIALS
Damping capacity of plastic compressor blades
A80-19868
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
Composite structural materials
[NASA-CR-162578] N80-15076
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report --- to verify strength of selected composite materials
[NASA-CR-135075] N80-15100
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119
COMPOSITE STRUCTURES
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122
Composite structural materials
[NASA-CR-162578] N80-15076
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108
COMPRESSIBILITY EFFECTS
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238
COMPRESSIBLE FLOW
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238
COMPRESSOR BLADES
Damping capacity of plastic compressor blades
A80-19868
COMPRESSOR EFFICIENCY
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor
A80-17724
Flow in transonic compressors
[AIAA PAPER 80-0124] A80-18357
COMPUTATIONAL FLUID DYNAMICS
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
A numerical approach to subsonic viscous-inviscid interaction
A80-19070
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047
COMPUTER DESIGN
Analog aircraft weight and balance computer
[SAWE PAPER 1283] A80-20631
COMPUTER INFORMATION SECURITY
The integrity of onboard computer programs: A solution
N80-14028
COMPUTER PROGRAMMING
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
COMPUTER PROGRAMS
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
The integrity of onboard computer programs: A solution
N80-14028
The avionics computer program: Practical experiences with a methodology --- Mirage F1 and Mirage 200 aircraft
N80-14037
Modification of axial compressor streamline program for analysis of engine test data
[NASA-TM-79312] N80-14051
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom
[NASA-TM-80153] N80-14055
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets
[AD-A074187] N80-14133
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137
Computer program to prepare airfoil characteristic data for use in helicopter performance calculations
[NASA-TM-78627] N80-15031
Data reduction software for LORAN-C flight test evaluation
[NASA-CR-162730] N80-15064
COMPUTER SYSTEMS DESIGN
Modular strapdown guidance unit with embedded microprocessors
[AIAA PAPER 78-1239] A80-18534

Automation and air traffic control
A80-18722
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
COMPUTER SYSTEMS PROGRAMS
An assessment of and approach to the validation of digital flight control systems
N80-14036
COMPUTER TECHNIQUES
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations
A80-18022
Recent developments in flight simulation techniques
A80-20907
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135
COMPUTERIZED DESIGN
An analytical method of testing pavement strength
A80-17998
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model
[NASA-CR-159180] N80-14054
Composite structural materials
[NASA-CR-162578] N80-15076
COMPUTERIZED SIMULATION
Computer simulation of engine systems --- for aircraft design
[AIAA PAPER 80-0051] A80-18253
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
Code optimization for solving large 3D EMP problems --- electromagnetic scattering by aircraft structures
A80-19764
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
Computer simulation of an air cargo small package sorting system
A80-20866
Covariance simulation of BCAS - An aircraft collision avoidance system
A80-20915
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
Simulation of a surveillance and control system of surface traffic in an airport
N80-14073
An air traffic channel simulation by means of ray-tracing techniques
N80-14088
Pilot control through the TAFCOS automatic flight control system
[NASA-TM-81152] N80-14138
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine simulation report
[NASA-CR-134914] N80-15091
Computer simulation of engine systems
[NASA-TM-79290] N80-15132
CONFERENCES
Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017
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[FUB-11-1979] N80-14065
Quiet powered-lift propulsion
[NASA-CP-2077] N80-15127
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-AR-148] N80-15140
Low cost aircraft flutter clearance --- conference
[AGARD-CP-278] N80-15141
Aerodynamic characteristics of controls --- conferences
[AGARD-CP-262] N80-15149
CONFIGURATION MANAGEMENT
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
CONFORMAL MAPPING
Conformal mapping analysis of multielement airfoils with boundary-layer corrections
[AIAA PAPER 80-0069] A80-18261
CONTOURS
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111
CONTROL
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-AR-148] N80-15140
CONTROL CONFIGURED VEHICLES
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026
Control considerations for CCV fighters at high angles of attack
N80-15160
Trajectory behaviour of a control configurated aircraft subjected to random disturbances
N80-15171
CONTROL EQUIPMENT
Aircraft torque motors --- Russian book
A80-19199
CONTROL SIMULATION
A statistical method applied to pilot behavior analysis in multiloop systems
A80-18537
Infrared sensor system performance simulations
A80-20900
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation
A80-20901
Recent developments in flight simulation techniques
A80-20907
A flight control system using the DAIS architecture
N80-14019
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing engine and control simulation results
[NASA-CR-135049] N80-15114
CONTROL SURFACES
Comment on 'Handling quality criterion for heading control'
A80-17698
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034
Aerodynamic characteristics of controls --- conferences
[AGARD-CP-262] N80-15149
Theoretical aerodynamic methods for active control devices
N80-15150

A survey of experimental data on the aerodynamics of controls, in the light of future needs N80-15151
Correlation of F-15 flight and wind tunnel test control effectiveness N80-15152
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations N80-15155
Problems of unsteady aerodynamics raised by the use of control surfaces as active controls N80-15167
On the effects of gaps on control surface characteristics N80-15176

CONTROLLABILITY
Pilot control through the TAFCOS automatic flight control system
[NASA-TM-81152] N80-14138

CONTROLLERS
Controllers for aircraft motion simulators
[AIAA PAPER 80-0050] A80-18252

COOLING SYSTEMS
Thermal state of structural members of aircraft engines --- Russian book A80-19412

CORE FLOW
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel A80-17673
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087

CORROSION TESTS
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack A80-18062

COSMOS SATELLITES
The Russian satellite navigation system A80-20982

COST ANALYSIS
Shipping by air - Is the value of your time worth it A80-20868
Problems related to the design and construction of a radar network N80-14066
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106

COST ESTIMATES
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636
Application of parametric weight and cost estimating relationships to future transport aircraft
[SAWE PAPER 1292] A80-20637
Study of turboprop systems reliability and maintenance costs
[NASA-CR-135192] N80-14129
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135

COST REDUCTION
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636

COSTS
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135

COUPLING
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response A80-17716

COVARIANCE
Covariance simulation of BCAS - An aircraft collision avoidance system A80-20915

COWLINGS
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119

CRACK PROPAGATION
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
Model 540 rotor blade crack propagation investigation
[AD-A074734] N80-15081

CRACKING (FRACTURING)
Reflection cracking of bituminous overlays for airport pavements: A state of the art
[AD-A073484] N80-14144

CRASH LANDING
Soil analyses and evaluations at the impact dynamics research facility for two full-scale aircraft crash tests
[NASA-CR-159199] N80-15299

CRATERING
Atmospheric effects on Martian ejecta emplacement A80-20192
Soil analyses and evaluations at the impact dynamics research facility for two full-scale aircraft crash tests
[NASA-CR-159199] N80-15299

CROSS CORRELATION
Guidance system position update by multiple subarea correlation A80-17518

CROSS COUPLING
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699

CROSS FLOW
An experimental study of the structure and acoustic field of a jet in a cross stream --- Ames 7-ft by 10-ft wind tunnel tests
[NASA-CR-162464] N80-15871

CRUDE OIL
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259

CRUISING FLIGHT
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072

CRYSTAL OSCILLATORS
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles A80-19990

CURVATURE
Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045

D

DASSAULT AIRCRAFT
The avionics computer program: Practical experiences with a methodology --- Mirage F1 and Mirage 200 aircraft N80-14037

DATA ACQUISITION
Concerning the information efficiency of aerodynamic experiments A80-17671
Analysis of low-speed helicopter flight test data
[AD-A074141] N80-15079

DATA BASES
Aerodynamic data base users guide
[AD-A074448] N80-15983

DATA PROCESSING
A distributed processing system for radar data presentation N80-14075

DATA PROCESSING TERMINALS
AEROPP - Message and data switching systems for aeronautical operations A80-19579
DATA RECORDERS
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis
[AD-A074801] N80-15030
DATA REDUCTION
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(0)] N80-14140
Data reduction software for LORAN-C flight test evaluation
[NASA-CR-162730] N80-15064
DATA STORAGE
Aerodynamic data base users guide
[AD-A074448] N80-15983
DATA SYSTEMS
Some practical aspects of the calibration of air data systems A80-18865
DECISION MAKING
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations A80-18022
DEGREES OF FREEDOM
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom
[NASA-TM-80153] N80-14055
DEICING
Aircraft anti-icing/de-icing
[AD-A074128] N80-15078
DELAY
Aircraft delays at major US airports can be reduced
[PB-299442/4] N80-15061
DELTA WINGS
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow A80-17697
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376
DENSITY MEASUREMENT
Air traffic density and distribution measurements
[AD-A073229] N80-14064
DESIGN ANALYSIS
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
Problems related to the design and construction of a radar network N80-14066
Design study for ATA vacuum system aperture
[UCRL-15050] N80-15182
DESTRUCTIVE TESTS
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack A80-18062
DETERIORATION
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259
DETONATION WAVES
Oblique detonation wave ramjet
[NASA-CR-159192] N80-14131
DIFFUSERS
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
DIGITAL COMMAND SYSTEMS
Roll control by digitally controlled segment spoilers N80-15156
DIGITAL COMPUTERS
An observer system for sensor failure detection and isolation in digital flight control systems N80-14023
DIGITAL FILTERS
Filtering of synthetic radar data N80-14076
DIGITAL NAVIGATION
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
DIGITAL SYSTEMS
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system N80-14026
Failure detection, isolation and indication in highly integrated digital guidance and control system N80-14027
An assessment of and approach to the validation of digital flight control systems N80-14036
Integration of flight and fire control --- systems analysis of digital controlled integrated flight and fire control systems N80-14043
Digital system for dynamic turbine engine blade displacement measurements
[NASA-TM-81382] N80-14113
Loran digital phase-locked loop and RF front-end system error analysis
[NASA-CR-162731] N80-15065
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine digital control system design report
[NASA-CR-134920] N80-15090
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing control system design report
[NASA-CR-135337] N80-15092
DIGITAL TECHNIQUES
Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-CP-272] N80-14017
State of the art for digital avionics and controls, 1978 N80-14018
A flight control system using the DAIS architecture N80-14019
Trends in digital data processing and system architecture --- avionics applications N80-14020
Recent advances in fibre optics for high integrity digital control systems N80-14025
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-AR-148] N80-15140
DIRECT LIFT CONTROLS
In-flight measured characteristics of combined flap-spoiler direct lift controls N80-15165
DISPLAY DEVICES
ATC and the airborne traffic-situation display A80-18724
Infrared sensor system performance simulations A80-20900
Visual displays for air traffic control data N80-14077
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062
Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator
[AD-A071410] N80-15180
DOPPLER RADAR
Target tracking using Doppler-information in sensor oriented coordinates with a three dimensional array radar
[REPT-270] N80-14325
DRAG REDUCTION
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272

Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309
The minimum induced drag of aerofoils
[NACA-121] N80-15038
Direct side force and drag control with the aid of pylon split flaps
N80-15163

DRONE AIRCRAFT
Propulsion options for the HI SPOT long endurance drone airship
[AD-A074595] N80-14132

DROPS (LIQUIDS)
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953

DUCTED FAN ENGINES
The analysis of sound propagation in jet engine ducts using the finite difference method
[AD-A074233] N80-14853

DUCTED FANS
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan --- quiet engine program
[NASA-CR-134891] N80-15102

DUCTED FLOW
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970

DYNAMIC CHARACTERISTICS
On the dynamics of compressor surge
A80-17900
Dynamic identification of light aircraft structures and their flutter certification
N80-15145

DYNAMIC CONTROL
Theoretical aerodynamic methods for active control devices
N80-15150
A survey of experimental data on the aerodynamics of controls, in the light of future needs
N80-15151
AFFDL experience in active control technology
N80-15159
Fin design with ACT in the presence of strakes
N80-15161
Control integration technology impact --- as a basis for improving the combat effectiveness of all tactical aircraft
N80-15162

DYNAMIC RESPONSE
Linear systems analysis program, L224(QP). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137
Unsteady flow and dynamic response analyses for helicopter rotor blades
[NASA-CR-159190] N80-14355

DYNAMIC STRUCTURAL ANALYSIS
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response
A80-17716
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073

E

E-4A AIRCRAFT
Trajectory behaviour of a control configurated aircraft subjected to random disturbances
N80-15171

ECONOMIC FACTORS
The next supersonic transport
A80-20214

ECONOMICS
The economics of air traffic control
A80-18723

EJECTORS
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277

ELASTIC PROPERTIES
Determination of the stress intensity factor of composite structural members
A80-17958

ELASTIC WAVES
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition
A80-20151

ELECTRIC POWER SUPPLIES
Centralized ground power systems conserve energy
A80-18000

ELECTRICAL RESISTIVITY
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit
A80-19053

ELECTRO-OPTICS
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111

ELECTROMAGNETIC INTERFERENCE
Performance evaluation methods of a secondary radar network
N80-14068

ELECTROMAGNETIC SCATTERING
Code optimization for solving large 3D EMP problems --- electromagnetic scattering by aircraft structures
A80-19764

ELEVATORS (CONTROL SURFACES)
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics
N80-15178

ENERGY CONSERVATION
Centralized ground power systems conserve energy
A80-18000
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133

ENERGY POLICY
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259

ENGINE CONTROL
Integrated circuit characteristics at 260 C for aircraft engine-control applications
A80-20112
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine digital control system design report
[NASA-CR-134920] N80-15090
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine simulation report
[NASA-CR-134914] N80-15091
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing control system design report
[NASA-CR-135337] N80-15092

ENGINE DESIGN
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737
Computer simulation of engine systems --- for aircraft design
[AIAA PAPER 80-0051] A80-18253
Multi-variable cycle optimization by gradient methods --- for variable-cycle engines
[AIAA PAPER 80-0052] A80-18254
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255
Flow in transonic compressors
[AIAA PAPER 80-0124] A80-18357
Technology of the Rolls-Royce RB211 engine
A80-18864
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269

Installation effects on cycle selection for small turbo-fan engines
[AIAA PAPER 80-0106] A80-19280
Technologies conceived for the utilization of ceramics in turboengines
[ONERA, TP NO. 1979-132] A80-20076
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (CTW) engine acoustic design
[NASA-CR-135268] N80-14118
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
Oblique detonation wave ramjet
[NASA-CR-159192] N80-14131
Quiet Clean Short-haul Experimental Engine (QCSEE) Over The Wing (OTW) design report
[NASA-CR-134848] N80-15086
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) engine composite nacelle test report. Volume 1: Summary, aerodynamic and mechanical performance
[NASA-CR-159471] N80-15094
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary over-the-wing flight propulsion system analysis report
[NASA-CR-135296] N80-15095
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report
[NASA-CR-135010] N80-15098
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears test program
[NASA-CR-134669] N80-15103
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
Quiet Clean Short-haul Experimental Engine (QCSEE): Hamilton Standard cam/harmonic drive variable pitch fan actuation system detail design report
[NASA-CR-134852] N80-15107
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and mechanical design of the QCSEE under-the-wing fan
[NASA-CR-135009] N80-15109
Quiet Clean Short-haul Experimental Engine (QCSEE) UTW fan preliminary design
[NASA-CR-134842] N80-15111
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and preliminary mechanical design of the QCSEE OTW fan
[NASA-CR-134841] N80-15112
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design
[NASA-CR-134840] N80-15113
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing engine and control simulation results
[NASA-CR-135049] N80-15114
Quiet Clean Short-Haul Experimental Engine (QCSEE) ball spline pitch-change mechanism whirligig test report
[NASA-CR-135354] N80-15115
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) boiler plate nacelle and core exhaust nozzle design report
[NASA-CR-135008] N80-15116
Quiet Clean Short-haul Experimental Engine (QCSEE) whirl test of cam/harmonic pitch change actuation system
[NASA-CR-135140] N80-15117
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
Quiet Clean Short-Haul Experimental Engine (QSCEE). Preliminary analyses and design report, volume 1
[NASA-CR-134838] N80-15123
Quiet Clean Short-Haul Experimental Engine (QCSEE). Preliminary analyses and design report, volume 2
[NASA-CR-134839] N80-15124
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 1: Summary report
[NASA-CR-135323] N80-15125
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The Wing (OTW) propulsion system test report. Volume 3: Mechanical performance
[NASA-CR-135325] N80-15126
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135
PRS composites for advanced gas turbine engine components
[AD-A074287] N80-15137

ENGINE MONITORING INSTRUMENTS

Experimental investigation of the characteristics of pneumatic transfer lines A80-19052

ENGINE NOISE

Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) engine acoustic design
[NASA-CR-135268] N80-14118
Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen
[AD-A074391] N80-14147
Applications of diffraction theory to aeroacoustics --- aircraft noise N80-14870
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093

ENGINE PARTS

Engine component improvement program - Performance improvement
[AIAA PAPER 80-0223] A80-19300
Thermal state of structural members of aircraft engines --- Russian book A80-19412
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108

ENGINE TESTS

Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques A80-17521
Gas turbine carcase and accessory vibration - Problems of measurement and analysis A80-17730
A method of evaluation of gas turbine engines A80-20064
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968
Modification of axial compressor streamline program for analysis of engine test data
[NASA-TM-79312] N80-14051
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 2: Aerodynamics and performance --- engine performance tests to define propulsion system performance on turbofan engines
[NASA-CR-135324] N80-14120

Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen
[AD-A074391] N80-14147
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 1: Summary report
[NASA-CR-135323] N80-15125

ENTROPY
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition
A80-20151

ENVIRONMENT PROTECTION
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737

ENVIRONMENTAL MONITORING
A light aircraft camera Pod - The Enviro-Pod
A80-20251

ENVIRONMENTAL TESTS
Climatic chamber testing aircraft, engines armament and avionics; Test operations procedure --- environmental test chambers and facility for testing aircraft construction materials and engines
[AD-A074049] N80-15181

EQUATIONS OF MOTION
Formulation of coupled rotor/fuselage equations of motion
A80-17717
Hinged vehicle equations of motion
[AIAA PAPER 80-0364] A80-18336

ERROR ANALYSIS
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar
N80-14100
Determination of the repeatability of PEC --- flight tests for position error calibrating
[AETE-PR-79/36] N80-14109
Loran digital phase-locked loop and RF front-end system error analysis
[NASA-CR-162731] N80-15065

ERROR DETECTION CODES
Failure detection, isolation and indication in highly integrated digital guidance and control system
N80-14027

ESCAPE SYSTEMS
Aeronautical systems technology needs: Escape, rescue and survival
[AD-A074906] N80-14061

ESTIMATING
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647

EXHAUST DIFFUSERS
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277

EXHAUST EMISSION
Exhaust emission reduction for intermittent combustion aircraft engines
[NASA-CR-159757] N80-14130

EXHAUST FLOW SIMULATION
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968

EXHAUST GASES
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines
[NASA-TP-1582] N80-14125
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120

EXHAUST NOZZLES
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics
A80-20952
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) boiler plate nacelle and core exhaust nozzle design report
[NASA-CR-135008] N80-15116

EXHAUST SYSTEMS
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121

EXPERIMENTAL DESIGN
Concerning the information efficiency of aerodynamic experiments
A80-17671
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302

EXTERNALLY BLOWN FLAPS
The YC-14 upper surface blown flap: A unique control surface
N80-15157

F

F-15 AIRCRAFT
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627
Correlation of F-15 flight and wind tunnel test control effectiveness
N80-15152

F-16 AIRCRAFT
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability --- F-16
[NASA-TP-1538] N80-14136

F-18 AIRCRAFT
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638

F-104 AIRCRAFT
Stability and control aspects of the CCV-F104G
[MBB-UFE-1447(O)] N80-14141

FAIL-SAFE SYSTEMS
Failure detection, isolation and indication in highly integrated digital guidance and control system
N80-14027

FAILURE
Automatic recovery after sensor failure onboard
N80-14024

FAR FIELDS
Rotational noise of helicopter rotors
A80-17718
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964

FATIGUE (MATERIALS)
Review of investigations into aeronautics related fatigue Federal Republic of Germany
[LBF-S-142] N80-14422

FATIGUE LIFE
Fatigue life prediction of a bonded splice joint
[AIAA PAPER 80-0305] A80-18306
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346

FATIGUE TESTS
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
Model 540 rotor blade crack propagation investigation
[AD-A074734] N80-15081
FEASIBILITY ANALYSIS
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104
FEEDBACK CONTROL
Design criteria for optimal flight control systems --- study of optimal flight control systems engineering for feedback control
[AD-A074092] N80-15139
FIBER COMPOSITES
FRS composites for advanced gas turbine engine components
[AD-A074287] N80-15137
FIBER OPTICS
Recent advances in fibre optics for high integrity digital control systems
N80-14025
FIGHTER AIRCRAFT
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(0)] N80-14058
Flight testing of the buffeting behavior of combat aircraft
[ESA-TT-523] N80-14143
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations
N80-15155
Flaperon control: The versatile surface for fighter aircraft
N80-15158
Control considerations for CCV fighters at high angles of attack
N80-15160
Fin design with ACT in the presence of strakes
N80-15161
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack
N80-15166
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft
N80-15172
FILM COOLING
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299] A80-19316
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136
FINITE DIFFERENCE THEORY
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
The analysis of sound propagation in jet engine ducts using the finite difference method
[AD-A074233] N80-14853
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils
[NASA-CR-159141] N80-15052
FINITE ELEMENT METHOD
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627
FINNED BODIES
Fin design with ACT in the presence of strakes
N80-15161
FIRE CONTROL
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design
A80-20879
Integration of flight and fire control --- systems analysis of digital controlled integrated flight and fire control systems
N80-14043
Control integration technology impact --- as a basis for improving the combat effectiveness of all tactical aircraft
N80-15162
FIREPROOFING
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060
FLAMMABILITY
Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256
FLAPPING HINGES
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138
FLAPS (CONTROL SURFACES)
Direct side force and drag control with the aid of pylon split flaps
N80-15163
In-flight measured characteristics of combined flap-spoiler direct lift controls
N80-15165
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics
N80-15178
FLEXIBLE BODIES
Surface conforming thermal/pressure seal --- for control devices in space vehicles
[NASA-CASE-MSC-18422-1] N80-14400
FLEXIBLE WINGS
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
FLIGHT CHARACTERISTICS
Designing light airplanes --- Russian book
A80-19414
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965
Investigation of the oscillatory and flight behavior of rotor systems in relation with atmospheric turbulence
[BMVG-FBWT-79-5] N80-14142
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA
N80-15142
Control integration technology impact --- as a basis for improving the combat effectiveness of all tactical aircraft
N80-15162
FLIGHT CONDITIONS
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis
[AD-A074801] N80-15030

FLIGHT CONTROL
A strapdown inertial reference system for commercial airline use in navigation and flight control A80-17558
An integrated strapdown guidance and control system for launch vehicle application A80-17559
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations A80-18022
Advances in Guidance and Control Systems Using Digital Techniques [AGARD-CP-272] N80-14017
State of the art for digital avionics and controls, 1978 N80-14018
A flight control system using the DAIS architecture N80-14019
An observer system for sensor failure detection and isolation in digital flight control systems N80-14023
Automatic recovery after sensor failure onboard N80-14024
Recent advances in fibre optics for high integrity digital control systems N80-14025
Integration of flight and fire control --- systems analysis of digital controlled integrated flight and fire control systems N80-14043
Design criteria for optimal flight control systems --- study of optimal flight control systems engineering for feedback control [AD-A074092] N80-15139
Flight control and configuration design considerations for highly maneuverable aircraft N80-15154

FLIGHT PATHS
Constrained optimum trajectories with specified range A80-18538

FLIGHT RECORDERS
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis [AD-A074801] N80-15030

FLIGHT SAFETY
An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC) [AD-A074390] N80-14063

FLIGHT SIMULATION
Computer simulation of engine systems --- for aircraft design [AIAA PAPER 80-0051] A80-18253
Recent developments in flight simulation techniques A80-20907
Covariance simulation of ECAS - An aircraft collision avoidance system A80-20915
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability --- F-16 [NASA-TP-1538] N80-14136
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks [NASA-TP-1601] N80-15069

FLIGHT SIMULATORS
Controllers for aircraft motion simulators [AIAA PAPER 80-0050] A80-18252
Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator [AD-A071410] N80-15180

FLIGHT STABILITY TESTS
Stability and control aspects of the CCV-F104G [MBB-UFE-1447(0)] N80-14141

FLIGHT TESTS
Estimation of the accuracy of dynamic flight-determined coefficients [AIAA PAPER 80-0171] A80-17700
Flight certification of the Cessna TU206G amphibious floatplane A80-18186
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle [AIAA PAPER 80-0165] A80-20971
Determination of the repeatability of PEC --- flight tests for position error calibrating [AETE-PR-79/36] N80-14109
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time [NASA-TM-80194] N80-14114
Flight testing of the buffeting behavior of combat aircraft [ESA-TT-523] N80-14143
Data reduction software for LORAN-C flight test evaluation [NASA-CR-162730] N80-15064
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads [AD-A075612] N80-15077
Analysis of low-speed helicopter flight test data [AD-A074141] N80-15079
JA-6A circulation control wing contractor flight demonstration [AD-A074888] N80-15080
Correlation of F-15 flight and wind tunnel test control effectiveness N80-15152

FLIGHT TIME
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time [NASA-TM-80194] N80-14114

FLIGHT VEHICLES
Hinged vehicle equations of motion [AIAA PAPER 80-0364] A80-18336

FLOW CHARACTERISTICS
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor A80-17724
Separation due to shock wave-turbulent boundary layer interaction [ONERA, TP NO. 1979-146] A80-20083

FLOW DISTORTION
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor A80-17724

FLOW DISTRIBUTION
Improved numerical simulation of high speed inlets using the Navier-Stokes equations [AIAA PAPER 80-0383] A80-18340
Flow in transonic compressors [AIAA PAPER 80-0124] A80-18357
Streamwise development of the flow over a delta wing [AIAA PAPER 80-0200] A80-18376
Theoretical study of aerodynamic characteristics of wings having vortex flow [NASA-CR-159184] N80-14053
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets [AD-A074187] N80-14133
Aerodynamic interaction on a close-coupled canard wing configuration N80-15175
On the effects of gaps on control surface characteristics N80-15176

FLOW GEOMETRY
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet [AIAA PAPER 80-0386] A80-20970
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data [NASA-TM-81410] N80-15364

FLOW MEASUREMENT
Photon correlation laser velocimeter measurements in highly turbulent flow fields [AIAA PAPER 80-0344] A80-18328
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover [NASA-TM-78615] N80-14049

FLOW STABILITY
Sound generation in a flow near a compliant wall A80-20153

FLOW VELOCITY
Streamwise development of the flow over a delta wing [AIAA PAPER 80-0200] A80-18376
FLUID DYNAMICS
AFFDL experience in active control technology N80-15159
FLUTTER
General theory of aerodynamic instability and the mechanism of flutter [NACA-496] N80-15047
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA N80-15142
FLUTTER ANALYSIS
Evaluation of the intensity of beat-induced vibrations A80-17965
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom [NASA-TM-80153] N80-14055
Excitation and analysis technique for flight flutter tests [MBB-UF-1446(O)] N80-14140
Low cost aircraft flutter clearance --- conference [AGARD-CP-278] N80-15141
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers N80-15143
An empirical approach for checking flutter stability of gliders and light aircraft N80-15144
Dynamic identification of light aircraft structures and their flutter certification N80-15145
A flutter-speed formula for wings of high aspect ratio N80-15147
The minimum cost approach to flutter clearance N80-15148
FLY BY WIRE CONTROL
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system N80-14026
Stability and control aspects of the CCV-F104G [MBB-UFE-1447(O)] N80-14141
Flaperon control: The versatile surface for fighter aircraft N80-15158
FOREBODIES
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation [AIAA PAPER 80-0173] A80-18352
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet [AIAA PAPER 80-0386] A80-20970
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft N80-15172
FOURIER TRANSFORMATION
Map-matching techniques for terminal guidance using Fourier phase information A80-17517
Implementation of air traffic control radar receivers with fast Fourier transform processors N80-14086
FRACTURE MECHANICS
Determination of the stress intensity factor of composite structural members A80-17958
Fatigue life prediction of a bonded splice joint [AIAA PAPER 80-0305] A80-18306
FRANCE
Marseilles - Metamorphosis of an airport A80-17999
FREE FLOW
Hybrid vortex method for lifting surfaces with free-vortex flow [AIAA PAPER 80-0070] A80-19307
FREE JETS
Photon correlation laser velocimeter measurements in highly turbulent flow fields [AIAA PAPER 80-0344] A80-18328
FREQUENCY STABILITY
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles A80-19990
FRICTION MEASUREMENT
An improved sensing element for skin-friction balance measurements --- supersonic drag measuring instrument [AIAA PAPER 80-0049] A80-18251
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit A80-19053
FUEL COMBUSTION
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition A80-20151
NASA broad-specification fuels combustion technology program: Status and description [NASA-TM-79315] N80-14126
Exhaust emission reduction for intermittent combustion aircraft engines [NASA-CR-159757] N80-14130
FUEL CONSUMPTION
Preparing aircraft propulsion for a new era in energy and the environment A80-17737
Technology of the Rolls-Royce RB211 engine A80-18864
Engine component improvement program - Performance improvement [AIAA PAPER 80-0223] A80-19300
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines [AIAA PAPER 80-0224] A80-19301
The next supersonic transport A80-20214
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment --- flight tests of an algorithm to minimize fuel consumption of aircraft based on flight time [NASA-TM-80194] N80-14114
FUEL CORROSION
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel --- jet engine fuels A80-17675
FUEL INJECTION
Mach 3 hydrogen external/base burning [AIAA PAPER 80-0280] A80-19311
FUEL-AIR RATIO
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines [NASA-TP-1582] N80-14125
FULL SCALE TESTS
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics A80-20952
FUSELAGES
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response A80-17716
Formulation of coupled rotor/fuselage equations of motion A80-17717
Experimental and numerical results of sound scattering by a body --- interaction of aerodynamic noise and fuselage N80-14873

G

GAPS
On the effects of gaps on control surface characteristics N80-15176
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics N80-15178

GAS INJECTION
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299] A80-19316
GAS MIXTURES
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines
[NASA-TP-1582] N80-14125
GAS TURBINE ENGINES
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730
Evaluation of the intensity of beat-induced vibrations
A80-17965
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303
Thermal state of structural members of aircraft engines --- Russian book
A80-19412
A method of evaluation of gas turbine engines
A80-20064
Unification of oils for aircraft gas-turbine engines
A80-20690
Digital system for dynamic turbine engine blade displacement measurements
[NASA-TM-81382] N80-14113
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines
[NASA-TP-1582] N80-14125
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128
Contact stress analysis of ceramic-to-metal interfaces --- in gas turbine engines
[AD-A074491] N80-14417
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136
FRS composites for advanced gas turbine engine components
[AD-A074287] N80-15137
GAS TURBINES
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122
GASEOUS FUELS
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition
A80-20151
GEARS
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears test program
[NASA-CR-134669] N80-15103
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears bearing development program
[NASA-CR-134890] N80-15105
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
GENERAL AVIATION AIRCRAFT
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351
Designing light airplanes --- Russian book
A80-19414
Meteorological input to general aviation pilot training
N80-14634
Accident investigation
N80-14636
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers
N80-15143
GLIDE PATHS
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories --- for low level weapons delivery
[AIAA PAPER 80-0061] A80-18260
GLIDERS
Low cost aircraft flutter clearance --- conference
[AGARD-CP-278] N80-15141
An empirical approach for checking flutter stability of gliders and light aircraft
N80-15144
A simplified ground vibration test procedure for sailplanes and light aircraft
N80-15146
GLOBAL ATMOSPHERIC RESEARCH PROGRAM
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059
GLOBAL POSITIONING SYSTEM
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904
The Global Positioning System
A80-20992
Development of aiding GPS/strapdown inertial navigation system
N80-14031
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062
GRAPHITE-EPOXY COMPOSITE MATERIALS
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report
[NASA-CR-135010] N80-15098
Quiet Clean Short-haul Experimental Engine (QCSEE) composite fan frame design report
[NASA-CR-135278] N80-15110
GROUND EFFECT (AERODYNAMICS)
The criticality of engine exhaust simulations on VSTOL model-measured ground effects
[AIAA PAPER 80-0230] A80-18276
GROUND HANDLING
Computer simulation of an air cargo small package sorting system
A80-20866
Models for freight access to air terminals
A80-20869
Air cargo container utilization optimization through modeling
A80-20870
GROUND STATIONS
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
GROUND TESTS
A simplified ground vibration test procedure for sailplanes and light aircraft
N80-15146
The minimum cost approach to flutter clearance
N80-15148
GUIDANCE (MOTION)
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-AR-148] N80-15140
GUIDANCE SENSORS
An observer system for sensor failure detection and isolation in digital flight control systems
N80-14023
Automatic recovery after sensor failure onboard
N80-14024
GUN TURRETS
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design
A80-20879

GUST LOADS
Effect of spanwise gust variations N80-14639
GUSTS
Investigation of the oscillatory and flight behavior of rotor systems in relation with atmospheric turbulence
[BMVG-FBWT-79-5] N80-14142
GYROCOMPASSES
Development aspects of a dynamically tuned gyro for strapdown - AHRS --- Attitude and Heading Reference System A80-17553
GYROSCOPIC STABILITY
Development aspects of a dynamically tuned gyro for strapdown - AHRS --- Attitude and Heading Reference System A80-17553
A strapdown inertial reference system for commercial airline use in navigation and flight control A80-17558
An integrated strapdown guidance and control system for launch vehicle application A80-17559

H

HAIL
The T-28 thunder/hailstorm penetration aircraft N80-14640
HARDNESS
Fleet hardness variation --- to determine aircraft survivability due to blast loads
[AD-A074849] N80-15029
HARDNESS TESTS
Fleet hardness variation --- to determine aircraft survivability due to blast loads
[AD-A074849] N80-15029
HARMONIC EXCITATION
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(0)] N80-14140
HARMONIC OSCILLATION
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
HAZARDS
Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen
[AD-A074391] N80-14147
HEAT TRANSFER
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133
HELICOPTER CONTROL
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response A80-17716
HELICOPTER DESIGN
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design A80-20879
HELICOPTER PERFORMANCE
Computer program to prepare airfoil characteristic data for use in helicopter performance calculations
[NASA-TM-78627] N80-15031
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138
HELICOPTER TAIL ROTORS
Formulation of coupled rotor/fuselage equations of motion A80-17717
HELICOPTERS
Rotational noise of helicopter rotors A80-17718
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086
Experience in producing software for the ground station of a remotely piloted helicopter system N80-14038
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis
[AD-A074801] N80-15030
HIGH ALTITUDE ENVIRONMENTS
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
HIGH ASPECT RATIO
A flutter-speed formula for wings of high aspect ratio N80-15147
HIGH PRESSURE OXYGEN
LOX/GOX mechanical impact tester assessment
[NASA-TM-74106] N80-15179
HIGH TEMPERATURE ENVIRONMENTS
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122
HINGES
Hinged vehicle equations of motion
[AIAA PAPER 80-0364] A80-18336
HISTORIES
AFFDL experience in active control technology N80-15159
HORIZONTAL FLIGHT
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories --- for low level weapons delivery
[AIAA PAPER 80-0061] A80-18260
HOVERING
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
HOVERING STABILITY
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
HUMAN FACTORS ENGINEERING
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060
HUMAN TOLERANCES
Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen
[AD-A074391] N80-14147
HYDROCARBON FUELS
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel --- jet engine fuels A80-17675
HYDRODYNAMICS
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034
Pressure distribution on Joukowski wings
[NACA-TM-336] N80-15036
HYDROGEN FUELS
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
HYPERSONIC AIRCRAFT
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068
HYPERSONIC VEHICLES
Hypersonic cruise aircraft propulsion integration study, volume 1
[NASA-CR-158926-VOL-1] N80-15074
Hypersonic cruise aircraft propulsion integration study, volume 2
[NASA-CR-158926-VOL-2] N80-15075
HYPERSONIC WIND TUNNELS
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel A80-17673

I

IMAGE CORRELATORS
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques A80-17521
Performance evaluation of image correlation techniques --- for aircraft inertial navigation systems A80-17534

IMAGE PROCESSING
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects A80-17402
Map-matching techniques for terminal guidance using Fourier phase information A80-17517
Guidance system position update by multiple subarea correlation A80-17518

IMAGE TUBES
Visual displays for air traffic control data N80-14077

IMAGES
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082

IMPACT DAMAGE
Atmospheric effects on Martian ejecta emplacement A80-20192
Soil analyses and evaluations at the impact dynamics research facility for two full-scale aircraft crash tests
[NASA-CR-159199] N80-15299

IMPACT LOADS
The loads at landing impact --- for aircraft A80-17723

IMPACT RESISTANCE
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060

IMPACT TESTING MACHINES
LOX/GOX mechanical impact tester assessment
[NASA-TM-74106] N80-15179

IN-FLIGHT MONITORING
In-flight measured characteristics of combined flap-spoiler direct lift controls N80-15165

INDICATING INSTRUMENTS
Some practical aspects of the calibration of air data systems A80-18865

INERTIAL GUIDANCE
Guidance system position update by multiple subarea correlation A80-17518

INERTIAL NAVIGATION
Development aspects of a dynamically tuned gyro for strapdown - AHRS --- Attitude and Heading Reference System A80-17553
A strapdown inertial reference system for commercial airline use in navigation and flight control A80-17558
An integrated strapdown guidance and control system for launch vehicle application A80-17559
Development of aiding GPS/strapdown inertial navigation system N80-14031
Methods for strap-down attitude estimation and navigation with accelerometers N80-14034
A high accuracy flight profile determining system --- systems analysis of inertial navigation system for aircraft position determination N80-14042

INERTIAL REFERENCE SYSTEMS
A strapdown inertial reference system for commercial airline use in navigation and flight control A80-17558

INFORMATION RETRIEVAL
Aerodynamic data base users guide
[AD-A074448] N80-15983

INFRARED SCANNERS
Infrared sensor system performance simulations A80-20900

INLET FLOW
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Improved numerical simulation of high speed inlets using the Navier-Stokes equations
[AIAA PAPER 80-0383] A80-18340
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134

INSTALLING
Installation effects on cycle selection for small turbo-fan engines
[AIAA PAPER 80-0106] A80-19280

INSTRUMENT LANDING SYSTEMS
What brings us down tomorrow - Landing guidance systems for the 1980s A80-18725

INTEGRATED CIRCUITS
Integrated circuit characteristics at 260 C for aircraft engine-control applications A80-20112

INVISCID FLOW
A numerical approach to subsonic viscous-inviscid interaction A80-19070

ITALY
On radar in air traffic control --- conference, Rome, Jul. 1979
[PUB-11-1979] N80-14065
Problems related to the design and construction of a radar network N80-14066
Organization of an integrated global maintenance service --- Radar Networks N80-14069

J

JET AIRCRAFT
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318

JET AIRCRAFT NOISE
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition A80-20151
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965
Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion systems test report. Volume 4: Acoustic performance
[NASA-CR-135326] N80-15118
An experimental study of the structure and acoustic field of a jet in a cross stream --- Ames 7-ft by 10-ft wind tunnel tests
[NASA-CR-162464] N80-15871

JET ENGINE FUELS
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel --- jet engine fuels A80-17675

Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256

JET ENGINES
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor A80-17724
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
Computer simulation of engine systems
[NASA-TM-79290] N80-15132

JET EXHAUST
The criticality of engine exhaust simulations on VSTOL model-measured ground effects
[AIAA PAPER 80-0230] A80-18276

JET MIXING FLOW
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968

JOUKOWSKI TRANSFORMATION
Pressure distribution on Joukowski wings
[NACA-TM-336] N80-15036

K

KEROSENE
Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256

KINETIC THEORY
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040

L

LAMINAR FLOW
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238

LAMINAR FLOW AIRFOILS
A parametric wing design study for a modern laminar flow wing
[NASA-TM-80154] N80-15050

LAMINATES
Determination of the stress intensity factor of composite structural members A80-17958
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632

LANDING GEAR
The loads at landing impact --- for aircraft A80-17723

LANDING LOADS
The loads at landing impact --- for aircraft A80-17723

LASER APPLICATIONS
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128

LASER DOPPLER VELOCIMETERS
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328

LATERAL CONTROL
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls N80-15153
Roll control by digitally controlled segment spoilers N80-15156
Flaperon control: The versatile surface for fighter aircraft N80-15158

LATERAL STABILITY
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book A80-19374

LATTICES (MATHEMATICS)
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052

LAUNCH VEHICLES
An integrated strapdown guidance and control system for launch vehicle application A80-17559

LEADING EDGES
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309
Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052

LIFE CYCLE COSTS
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638

LIFE SUPPORT SYSTEMS
Aeronautical systems technology needs: Escape, rescue and survival
[AD-A074906] N80-14061

LIFT
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls N80-15153

LIGHT AIRCRAFT
Designing light airplanes --- Russian book A80-19414
A light aircraft camera Pod - The Enviro-Pod A80-20251
A method of simplifying weight and balance for small aircraft
[SAWE PAPER 1278] A80-20630
Low cost aircraft flutter clearance --- conference
[AGARD-CP-278] N80-15141
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA N80-15142
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers N80-15143
An empirical approach for checking flutter stability of gliders and light aircraft N80-15144
Dynamic identification of light aircraft structures and their flutter certification N80-15145
A simplified ground vibration test procedure for sailplanes and light aircraft N80-15146
The minimum cost approach to flutter clearance N80-15148

LINEAR SYSTEMS
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137

LIQUID OXYGEN
LOX/GOX mechanical impact tester assessment
[NASA-TM-74106] N80-15179

LOAD TESTS
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068

LONGITUDINAL STABILITY
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion --- Russian book A80-19374
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability --- F-16 [NASA-TP-1538] N80-14136
LOOP ANTENNAS
Experimental loop antennas for 60 KHz to 200 KHz [NASA-CR-162729] N80-15063
LORAN
Loran digital phase-locked loop and RF front-end system error analysis [NASA-CR-162731] N80-15065
LORAN C
Experimental loop antennas for 60 KHz to 200 KHz [NASA-CR-162729] N80-15063
Data reduction software for LORAN-C flight test evaluation [NASA-CR-162730] N80-15064
LOW ASPECT RATIO
Low-aspect-ratio limit of the toroidal reactor - The spheromak A80-17876
LOW COST
The minimum cost approach to flutter clearance N80-15148
LOW SPEED
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls N80-15153
Unsteady aerodynamics of two-dimensional spoilers at low speeds N80-15170
LUBRICANTS
The physical and chemical characterization of ten military turbine engine lubricants [AD-A074073] N80-15265
LUBRICATING OILS
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit A80-19053
Unification of oils for aircraft gas-turbine engines A80-20690

M

MAGNETOHYDRODYNAMIC STABILITY
Low-aspect-ratio limit of the toroidal reactor - The spheromak A80-17876
MAINTENANCE
Organization of an integrated global maintenance service --- Radar Networks N80-14069
MAN MACHINE SYSTEMS
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations A80-18022
A statistical method applied to pilot behavior analysis in multiloop systems A80-18537
Automation and air traffic control A80-18722
Vocabulary specification for automatic speech recognition in aircraft cockpits [AD-A073703] N80-14303
MANUAL CONTROL
Pilot control through the TAFCOS automatic flight control system [NASA-TM-81152] N80-14138
MANUFACTURING
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers N80-15143
MAP MATCHING GUIDANCE
Map-matching techniques for terminal guidance using Fourier phase information A80-17517
Guidance system position update by multiple subarea correlation A80-17518
MARKET RESEARCH
Airport noise, location rent, and the market for residential amenities A80-17720
MARS ATMOSPHERE
Atmospheric effects on Martian ejecta emplacement A80-20192
MARS SURFACE
Atmospheric effects on Martian ejecta emplacement A80-20192
MATHEMATICAL MODELS
Models for freight access to air terminals A80-20869
Air cargo container utilization optimization through modeling A80-20870
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system [AD-A073681] N80-14106
Application of the multistage axial-flow compressor time-dependent mathematical modeling technique to the TF41-A-1 modified block 76 compressor [AD-A074478] N80-14134
Pressure distribution on Joukowski wings [NACA-TM-336] N80-15036
A flutter-speed formula for wings of high aspect ratio N80-15147
MEASURING INSTRUMENTS
An improved sensing element for skin-friction balance measurements --- supersonic drag measuring instrument [AIAA PAPER 80-0049] A80-18251
MECHANICAL PROPERTIES
The physical and chemical characterization of ten military turbine engine lubricants [AD-A074073] N80-15265
METAL FATIGUE
Sonic fatigue design data for bonded aluminum aircraft structures [AIAA PAPER 80-0303] A80-18304
Fatigue life prediction of a bonded splice joint [AIAA PAPER 80-0305] A80-18306
METAL JOINTS
Fatigue life prediction of a bonded splice joint [AIAA PAPER 80-0305] A80-18306
METAL MATRIX COMPOSITES
FRS composites for advanced gas turbine engine components [AD-A074287] N80-15137
METAL PARTICLES
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit A80-19053
METAL SURFACES
Contact stress analysis of ceramic-to-metal interfaces --- in gas turbine engines [AD-A074491] N80-14417
METEOROLOGICAL INSTRUMENTS
Current research on aviation weather (bibliography), 1979 [NASA-CR-3214] N80-14651
METEOROLOGICAL RADAR
Weather detection using airport surveillance radar A80-19129
METEOROLOGY
Meteorological input to general aviation pilot training N80-14634
MICROORGANISMS
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments [AD-A073761] N80-14259
MICROPROCESSORS
Modular strapdown guidance unit with embedded microprocessors [AIAA PAPER 78-1239] A80-18534
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
MICROWAVE FREQUENCIES
Development trends of airport surface traffic control radar N80-14087
MICROWAVE LANDING SYSTEMS
What brings us down tomorrow - Landing guidance systems for the 1980s A80-18725

MILITARY AIRCRAFT
Application of RCS guidelines to weight effective aircraft design --- Radar Cross Section
[SAWE PAPER 1270] A80-20626
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636
AFFDL experience in active control technology
N80-15159
MILITARY HELICOPTERS
Analysis of low-speed helicopter flight test data
[AD-A074141] N80-15079
MILITARY TECHNOLOGY
Navy V/STOL - A continuing initiative
[SAWE PAPER 1325] A80-20655
AFFDL experience in active control technology
N80-15159
Control integration technology impact --- as a basis for improving the combat effectiveness of all tactical aircraft
N80-15162
MISSILE CONTROL
Modular strapdown guidance unit with embedded microprocessors
[AIAA PAPER 78-1239] A80-18534
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation
A80-20901
MISSILE DESIGN
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
MODAL RESPONSE
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
MODELS
Model 540 rotor blade crack propagation investigation
[AD-A074734] N80-15081
MOMENTUM
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040
MOTION SIMULATORS
Controllers for aircraft motion simulators
[AIAA PAPER 80-0050] A80-18252
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15059
MTBF
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638

N

NACELLES
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report
[NASA-CR-134868] N80-15088
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report, volume 1
[NASA-CR-135249] N80-15096
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report. Volume 3: Mechanical performance
[NASA-CR-135251] N80-15097
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) boilerplate nacelle design report
[NASA-CR-135168] N80-15099
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report --- to verify strength of selected composite materials
[NASA-CR-135075] N80-15100
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) boiler plate nacelle and core exhaust nozzle design report
[NASA-CR-135008] N80-15116
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119
NASA PROGRAMS
Engine component improvement program - Performance improvement
[AIAA PAPER 80-0223] A80-19300
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060
Quiet powered-lift propulsion
[NASA-CP-2077] N80-15127
NAVIER-STOKES EQUATION
Improved numerical simulation of high speed inlets using the Navier-Stokes equations
[AIAA PAPER 80-0383] A80-18340
NAVIGATION AIDS
Performance evaluation of image correlation techniques --- for aircraft inertial navigation systems
A80-17534
NAVIGATION SATELLITES
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904
NAVSTAR SATELLITES
The Global Positioning System
A80-20992
NEAR FIELDS
Rotational noise of helicopter rotors
A80-17718
NOISE GENERATORS
Sound generation in a flow near a compliant wall
A80-20153
An experimental study of the structure and acoustic field of a jet in a cross stream --- Ames 7-ft by 10-ft wind tunnel tests
[NASA-CR-162464] N80-15871
NOISE INTENSITY
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
NOISE MEASUREMENT
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874
NOISE POLLUTION
Airport noise, location rent, and the market for residential amenities
A80-17720
NOISE PREDICTION (AIRCRAFT)
Rotational noise of helicopter rotors
A80-17718
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965
NOISE PROPAGATION
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874
NOISE REDUCTION
Structural parameters that influence the noise reduction characteristics of typical general aviation materials
[AIAA PAPER 80-0038] A80-18248
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965

Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle [AIAA PAPER 80-0165] A80-20971
Acoustically swept rotor --- helicopter noise reduction [NASA-CASE-ARC-11106-1] N80-14107
Quiet short-haul research aircraft familiarization document --- STOL [NASA-TM-81149] N80-14108
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1 [NASA-CR-134849] N80-15083
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8) diameter fan, volume 2 [NASA-CR-134850] N80-15084
Demonstration of short haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 3 [NASA-CR-134851] N80-15085
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan --- quiet engine program [NASA-CR-134891] N80-15102
Quiet Clean Short-Haul Experimental Engine (QCSEE): Acoustic treatment development and design [NASA-CR-135266] N80-15122
Evaluation of approximate methods for the prediction of noise shielding by airframe components [NASA-TP-1004] N80-15129

MONOGRAPHS
A method of simplifying weight and balance for small aircraft [SAWE PAPER 1278] A80-20630

NONDESTRUCTIVE TESTS
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques A80-17521

NOSE FINS
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration [AIAA PAPER 80-0329] A80-18318

NOSES (FOREBODIES)
Control of forebody three-dimensional flow separations N80-15164

NOZZLE DESIGN
Acoustic considerations of flight effects on jet noise suppressor nozzles [AIAA PAPER 80-0164] A80-20965
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle [AIAA PAPER 80-0165] A80-20971

NOZZLE FLOW
Photon correlation laser velocimeter measurements in highly turbulent flow fields [AIAA PAPER 80-0344] A80-18328
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data [NASA-TM-81410] N80-15364

NOZZLE GEOMETRY
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA) [NASA-TP-1556] N80-14121

NUCLEAR EXPLOSION EFFECT
Protective coatings for aircraft composites in nuclear environments [AD-A074889] N80-14199

NUMERICAL ANALYSIS
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories --- for low level weapons delivery [AIAA PAPER 80-0061] A80-18260
The minimum cost approach to flutter clearance N80-15148

NUMERICAL CONTROL
Modular strapdown guidance unit with embedded microprocessors [AIAA PAPER 78-1239] A80-18534

NUMERICAL FLOW VISUALIZATION
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil [AIAA PAPER 80-0010] A80-18238
Engine aerodynamic installation by numerical simulation [AIAA PAPER 80-0108] A80-18271
Improved numerical simulation of high speed inlets using the Navier-Stokes equations [AIAA PAPER 80-0383] A80-18340
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis [AIAA PAPER 80-0384] A80-20969

NUMERICAL INTEGRATION
Direct integration of transient rotor dynamics [NASA-TP-1597] N80-15128

O

OBLIQUE SHOCK WAVES
Oblique detonation wave ramjet [NASA-CR-159192] N80-14131

OMEGA NAVIGATION SYSTEM
The Omega radio navigation system --- Russian book A80-19413

OPERATING SYSTEMS (COMPUTERS)
The integrity of onboard computer programs: A solution N80-14028
The avionics computer program: Practical experiences with a methodology --- Mirage F1 and Mirage 200 aircraft N80-14037

OPTIMAL CONTROL
Controllers for aircraft motion simulators [AIAA PAPER 80-0050] A80-18252
Constrained optimum trajectories with specified range A80-18538
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design A80-20879
Design criteria for optimal flight control systems --- study of optimal flight control systems engineering for feedback control [AD-A074092] N80-15139

OPTIMIZATION
Multi-variable cycle optimization by gradient methods --- for variable-cycle engines [AIAA PAPER 80-0052] A80-18254
Optimization of turbine nozzle cooling by combining impingement and film injection [AIAA PAPER 80-0299] A80-19316
Code optimization for solving large 3D EMP problems --- electromagnetic scattering by aircraft structures A80-19764
Advanced technology effects on V/STOL propulsive system weight [SAWE PAPER 1300] A80-20640
Air cargo container utilization optimization through modeling A80-20870

ORBITAL POSITION ESTIMATION
The Russian satellite navigation system A80-20982

OXIDATION
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel --- jet engine fuels A80-17675

OZONE
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1 [NASA-TM-79166] N80-15059

P

PANORAMIC CAMERAS
A light aircraft camera Pod - The Enviro-Pod A80-20251

PARTICLE SIZE DISTRIBUTION
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit A80-19053

PASSENGERS
NASA technical advances in aircraft occupant safety --- clear air turbulence detectors, fire resistant materials, and crashworthiness
[NASA-TM-80851] N80-15060
PAVEMENTS
An analytical method of testing pavement strength A80-17998
Reflection cracking of bituminous overlays for airport pavements: A state of the art
[AD-A073484] N80-14144
PENALTY FUNCTION
A first look at the effect of severe rainfall upon an aircraft
[NASA-CR-162569] N80-15058
PERFORMANCE PREDICTION
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow A80-17697
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
Infrared sensor system performance simulations A80-20900
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
Summary of advanced methods for predicting high speed propeller performance
[NASA-TM-81409] N80-15051
PERFORMANCE TESTS
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel A80-17673
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
Performance evaluation methods of a secondary radar network N80-14068
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 2: Aerodynamics and performance --- engine performance tests to define propulsion system performance on turbofan engines
[NASA-CR-135324] N80-14120
The CF6 jet engine performance improvement: New front mount
[NASA-CR-159639] N80-14127
JA-6A circulation control wing contractor flight demonstration
[AD-A074888] N80-15080
PERTURBATION
Trajectory behaviour of a control configurated aircraft subjected to random disturbances N80-15171
PHASED ARRAYS
Target tracking using Doppler-information in sensor oriented coordinates with a three dimensional array radar
[REPT-270] N80-14325
PHOTOGRAPHIC RECORDING
US Army Test and Evaluation Command test operations procedures: Photographic and video image support aviation materiel
[AD-A074883] N80-14377
PHYSIOLOGICAL RESPONSES
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082
PILOT PERFORMANCE
A statistical method applied to pilot behavior analysis in multiloop systems A80-18537
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15069
Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator
[AD-A071410] N80-15180
PILOT TRAINING
Meteorological input to general aviation pilot training N80-14634
PISTON ENGINES
Experimental investigation of the characteristics of pneumatic transfer lines A80-19052
Exhaust emission reduction for intermittent combustion aircraft engines
[NASA-CR-159757] N80-14130
PITCH (INCLINATION)
Quiet Clean Short-haul Experimental Engine (QCSEE). Ball spline pitch change mechanism design report
[NASA-CR-134873] N80-15101
PLANFORMS
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
PLASMA CONTROL
Low-aspect-ratio limit of the toroidal reactor - The spheromak A80-17876
PNEUMATIC EQUIPMENT
Experimental investigation of the characteristics of pneumatic transfer lines A80-19052
PNEUMATICS
On the dynamics of compressor surge A80-17900
PODS (EXTERNAL STORES)
A light aircraft camera Pod - The Enviro-Pod A80-20251
POLLUTION CONTROL
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
POLYIMIDE RESINS
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119
POLYMER MATRIX COMPOSITE MATERIALS
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632
POROUS WALLS
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047
POSITION (LOCATION)
Guidance system position update by multiple subarea correlation A80-17518
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128
POSITION ERRORS
Determination of the repeatability of PEC --- flight tests for position error calibrating
[AETE-PR-79/36] N80-14109
POSITION INDICATORS
A high accuracy flight profile determining system --- systems analysis of inertial navigation system for aircraft position determination N80-14042
POTENTIAL FLOW
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
POTENTIAL THEORY
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
POWER SUPPLY CIRCUITS
An overvoltage safety system for direct current aircraft generators A80-19051
POWERED LIFT AIRCRAFT
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
Quiet powered-lift propulsion
[NASA-CP-2077] N80-15127
The YC-14 upper surface blown flap: A unique control surface N80-15157

PREDICTION ANALYSIS TECHNIQUES
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets
[AD-A074187] N80-14133
PRESSURE
Surface conforming thermal/pressure seal --- for control devices in space vehicles
[NASA-CASE-MSC-18422-1] N80-14400
PRESSURE DISTRIBUTION
Pressure distribution on Joukowski wings
[NACA-TM-336] N80-15036
The aerodynamic forces on airship hulls
[NACA-184] N80-15039
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils
[NASA-CR-159141] N80-15052
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071
PRESSURE MEASUREMENTS
Aeroacoustic measuring techniques in or outside turbulent flows
N80-14876
PRESSURE RECOVERY
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel
A80-17673
PROBLEM SOLVING
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom
[NASA-TM-80153] N80-14055
PROFILOMETERS
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques
A80-17521
PROGRAM VERIFICATION (COMPUTERS)
An assessment of and approach to the validation of digital flight control systems
N80-14036
PROJECT PLANNING
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan --- Ames 40-ft by 80-ft wind tunnel tests
[NASA-TM-78562] N80-15067
PROPELLER BLADES
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
PROPELLER EFFICIENCY
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
Summary of advanced methods for predicting high speed propeller performance
[NASA-TM-81409] N80-15051
PROPULSION SYSTEM CONFIGURATIONS
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640
Oblique detonation wave ramjet
[NASA-CR-159192] N80-14131
Propulsion options for the HI SPOT long endurance drone airship
[AD-A074595] N80-14132
Hypersonic cruise aircraft propulsion integration study, volume 1
[NASA-CR-158926-VOL-1] N80-15074
Hypersonic cruise aircraft propulsion integration study, volume 2
[NASA-CR-158926-VOL-2] N80-15075
Quiet Clean Short-haul Experimental Engine (QCSEE) Over The Wing (OTW) design report
[NASA-CR-134848] N80-15086
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary over-the-wing flight propulsion system analysis report
[NASA-CR-135296] N80-15095
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) boilerplate nacelle design report
[NASA-CR-135168] N80-15099
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and mechanical design of the QCSEE under-the-wing fan
[NASA-CR-135009] N80-15109
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
Quiet Clean Short-Haul Experimental Engine (QSCEE). Preliminary analyses and design report, volume 1
[NASA-CR-134838] N80-15123
Quiet Clean Short-Haul Experimental Engine (QCSEE). Preliminary analyses and design report, volume 2
[NASA-CR-134839] N80-15124
PROPULSION SYSTEM PERFORMANCE
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737
Multi-variable cycle optimization by gradient methods --- for variable-cycle engines
[AIAA PAPER 80-0052] A80-18254
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 2: Aerodynamics and performance --- engine performance tests to define propulsion system performance on turbofan engines
[NASA-CR-135324] N80-14120
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report
[NASA-CR-134868] N80-15088
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) engine composite nacelle test report. Volume 1: Summary, aerodynamic and mechanical performance
[NASA-CR-159471] N80-15094
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report, volume 1
[NASA-CR-135249] N80-15096
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report. Volume 3: Mechanical performance
[NASA-CR-135251] N80-15097
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears bearing development program
[NASA-CR-134890] N80-15105
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 1: Summary report
[NASA-CR-135323] N80-15125
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The Wing (OTW) propulsion system test report. Volume 3: Mechanical performance
[NASA-CR-135325] N80-15126
PROPULSIVE EFFICIENCY
Engine component improvement program - Performance improvement
[AIAA PAPER 80-0223] A80-19300
Quiet Clean Short-Haul Experimental Engine (QCSEE). Under-the-wing (UTW) engine boilerplate Nacelle test report. Volume 2: Aerodynamics and performance
[NASA-CR-135250] N80-14116
PROTECTIVE COATINGS
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
PYLON MOUNTING
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645

PYLONS
Direct side force and drag control with the aid of pylon split flaps
N80-15163

Q

QUARTZ CRYSTALS
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles
A80-19990

QUIET ENGINE PROGRAM
Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115
Quiet Clean Short-Haul Experimental Engine (QCSEE). Under-the-wing (UTW) engine boilerplate Nacelle test report. Volume 2: Aerodynamics and performance
[NASA-CR-135250] N80-14116
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) engine acoustic design
[NASA-CR-135268] N80-14118
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1
[NASA-CR-134849] N80-15083
Demonstration of short haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 3
[NASA-CR-134851] N80-15085
Quiet Clean Short-haul Experimental Engine (QCSEE) Over The Wing (OTW) design report
[NASA-CR-134848] N80-15086
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report
[NASA-CR-134868] N80-15088
Quiet Clean Short-haul Experimental Engine (QCSEE). The aerodynamic and mechanical design of the QCSEE over-the-wing fan
[NASA-CR-134915] N80-15089
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine digital control system design report
[NASA-CR-134920] N80-15090
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine simulation report
[NASA-CR-134914] N80-15091
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing control system design report
[NASA-CR-135337] N80-15092
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) engine composite nacelle test report. Volume 1: Summary, aerodynamic and mechanical performance
[NASA-CR-159471] N80-15094
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary over-the-wing flight propulsion system analysis report
[NASA-CR-135296] N80-15095
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report, volume 1
[NASA-CR-135249] N80-15096
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report. Volume 3: Mechanical performance
[NASA-CR-135251] N80-15097
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report
[NASA-CR-135010] N80-15098
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) boilerplate nacelle design report
[NASA-CR-135168] N80-15099
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report --- to verify strength of selected composite materials
[NASA-CR-135075] N80-15100
Quiet Clean Short-haul Experimental Engine (QCSEE). Ball spline pitch change mechanism design report
[NASA-CR-134873] N80-15101
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan --- quiet engine program
[NASA-CR-134891] N80-15102
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears test program
[NASA-CR-134669] N80-15103
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears bearing development program
[NASA-CR-134890] N80-15105
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
Quiet Clean Short-haul Experimental Engine (QCSEE): Hamilton Standard cam/harmonic drive variable pitch fan actuation system detail design report
[NASA-CR-134852] N80-15107
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and mechanical design of the QCSEE under-the-wing fan
[NASA-CR-135009] N80-15109
Quiet Clean Short-haul Experimental Engine (QCSEE) composite fan frame design report
[NASA-CR-135278] N80-15110
Quiet Clean Short-haul Experimental Engine (QCSEE) UTW fan preliminary design
[NASA-CR-134842] N80-15111
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and preliminary mechanical design of the QCSEE OTW fan
[NASA-CR-134841] N80-15112
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design
[NASA-CR-134840] N80-15113
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing engine and control simulation results
[NASA-CR-135049] N80-15114
Quiet Clean Short-Haul Experimental Engine (QCSEE) ball spline pitch-change mechanism whirligig test report
[NASA-CR-135354] N80-15115
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) boiler plate nacelle and core exhaust nozzle design report
[NASA-CR-135008] N80-15116
Quiet Clean Short-haul Experimental Engine (QCSEE) whirl test of cam/harmonic pitch change actuation system
[NASA-CR-135140] N80-15117
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion systems test report. Volume 4: Acoustic performance
[NASA-CR-135326] N80-15118
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119

Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
Quiet Clean Short-Haul Experimental Engine (QCSEE): Acoustic treatment development and design
[NASA-CR-135266] N80-15122
Quiet Clean Short-Haul Experimental Engine (QSCEE). Preliminary analyses and design report, volume 1
[NASA-CR-134838] N80-15123
Quiet Clean Short-Haul Experimental Engine (QCSEE). Preliminary analyses and design report, volume 2
[NASA-CR-134839] N80-15124
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 1: Summary report
[NASA-CR-135323] N80-15125
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The Wing (OTW) propulsion system test report. Volume 3: Mechanical performance
[NASA-CR-135325] N80-15126
Quiet powered-lift propulsion
[NASA-CP-2077] N80-15127

R

RADAR APPROACH CONTROL
What brings us down tomorrow - Landing guidance systems for the 1980s
A80-18725

RADAR BEACONS
On radar in air traffic control --- conference, Rome, Jul. 1979
[PUB-11-1979] N80-14065

RADAR CROSS SECTIONS
Application of RCS guidelines to weight effective aircraft design --- Radar Cross Section
[SAWE PAPER 1270] A80-20626

RADAR DATA
Radar data utilization in automating the sequencing of aircrafts in terminal areas
N80-14071
A distributed processing system for radar data presentation
N80-14075
Filtering of synthetic radar data
N80-14076

RADAR FILTERS
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867

RADAR NETWORKS
Problems related to the design and construction of a radar network
N80-14066
Methodology for the evaluation of a radar site
N80-14067
Organization of an integrated global maintenance service --- Radar Networks
N80-14069

RADAR RECEIVERS
Implementation of air traffic control radar receivers with fast Fourier transform processors
N80-14086
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062

RADAR SIGNATURES
Filtering of synthetic radar data
N80-14076

RADAR TRACKING
Problems related to the design and construction of a radar network
N80-14066
Methodology for the evaluation of a radar site
N80-14067
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
Tracking algorithms for mono and multiradar
N80-14074
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements
N80-14105
Target tracking using Doppler-information in sensor oriented coordinates with a three dimensional array radar
[REPT-270] N80-14325

RADARSCOPES
Visual displays for air traffic control data
N80-14077

RADIO NAVIGATION
The Omega radio navigation system --- Russian book
A80-19413

RADIO TRANSMISSION
The Omega radio navigation system --- Russian book
A80-19413

RADIOGRAPHY
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques
A80-17521

RAIN
A first look at the effect of severe rainfall upon an aircraft
[NASA-CR-162569] N80-15058

RAMJET ENGINES
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
Oblique detonation wave ramjet
[NASA-CR-159192] N80-14131
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets
[AD-A074187] N80-14133

RANGE FINDERS
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111

RAY TRACING
An air traffic channel simulation by means of ray-tracing techniques
N80-14088

REACTOR DESIGN
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876

REAL TIME OPERATION
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects
A80-17402
Automation of flight on-line strategic control: The case of speed control on pre-established routes
N80-14070

RECTANGULAR PANELS
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304

RECTANGULAR WINGS
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375

REDUNDANCY
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026
Failure detection, isolation and indication in highly integrated digital guidance and control system
N80-14027

REGENERATORS
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301

REGRESSION ANALYSIS
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255

REINFORCING FIBERS
PRS composites for advanced gas turbine engine components
[AD-A074287] N80-15137

RELIABILITY ANALYSIS
Study of turboprop systems reliability and maintenance costs
[NASA-CR-135192] N80-14129
RELIABILITY ENGINEERING
US Army Test and Evaluation Command test operations procedures: Photographic and video image support aviation materiel
[AD-A074883] N80-14377
REMOTE SENSORS
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects
A80-17402
Infrared sensor system performance simulations
A80-20900
REMOTELY PILOTED VEHICLES
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
RESEARCH
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651
RESEARCH AIRCRAFT
Quiet short-haul research aircraft familiarization document --- STOL
[NASA-TM-81149] N80-14108
The T-28 thunder/hailstorm penetration aircraft
N80-14640
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan --- Ames 40-ft by 80-ft wind tunnel tests
[NASA-TM-78562] N80-15067
RESEARCH FACILITIES
Aeronautical Research Laboratories
[RM78/30107] N80-15026
RESEARCH MANAGEMENT
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
Unsteady flow and dynamic response analyses for helicopter rotor blades
[NASA-CR-159190] N80-14355
RESEARCH PROJECTS
Navy V/STOL - A continuing initiative
[SAWE PAPER 1325] A80-20655
RESIDENTIAL AREAS
Airport noise, location rent, and the market for residential amenities
A80-17720
REYNOLDS NUMBER
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238
RIGID ROTORS
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138
ROLLER BEARINGS
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears bearing development program
[NASA-CR-134890] N80-15105
ROLLING MOMENTS
Effect of spanwise gust variations
N80-14639
ROTARY STABILITY
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308
ROTARY WINGS
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response
A80-17716
Rotational noise of helicopter rotors
A80-17718
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
Acoustically swept rotor --- helicopter noise reduction
[NASA-CASE-ARC-11106-1] N80-14107
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111
Investigation of the oscillatory and flight behavior of rotor systems in relation with atmospheric turbulence
[BMVG-FBWT-79-5] N80-14142
Unsteady flow and dynamic response analyses for helicopter rotor blades
[NASA-CR-159190] N80-14355
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads
[AD-A075612] N80-15077
Analysis of low-speed helicopter flight test data
[AD-A074141] N80-15079
Model 540 rotor blade crack propagation investigation
[AD-A074734] N80-15081
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138
ROTATING BODIES
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery
N80-14135
ROTATING SHAFTS
Direct integration of transient rotor dynamics
[NASA-TP-1597] N80-15128
ROTATING STALLS
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086
ROTOR AERODYNAMICS
Evaluation of the intensity of beat-induced vibrations
A80-17965
Flow in transonic compressors
[AIAA PAPER 80-0124] A80-18357
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
Acoustically swept rotor --- helicopter noise reduction
[NASA-CASE-ARC-11106-1] N80-14107
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138
ROTORS
Direct integration of transient rotor dynamics
[NASA-TP-1597] N80-15128
RUNWAYS
Reflection cracking of bituminous overlays for airport pavements: A state of the art
[AD-A073484] N80-14144
Effect of weather conditions on airport operations
N80-14638

S

SAFETY DEVICES
An overvoltage safety system for direct current aircraft generators
A80-19051
SATELLITE NAVIGATION SYSTEMS
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904
The Russian satellite navigation system
A80-20982
The Global Positioning System
A80-20992
SCALE MODELS
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968
SCHEDULING
Aircraft delays at major US airports can be reduced
[PB-299442/4] N80-15061
SEALS (STOPPERS)
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122

Surface conforming thermal/pressure seal --- for control devices in space vehicles
[NASA-CASE-MSC-18422-1] N80-14400

SECONDARY RADAR
Covariance simulation of BCAS - An aircraft collision avoidance system
A80-20915
On radar in air traffic control --- conference, Rome, Jul. 1979
[PUB-11-1979] N80-14065
Performance evaluation methods of a secondary radar network
N80-14068
An air traffic channel simulation by means of ray-tracing techniques
N80-14088
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar
N80-14100
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104

SELECTION
Methodology for the evaluation of a radar site
N80-14067

SELF OSCILLATION
On the dynamics of compressor surge
A80-17900

SEMICONDUCTOR DEVICES
Integrated circuit characteristics at 260 C for aircraft engine-control applications
A80-20112

SEPARATED FLOW
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow
A80-17697
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(0)] N80-14058
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134
Control of forebody three-dimensional flow separations
N80-15164

SEQUENCING
Radar data utilization in automating the sequencing of aircrafts in terminal areas
N80-14071

SERVICE LIFE
Technology of the Rolls-Royce RB211 engine
A80-18864

SERVOMOTORS
Aircraft torque motors --- Russian book
A80-19199

SHALE OIL
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259

SHARP LEADING EDGES
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359

SHIPS
Small ship-based VTOL aircraft - A design exercise
[SAWE PAPER 1296] A80-20639

SHOCK WAVE CONTROL
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124

SHOCK WAVE INTERACTION
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083
Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045

SHORT HAUL AIRCRAFT
Quiet short-haul research aircraft familiarization document --- STOL
[NASA-TM-81149] N80-14108
Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115
Quiet Clean Short-Haul Experimental Engine (QCSEE). Under-the-wing (UTW) engine boilerplate Nacelle test report. Volume 2: Aerodynamics and performance
[NASA-CR-135250] N80-14116
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) engine acoustic design
[NASA-CR-135268] N80-14118
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1
[NASA-CR-134849] N80-15083
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8) diameter fan, volume 2
[NASA-CR-134850] N80-15084
Demonstration of short haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 3
[NASA-CR-134851] N80-15085
Quiet Clean Short-haul Experimental Engine (QCSEE) Over The Wing (OTW) design report
[NASA-CR-134848] N80-15086
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report
[NASA-CR-134868] N80-15088
Quiet Clean Short-haul Experimental Engine (QCSEE). The aerodynamic and mechanical design of the QCSEE over-the-wing fan
[NASA-CR-134915] N80-15089
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine digital control system design report
[NASA-CR-134920] N80-15090
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing control system design report
[NASA-CR-135337] N80-15092
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) engine composite nacelle test report. Volume 1: Summary, aerodynamic and mechanical performance
[NASA-CR-159471] N80-15094
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary over-the-wing flight propulsion system analysis report
[NASA-CR-135296] N80-15095
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report, volume 1
[NASA-CR-135249] N80-15096
Quiet Clean Short-haul Experimental Engine (QCSEE). Under-The-Wing (UTW) engine boilerplate nacelle test report. Volume 3: Mechanical performance
[NASA-CR-135251] N80-15097

Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report --- to verify strength of selected composite materials
[NASA-CR-135075] N80-15100
Quiet Clean Short-haul Experimental Engine (QCSEE). Ball spline pitch change mechanism design report
[NASA-CR-134873] N80-15101
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan --- quiet engine program
[NASA-CR-134891] N80-15102
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears test program
[NASA-CR-134669] N80-15103
Quiet Clean Short-haul Experimental Engine (QCSEE) clean combustor test report
[NASA-CR-134916] N80-15104
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears bearing development program
[NASA-CR-134890] N80-15105
Quiet Clean Short-haul Experimental Engine (QCSEE): Hamilton Standard cam/harmonic drive variable pitch fan actuation system detail design report
[NASA-CR-134852] N80-15107
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and mechanical design of the QCSEE under-the-wing fan
[NASA-CR-135009] N80-15109
Quiet Clean Short-haul Experimental Engine (QCSEE) composite fan frame design report
[NASA-CR-135278] N80-15110
Quiet Clean Short-haul Experimental Engine (QCSEE) UTW fan preliminary design
[NASA-CR-134842] N80-15111
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and preliminary mechanical design of the QCSEE OTW fan
[NASA-CR-134841] N80-15112
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design
[NASA-CR-134840] N80-15113
Quiet Clean Short-haul Experimental Engine (QCSEE) over-the-wing engine and control simulation results
[NASA-CR-135049] N80-15114
Quiet Clean Short-Haul Experimental Engine (QCSEE) ball spline pitch-change mechanism whirligig test report
[NASA-CR-135354] N80-15115
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) boiler plate nacelle and core exhaust nozzle design report
[NASA-CR-135008] N80-15116
Quiet Clean Short-haul Experimental Engine (QCSEE) whirl test of cam/harmonic pitch change actuation system
[NASA-CR-135140] N80-15117
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion systems test report. Volume 4: Acoustic performance
[NASA-CR-135326] N80-15118
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
Quiet Clean Short-Haul Experimental Engine (QCSEE): Acoustic treatment development and design
[NASA-CR-135266] N80-15122
Quiet Clean Short-Haul Experimental Engine (QSCEE). Preliminary analyses and design report, volume 1
[NASA-CR-134838] N80-15123
Quiet Clean Short-Haul Experimental Engine (QCSEE). Preliminary analyses and design report, volume 2
[NASA-CR-134839] N80-15124

SHORT TAKEOFF AIRCRAFT
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics
A80-20952
Quiet short-haul research aircraft familiarization document --- STOL
[NASA-TM-81149] N80-14108
JA-6A circulation control wing contractor flight demonstration
[AD-A074888] N80-15080
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
The YC-14 upper surface blown flap: A unique control surface
N80-15157

SIDESLIP
Comment on 'Handling quality criterion for heading control'
A80-17698

SIGNAL RECEPTION
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904

SILICON CARBIDES
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122

SILICON NITRIDES
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062

SIMULATORS
Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive) --- flammability tests
[AD-A073237] N80-14256

SITES
Methodology for the evaluation of a radar site
N80-14067

SKIN (STRUCTURAL MEMBER)
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199

SKIN FRICTION
An improved sensing element for skin-friction balance measurements --- supersonic drag measuring instrument
[AIAA PAPER 80-0049] A80-18251

SOIL MECHANICS
Soil analyses and evaluations at the impact dynamics research facility for two full-scale aircraft crash tests
[NASA-CR-159199] N80-15299

SOLID SOLUTIONS
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062

SOLID-SOLID INTERFACES
Contact stress analysis of ceramic-to-metal interfaces --- in gas turbine engines
[AD-A074491] N80-14417

SONIC BOOMS
Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045

SOOT
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953

SOUND PROPAGATION
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953
The analysis of sound propagation in jet engine ducts using the finite difference method
[AD-A074233] N80-14853

SOUND WAVES
Applications of diffraction theory to aeroacoustics --- aircraft noise
N80-14870

SPACE SHUTTLE ORBITERS
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
SPACECRAFT COMPONENTS
Surface conforming thermal/pressure seal --- for control devices in space vehicles
[NASA-CASE-MSC-18422-1] N80-14400
SPATIAL DISTRIBUTION
Air traffic density and distribution measurements
[AD-A073229] N80-14064
SPEECH RECOGNITION
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303
SPEED CONTROL
Automation of flight on-line strategic control: The case of speed control on pre-established routes
N80-14070
SPOILERS
Roll control by digitally controlled segment spoilers
N80-15156
In-flight measured characteristics of combined flap-spciler direct lift controls
N80-15165
Unsteady aerodynamics of two-dimensional spoilers at low speeds
N80-15170
SPOT WELDS
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068
STABILITY DERIVATIVES
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308
Altitude response of several airplanes during landing approach --- including space shuttle
[NASA-TM-80186] N80-14139
STATIC AERODYNAMIC CHARACTERISTICS
Evaluation of the aerodynamic characteristics of a 1/20-scale A-10 model at Mach numbers from 0.30 to 0.75
[AD-A074867] N80-15055
STATIC FIRING
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
STATIC PRESSURE
Some practical aspects of the calibration of air data systems
A80-18865
STATIC STABILITY
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability --- F-16
[NASA-TP-1538] N80-14136
STATISTICAL ANALYSIS
A statistical method applied to pilot behavior analysis in multiloop systems
A80-18537
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
STOCHASTIC PROCESSES
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867
STRAPDOWN INERTIAL GUIDANCE
Development aspects of a dynamically tuned gyro for strapdown - AHRS --- Attitude and Heading Reference System
A80-17553
A strapdown inertial reference system for commercial airline use in navigation and flight control
A80-17558
An integrated strapdown guidance and control system for launch vehicle application
A80-17559
Modular strapdown guidance unit with embedded microprocessors
[AIAA PAPER 78-1239] A80-18534
Development of aiding GPS/strapdown inertial navigation system
N80-14031
Methods for strap-down attitude estimation and navigation with accelerometers
N80-14034
STRESS ANALYSIS
Fatigue life prediction of a bonded splice joint
[AIAA PAPER 80-0305] A80-18306
Contact stress analysis of ceramic-to-metal interfaces --- in gas turbine engines
[AD-A074491] N80-14417
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136
STRESS CONCENTRATION
Determination of the stress intensity factor of composite structural members
A80-17958
STRESS-STRAIN DIAGRAMS
Review of investigations into aeronautics related fatigue Federal Republic of Germany
[LBF-S-142] N80-14422
STRUCTURAL ANALYSIS
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis
[AD-A074801] N80-15030
Computer simulation of engine systems
[NASA-TM-79290] N80-15132
STRUCTURAL DESIGN
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
Quiet Clean Short-haul Experimental Engine (QCSEE). The aerodynamic and mechanical design of the QCSEE over-the-wing fan
[NASA-CR-134915] N80-15089
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) boilerplate nacelle design report
[NASA-CR-135168] N80-15099
STRUCTURAL DESIGN CRITERIA
Computer simulation of engine systems
[NASA-TM-79290] N80-15132
Low cost aircraft flutter clearance --- conference
[AGARD-CP-278] N80-15141
STRUCTURAL ENGINEERING
Composite structural materials
[NASA-CR-162578] N80-15076
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119
STRUCTURAL FAILURE
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
STRUCTURAL INFLUENCE COEFFICIENTS
Structural parameters that influence the noise reduction characteristics of typical general aviation materials
[AIAA PAPER 80-0038] A80-18248
STRUCTURAL STABILITY
An analytical method of testing pavement strength
A80-17998
An empirical approach for checking flutter stability of gliders and light aircraft
N80-15144
STRUCTURAL VIBRATION
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730
Evaluation of the intensity of beat-induced vibrations
A80-17965
STRUCTURAL WEIGHT
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627

A method of simplifying weight and balance for small aircraft
[SAWE PAPER 1278] A80-20630
Application of parametric weight and cost estimating relationships to future transport aircraft
[SAWE PAPER 1292] A80-20637
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656

SUBSONIC FLOW
A numerical approach to subsonic viscous-inviscid interaction
A80-19070
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047
Summary of advanced methods for predicting high speed propeller performance
[NASA-TM-81409] N80-15051
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow
N80-15168

SUBSONIC SPEED
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model
[NASA-CR-159180] N80-14054
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds
N80-15169

SUPERSONIC AIRCRAFT
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696

SUPERSONIC CRUISE AIRCRAFT RESEARCH
Flight control and configuration design considerations for highly maneuverable aircraft
N80-15154

SUPERSONIC DRAG
An improved sensing element for skin-friction balance measurements --- supersonic drag measuring instrument
[AIAA PAPER 80-0049] A80-18251

SUPERSONIC FLIGHT
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309

SUPERSONIC FLOW
An improved sensing element for skin-friction balance measurements --- supersonic drag measuring instrument
[AIAA PAPER 80-0049] A80-18251
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
Summary of advanced methods for predicting high speed propeller performance
[NASA-TM-81409] N80-15051

SUPERSONIC INLETS
Improved numerical simulation of high speed inlets using the Navier-Stokes equations
[AIAA PAPER 80-0383] A80-18340
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134

SUPERSONIC JET FLOW
Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperture
[UCRL-15051] N80-15183

SUPERSONIC SPEEDS
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308

SUPERSONIC TRANSPORTS
The next supersonic transport
A80-20214
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971

SUPPORTS
The CF6 jet engine performance improvement: New front mount
[NASA-CR-159639] N80-14127

SURFACE NAVIGATION
The Omega radio navigation system --- Russian book
A80-19413

SURGES
On the dynamics of compressor surge
A80-17900

SURVEILLANCE RADAR
Weather detection using airport surveillance radar
A80-19129
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867
On radar in air traffic control --- conference, Rome, Jul. 1979
[FUB-11-1979] N80-14065
Problems related to the design and construction of a radar network
N80-14066
Methodology for the evaluation of a radar site
N80-14067
Performance evaluation methods of a secondary radar network
N80-14068
Organization of an integrated global maintenance service --- Radar Networks
N80-14069
Simulation of a surveillance and control system of surface traffic in an airport
N80-14073
Tracking algorithms for mono and multiradar
N80-14074
Filtering of synthetic radar data
N80-14076
Implementation of air traffic control radar receivers with fast Fourier transform processors
N80-14086
Development trends of airport surface traffic control radar
N80-14087
An air traffic channel simulation by means of ray-tracing techniques
N80-14088
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar
N80-14100
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104

SURVIVAL EQUIPMENT
Aeronautical systems technology needs: Escape, rescue and survival
[AD-A074906] N80-14061

SWEEP EFFECT
Acoustically swept rotor --- helicopter noise reduction
[NASA-CASE-ARC-11106-1] N80-14107

SWEPT WINGS
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow A80-17697
Experimental and computational study of transonic flow about swept wings [AIAA PAPER 80-0005] A80-18235
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack [AIAA PAPER 80-0310] A80-18309
A computer code to model swept wings in an adaptive wall transonic wind tunnel [AIAA PAPER 80-0156] A80-19287
Hybrid vortex method for lifting surfaces with free-vortex flow [AIAA PAPER 80-0070] A80-19307
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations N80-15155

SWITCHING THEORY
AEROPP - Message and data switching systems for aeronautical operations A80-19579

SYSTEM EFFECTIVENESS
Concerning the information efficiency of aerodynamic experiments A80-17671

SYSTEM FAILURES
Failure detection, isclation and indication in highly integrated digital guidance and control system N80-14027

SYSTEMS ANALYSIS
A high accuracy flight profile determining system --- systems analysis of inertial navigation system for aircraft position determination N80-14042
Integration of flight and fire control --- systems analysis of digital ccntrolled integrated flight and fire control systems N80-14043
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom [NASA-TM-80153] N80-14055
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage [NASA-CR-2861] N80-14137
Application of the SIRS concept to Navy helicopters --- systems analysis of flight data recorders of flight conditons of helicopters for structural analysis [AD-A074801] N80-15030
Loran digital phase-locked loop and RF front-end system error analysis [NASA-CR-162731] N80-15065
Design study for ATA vacuum system aperture [UCRL-15050] N80-15182

SYSTEMS ENGINEERING
A distributed processing system for radar data presentation N80-14075
Development trends of airport surface traffic control radar N80-14087
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements N80-14105
Design study of a low cost civil aviation GPS receiver system [NASA-CR-159176] N80-15062
Aircraft anti-icing/de-icing [AD-A074128] N80-15078
Design criteria for optimal flight control systems --- study of optimal flight control systems engineering for feedback control [AD-A074092] N80-15139

T

T-28 AIRCRAFT
The T-28 thunder/hailstorm penetration aircraft N80-14640

T-37 AIRCRAFT
Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator [AD-A071410] N80-15180

TAIL ASSEMBLIES
On the effect of wing wake on tail characteristics N80-15174

TARGET ACQUISITION
Infrared sensor system performance simulations A80-20900

TARGET RECOGNITION
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects A80-17402

TECHNOLOGICAL FORECASTING
What brings us down tomorrow - Landing guidance systems for the 1980s A80-18725
The next supersonic transport A80-20214
Application of parametric weight and cost estimating relationships to future transport aircraft [SAWE PAPER 1292] A80-20637
Aeronautical systems technology needs: Escape, rescue and survival [AD-A074906] N80-14061

TECHNOLOGY ASSESSMENT
Preparing aircraft propulsion for a new era in energy and the environment A80-17737
Technology of the Rolls-Royce RB211 engine A80-18864
Tilt rotor - An effective V/STOL concept [SAWE PAPER 1273] A80-20628
Small ship-based VTOL aircraft - A design exercise [SAWE PAPER 1296] A80-20639
Navy V/STOL - A continuing initiative [SAWE PAPER 1325] A80-20655
Review of investigations into aeronautics related fatigue Federal Republic of Germany [LBF-S-142] N80-14422
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques [AGARD-AR-148] N80-15140
The YC-14 upper surface blown flap: A unique control surface N80-15157

TECHNOLOGY UTILIZATION
Technologies conceived for the utilization of ceramics in turboengines [ONERA, TP NO. 1979-132] A80-20076

TEMPERATURE EFFECTS
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor A80-17724
Integrated circuit characteristics at 260 C for aircraft engine-control applications A80-20112

TERMINAL FACILITIES
Marseilles - Metamorphosis of an airport A80-17999
Centralized ground power systems conserve energy A80-18000
Computer simulation of an air cargo small package sorting system A80-20866
Models for freight access to air terminals A80-20869

TERMINAL GUIDANCE
Map-matching techniques for terminal guidance using Fourier phase information A80-17517

TERRAIN ANALYSIS
Performance evaluation of image correlation techniques --- for aircraft inertial navigation systems A80-17534

TEST CHAMBERS
Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen [AD-A074391] N80-14147

Climatic chamber testing aircraft, engines armament and avionics; Test operations procedure --- environmental test chambers and facility for testing aircraft construction materials and engines
[AD-A074049] N80-15181

TEST EQUIPMENT
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133

TEST FACILITIES
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971
Climatic chamber testing aircraft, engines armament and avionics; Test operations procedure --- environmental test chambers and facility for testing aircraft construction materials and engines
[AD-A074049] N80-15181

TESTS
US Army Test and Evaluation Command test operations procedures: Photographic and video image support aviation materiel
[AD-A074883] N80-14377

TF-41 ENGINE
Application of the multistage axial-flow compressor time-dependent mathematical modeling technique to the TF41-A-1 modified block 76 compressor
[AD-A074478] N80-14134

THERMAL CONTROL COATINGS
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303

THERMAL RESISTANCE
Surface conforming thermal/pressure seal --- for control devices in space vehicles
[NASA-CASE-MSC-18422-1] N80-14400

THERMODYNAMIC CYCLES
Installation effects on cycle selection for small turbo-fan engines
[AIAA PAPER 80-0106] A80-19280
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301

THERMODYNAMIC PROPERTIES
Thermal state of structural members of aircraft engines --- Russian book
A80-19412

THERMOMECHANICAL TREATMENT
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136

THIN AIRFOILS
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047

THREE DIMENSIONAL BOUNDARY LAYER
The minimum induced drag of aerofoils
[NACA-121] N80-15038

THREE DIMENSIONAL FLOW
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
Control of forebody three-dimensional flow separations
N80-15164
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data
[NASA-TM-81410] N80-15364

THRUST
Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315

THRUST AUGMENTATION
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303

THRUST REVERSAL
Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115

TILT ROTOR AIRCRAFT
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan --- Ames 40-ft by 80-ft wind tunnel tests
[NASA-TM-78562] N80-15067
Quiet powered-lift propulsion
[NASA-CP-2077] N80-15127

TIME DEPENDENCE
Application of the multistage axial-flow compressor time-dependent mathematical modeling technique to the TF41-A-1 modified block 76 compressor
[AD-A074478] N80-14134

TIME MEASURING INSTRUMENTS
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles
A80-19990

TIME SERIES ANALYSIS
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(O)] N80-14140

TOKAMAK DEVICES
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876

TOLERANCES (MECHANICS)
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques
A80-17521

TOROIDAL PLASMAS
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876

TORQUE MOTORS
Aircraft torque motors --- Russian book
A80-19199

TORSIONAL STRESS
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads
[AD-A075612] N80-15077

TRACKING (POSITION)
Some practical aspects of the calibration of air data systems
A80-18865
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design
A80-20879

TRACKING FILTERS
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867

TRAILING EDGES
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052

TRAILING-EDGE FLAPS
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow
N80-15168
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds
N80-15169

TRAINING AIRCRAFT
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft
N80-15172

TRAJECTORY ANALYSIS
Trajectory behaviour of a control configurated aircraft subjected to random disturbances
N80-15171

TRAJECTORY MEASUREMENT
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems A80-20867

TRAJECTORY OPTIMIZATION
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories --- for low level weapons delivery [AIAA PAPER 80-0061] A80-18260
Constrained optimum trajectories with specified range A80-18538

TRANSFER FUNCTIONS
The transfer of carbon fibers through a commercial aircraft water separator and air cleaner [NASA-CR-159183] N80-14359

TRANSONIC COMPRESSORS
Flow in transonic compressors [AIAA PAPER 80-0124] A80-18357

TRANSONIC FLOW
Experimental and computational study of transonic flow about swept wings [AIAA PAPER 80-0005] A80-18235
Engine aerodynamic installation by numerical simulation [AIAA PAPER 80-0108] A80-18271
An inverse transonic wing design method [AIAA PAPER 80-0330] A80-18319
Analysis of transonic flow about harmonically oscillating airfoils and wings [AIAA PAPER 80-0149] A80-18367
A computer code to model swept wings in an adaptive wall transonic wind tunnel [AIAA PAPER 80-0156] A80-19287
Separation due to shock wave-turbulent boundary layer interaction [ONERA, TP NO. 1979-146] A80-20083
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings [NASA-CR-159143] N80-14056
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils [NASA-CR-159141] N80-15052
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow N80-15168

TRANSONIC SPEED
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds N80-15169

TRANSONIC WIND TUNNELS
A computer code to model swept wings in an adaptive wall transonic wind tunnel [AIAA PAPER 80-0156] A80-19287

TRANSPORT AIRCRAFT
Application of parametric weight and cost estimating relationships to future transport aircraft [SAWE PAPER 1292] A80-20637
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model [NASA-CR-159180] N80-14054
Accident investigation N80-14636

TRANSPORTATION NETWORKS
Shipping by air - Is the value of your time worth it A80-20868

TRENDS
Development trends of airport surface traffic control radar N80-14087

TURBINE BLADES
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques A80-17521
Optimization of turbine nozzle cooling by combining impingement and film injection [AIAA PAPER 80-0299] A80-19316
Digital system for dynamic turbine engine blade displacement measurements [NASA-TM-81382] N80-14113
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report [NASA-CR-135046] N80-15108
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration [AD-A074098] N80-15136

TURBINE ENGINES
The physical and chemical characterization of ten military turbine engine lubricants [AD-A074073] N80-15265

TURBOCOMPRESSORS
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor A80-17724
Damping capacity of plastic compressor blades A80-19868
Modification of axial compressor streamline program for analysis of engine test data [NASA-TM-79312] N80-14051
Application of the multistage axial-flow compressor time-dependent mathematical modeling technique to the TF41-A-1 modified block 76 compressor [AD-A074478] N80-14134

TURBOFAN ENGINES
Technology of the Rolls-Royce RB211 engine A80-18864
Installation effects on cycle selection for small turbo-fan engines [AIAA PAPER 80-0106] A80-19280
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations [AIAA PAPER 80-0228] A80-19302
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system [AIAA PAPER 80-0229] A80-20968
Quiet Clean Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion system test report. Volume 2: Aerodynamics and performance --- engine performance tests to define propulsion system performance on turbofan engines [NASA-CR-135324] N80-14120
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA) [NASA-TP-1556] N80-14121
The CF6 jet engine performance improvement: New front mount [NASA-CR-159639] N80-14127
Study of turboprop systems reliability and maintenance costs [NASA-CR-135192] N80-14129
Quiet Clean Short-haul Experimental Engine (QCSEE) Over The Wing (OTW) design report [NASA-CR-134848] N80-15086
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report [NASA-CR-134868] N80-15088
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data [NASA-TM-81410] N80-15364

TURBOFANS
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1 [NASA-CR-134849] N80-15083
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8) diameter fan, volume 2 [NASA-CR-134850] N80-15084
Demonstration of short haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 3 [NASA-CR-134851] N80-15085
Quiet Clean Short-haul Experimental Engine (QCSEE). The aerodynamic and mechanical design of the QCSEE over-the-wing fan [NASA-CR-134915] N80-15089
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report [NASA-CR-135010] N80-15098

Quiet Clean Short-haul Experimental Engine (QCSEE): Hamilton Standard cam/harmonic drive variable pitch fan actuation system detail design report
[NASA-CR-134852] N80-15107
Quiet Clean Short-haul Experimental Engine (QCSEE) composite fan frame design report
[NASA-CR-135278] N80-15110
Quiet Clean Short-haul Experimental Engine (QCSEE) OTW fan preliminary design
[NASA-CR-134842] N80-15111
Quiet Clean Short-haul Experimental Engine (QCSEE): The aerodynamic and preliminary mechanical design of the QCSEE OTW fan
[NASA-CR-134841] N80-15112
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design
[NASA-CR-134840] N80-15113
Quiet Clean Short-haul Experimental Engine (QCSEE) whirl test of cam/harmonic pitch change actuation system
[NASA-CR-135140] N80-15117

TURBOJET ENGINES
Technologies conceived for the utilization of ceramics in turboengines
[ONERA, TP NO. 1979-132] A80-20076
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets
[AD-A074187] N80-14133
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135

TURBOMACHINE BLADES
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133

TURBOPROP ENGINES
Study of turboprop systems reliability and maintenance costs
[NASA-CR-135192] N80-14129

TURBOSHAFTS
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301

TURBULENT BOUNDARY LAYER
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034

TURBULENT FLOW
Aeroacoustic measuring techniques in or outside turbulent flows
N80-14876
On the effect of wing wake on tail characteristics
N80-15174

TURBULENT JETS
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328

TURBULENT MIXING
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data
[NASA-TM-81410] N80-15364

TWO DIMENSIONAL FLOW
Engine aerodynamic installation by numerical simulation
[AIAA PAPER 80-0108] A80-18271
Improved numerical simulation of high speed inlets using the Navier-Stokes equations
[AIAA PAPER 80-0383] A80-18340

Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow
N80-15168

U

ULTRAHIGH FREQUENCIES
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092

UNSTEADY FLOW
Unsteady flow and dynamic response analyses for helicopter rotor blades
[NASA-CR-159190] N80-14355
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow
N80-15168

UNSWEPT WINGS
A flutter-speed formula for wings of high aspect ratio
N80-15147

UPPER SURFACE BLOWN FLAPS
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072

URBAN RESEARCH
Airport noise, location rent, and the market for residential amenities
A80-17720

USER REQUIREMENTS
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628

V

V/STOL AIRCRAFT
The criticality of engine exhaust simulations on VSTOL model-measured ground effects
[AIAA PAPER 80-0230] A80-18276
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640
Navy V/STOL - A continuing initiative
[SAWE PAPER 1325] A80-20655

VACUUM SYSTEMS
Design study for ATA vacuum system aperture
[UCRL-15050] N80-15182
Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperture
[UCRL-15051] N80-15183

VAPORIZING
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system --- for gas turbine engines
[NASA-TP-1582] N80-14125

VARIABLE CYCLE ENGINES
Multi-variable cycle optimization by gradient methods --- for variable-cycle engines
[AIAA PAPER 80-0052] A80-18254

VARIABLE GEOMETRY STRUCTURES
Hinged vehicle equations of motion
[AIAA PAPER 80-0364] A80-18336

VARIABLE PITCH PROPELLERS
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
VELOCITY DISTRIBUTION
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
VERTICAL TAKEOFF AIRCRAFT
Small ship-based VTOL aircraft - A design exercise
[SAWE PAPER 1296] A80-20639
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656
VERY HIGH FREQUENCY RADIO EQUIPMENT
The Omega radio navigation system --- Russian book A80-19413
VIBRATION DAMPING
Damping capacity of plastic compressor blades A80-19868
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery N80-14135
VIBRATION MEASUREMENT
Gas turbine carcase and accessory vibration - Problems of measurement and analysis A80-17730
Digital system for dynamic turbine engine blade displacement measurements
[NASA-TM-81382] N80-14113
VIBRATION TESTS
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(O)] N80-14140
Flight testing of the buffeting behavior of combat aircraft
[ESA-TT-523] N80-14143
A simplified ground vibration test procedure for sailplanes and light aircraft N80-15146
VIDEO EQUIPMENT
US Army Test and Evaluation Command test operations procedures: Photographic and video image support aviation materiel
[AD-A074883] N80-14377
VISCOUS FLOW
A numerical approach to subsonic viscous-inviscid interaction A80-19070
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
VISUAL FIELDS
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082
VISUAL PERCEPTION
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082
VOICE COMMUNICATION
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303
VOLTAGE REGULATORS
An overvoltage safety system for direct current aircraft generators A80-19051
VORTEX GENERATORS
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics N80-15178
VORTEX STREETS
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307
VORTICES
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052
Theoretical study of aerodynamic characteristics of wings having vortex flow
[NASA-CR-159184] N80-14053
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft N80-15172
VORTICITY
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition A80-20151

W

WAKES
On the effect of wing wake on tail characteristics N80-15174
WALL FLOW
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
Sound generation in a flow near a compliant wall A80-20153
WARNING SYSTEMS
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects A80-17402
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model N80-14072
WAVE DIFFRACTION
Applications of diffraction theory to aeroacoustics --- aircraft noise N80-14870
WAVE FRONTS
Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045
WAVE REFLECTION
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar N80-14100
WEAPON SYSTEMS
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636
WEAPONS DELIVERY
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories --- for low level weapons delivery
[AIAA PAPER 80-0061] A80-18260
WEATHER
Accident investigation N80-14636
Effect of weather conditions on airport operations N80-14638
WEATHER FORECASTING
Weather detection using airport surveillance radar A80-19129
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651
WEATHER RECONNAISSANCE AIRCRAFT
The T-28 thunder/hailstorm penetration aircraft N80-14640
WEIGHT ANALYSIS
Analog aircraft weight and balance computer
[SAWE PAPER 1283] A80-20631
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646

A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656

WEIGHT REDUCTION
Application of RCS guidelines to weight effective aircraft design --- Radar Cross Section
[SAWE PAPER 1270] A80-20626
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640

WIND TUNNEL MODELS
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model
[NASA-CR-159180] N80-14054
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack
N80-15166

WIND TUNNEL STABILITY TESTS
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308

WIND TUNNEL TESTS
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel
A80-17673
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels --- computational fluid dynamics
[NASA-CR-3210] N80-14047
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet --- Lewis 10- by 10-ft. supersonic wind tunnel test
[NASA-TP-1532] N80-14124
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan --- Ames 40-ft by 80-ft wind tunnel tests
[NASA-TM-78562] N80-15067
Correlation of F-15 flight and wind tunnel test control effectiveness
N80-15152
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls
N80-15153
Fin design with ACT in the presence of strakes
N80-15161
An experimental study of the structure and acoustic field of a jet in a cross stream --- Ames 7-ft by 10-ft wind tunnel tests
[NASA-CR-162464] N80-15871

WINDOWS (APERTURES)
Design study for ATA vacuum system aperture
[UCRL-15050] N80-15182
Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperture
[UCRL-15051] N80-15183

WING CAMBER
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316

WING FLAPS
Flaperon control: The versatile surface for fighter aircraft
N80-15158

WING FLOW METHOD TESTS
Experimental and computational study of transonic flow about swept wings
[AIAA PAPER 80-0005] A80-18235
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376

WING LOADING
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627

WING NACELLE CONFIGURATIONS
Quiet Clean Short-Haul Experimental Engine (QCSEE). Under-the-wing (UTW) engine boilerplate Nacelle test report. Volume 2: Aerodynamics and performance
[NASA-CR-135250] N80-14116

WING OSCILLATIONS
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056

WING PANELS
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068

WING PLANFORMS
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375

WING PROFILES
Theoretical study of aerodynamic characteristics of wings having vortex flow
[NASA-CR-159184] N80-14053
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
General theory of aerodynamic instability and the mechanism of flutter
[NACA-496] N80-15047

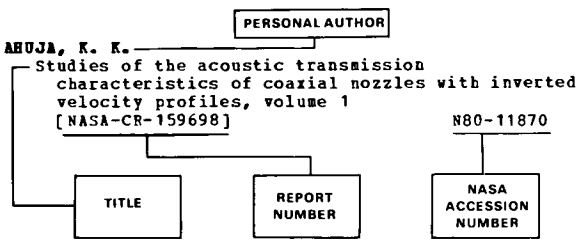
WING SLOTS
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics
N80-15178

WINGLETS
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model
[NASA-CR-159180] N80-14054

WINGS
An inverse transonic wing design method
[AIAA PAPER 80-0330] A80-18319
Optimized aerodynamic design process for subsonic transport wing fitted with winglets --- wind tunnel model
[NASA-CR-159180] N80-14054
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040
A parametric wing design study for a modern laminar flow wing
[NASA-TM-80154] N80-15050
JA-6A circulation control wing contractor flight demonstration
[AD-A074888] N80-15080
Aerodynamic interaction on a close-coupled canard wing configuration
N80-15175

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number is located beneath and to the right of the title, e.g. N80-11870. Under any one author's name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first.

A

ABZUG, M. J.
Hinged vehicle equations of motion
[AIAA PAPER 80-0364] A80-18336
APANASEV, A. IU.
Aircraft torque motors
A80-19199
AGNEW, J. W.
Correlation of F-15 flight and wind tunnel test control effectiveness
N80-15152
AHTYE, W. F.
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
AIELLO, R.
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads
[AD-A075612] N80-15077
ALBANES, W. V.
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation
A80-20901
ALEXANDER, C. A.
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062
ALEXANDER, J. G.
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
ALLEN, D.
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106
ALLEN, J. M.
An improved sensing element for skin-friction balance measurements
[AIAA PAPER 80-0049] A80-18251
ALPERIN, M.
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277
ANDERLE, R. J.
The Global Positioning System
A80-20992
ANDERSON, B. H.
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data
[NASA-TM-81410] N80-15364
ANDERSON, J. D., JR.
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
ANDERSON, J. L.
Application of parametric weight and cost estimating relationships to future transport aircraft
[SAWE PAPER 1292] A80-20637
ANDRIOTAKIS, G.
Covariance simulation of ECAS - An aircraft collision avoidance system
A80-20915
ANSELL, G. S.
Composite structural materials
[NASA-CR-162578] N80-15076
AYACHE, M. B.
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299]$_d$ A80-19316
AZUMA, A.
Rotational noise of helicopter rotors
A80-17718

B

BADIAGIN, A. A.
Designing light airplanes
A80-19414
BAHR, D. W.
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
BALLARD, J. D.
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
BARALE, G.
A distributed processing system for radar data presentation
N80-14075
BARGER, R. L.
Sonic-boom wave-front shapes and curvatures associated with maneuvering flight
[NASA-TP-1611] N80-14045
BARLOW, J. B.
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
BARNES, C. S.
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls
N80-15153
BARRANGER, J. P.
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128
BASTIANINI, G.
Simulation of a surveillance and control system of surface traffic in an airport
N80-14073

BAYLISS, A.
Experimental and numerical results of sound scattering by a body N80-14873
BEACHER, B. F.
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow [NASA-CR-135017] N80-15087
BEAUSSIER, J.
Investigations of the optimal configuration of high-stability quartz oscillators for aircraft and missiles A80-19990
BEECKEN, G.
An analytical method of testing pavement strength A80-17998
BEH, H.
Stability and control aspects of the CCV-F104G [MBB-UFE-1447(0)] N80-14141
BELTRAMO, M. N.
Application of parametric weight and cost estimating relationships to future transport aircraft [SAWE PAPER 1292] A80-20637
BENDO, J.
CH-46 composite rotor blade flight stress survey data. Volume 3: Plotted forward rotor blade chord, torsion and absolute loads [AD-A075612] N80-15077
BENI, P.
An air traffic channel simulation by means of ray-tracing techniques N80-14088
BERGMANN, M. Y.
Experimental and computational study of transonic flow about swept wings [AIAA PAPER 80-0005] A80-18235
BERTELRUD, A.
Experimental and computational study of transonic flow about swept wings [AIAA PAPER 80-0005] A80-18235
BERTINI, F.
An air traffic channel simulation by means of ray-tracing techniques N80-14088
BERTOLAZZI, P.
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model N80-14072
BETINI, S.
Development trends of airport surface traffic control radar N80-14087
BEZHENOV, V. IA.
Effect of the relative area of the flow core on the performance of a hypersonic wind tunnel A80-17673
BIANCO, L.
Automation of flight on-line strategic control: The case of speed control on pre-established routes N80-14070
Radar data utilization in automating the sequencing of aircrafts in terminal areas N80-14071
BLUMENTHAL, A. F.
Map-matching techniques for terminal guidance using Fourier phase information A80-17517
BLUMENTHAL, O.
Pressure distribution on Joukowski wings [NACA-TM-336] N80-15036
BOBER, L. A.
Summary of advanced methods for predicting high speed propeller performance [NASA-TM-81409] N80-15051
BOBER, L. J.
Summary of advanced methods for predicting high speed propeller performance [AIAA PAPER 80-0225] A80-20966
BOLDT, T. D.
Analog aircraft weight and balance computer [SAWE PAPER 1283] A80-20631
BORRINI, F.
Trajectory behaviour of a control configurated aircraft subjected to random disturbances N80-15171
BOSLEY, J. T.
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
BOUDIGUES, S.
Technologies conceived for the utilization of ceramics in turboengines [ONERA, TP NO. 1979-132] A80-20076
BOWDEN, J. H.
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report [NASA-CR-135010] N80-15098
BOXWELL, D. A.
Acoustically swept rotor [NASA-CASE-ARC-11106-1] N80-14107
BOYD, R. W.
JA-6A circulation control wing contractor flight demonstration [AD-A074888] N80-15080
BRADEN, J. A.
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests [NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests [NASA-CR-159135] N80-15071
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions [NASA-CR-159136] N80-15072
BRANSFORD, J. W.
LOX/GOX mechanical impact tester assessment [NASA-TM-74106] N80-15179
BRATANOW, T.
Unsteady flow and dynamic response analyses for helicopter rotor blades [NASA-CR-159190] N80-14355
BRAZIER, R. E. J.
The minimum cost approach to flutter clearance N80-15148
BREWER, G. D.
Hypersonic cruise aircraft propulsion integration study, volume 1 [NASA-CR-158926-VOL-1] N80-15074
Hypersonic cruise aircraft propulsion integration study, volume 2 [NASA-CR-158926-VOL-2] N80-15075
BROCARD, Y.
Aerodynamic interaction on a close-coupled canard wing configuration N80-15175
BROOKS, J. R.
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle [AIAA PAPER 80-0165] A80-20971
BROUSSARD, J. R.
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design A80-20879
BROWN, H.
Multi-variable cycle optimization by gradient methods [AIAA PAPER 80-0052] A80-18254
BROWN, P. W.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability [NASA-TP-1538] N80-14136
BRUNSTEIN, A. I.
Accident investigation N80-14636
BRYAN, C. J.
LOX/GOX mechanical impact tester assessment [NASA-TM-74106] N80-15179
BURCHAM, F. W., JR.
Landing approach airframe noise measurements and analysis [NASA-TP-1602] N80-15028

BURDGES, K. P.
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071

BURHANS, R. W.
Experimental loop antennas for 60 KHz to 200 KHz
[NASA-CR-162729] N80-15063

BURRUS, D. L.
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121

BUSSAC, M. N.
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876

BUXBAUM, O.
Review of investigations into aeronautics related fatigue Federal Republic of Germany
[LBF-S-142] N80-14422

BYAR, T. R.
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073

BYKOV, V. I.
The Omega radio navigation system
A80-19413

C

CALLAWAY, A. A.
Trends in digital data processing and system architecture
N80-14020

CAMELIER, I.
An experimental study of the structure and acoustic field of a jet in a cross stream
[NASA-CR-162464] N80-15871

CANNON, D. G.
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment
[NASA-TM-80194] N80-14114

CAPPADONA, R.
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092

CARLI, E.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104

CARLSON, H. W.
Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315

CASTELLANI, V.
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements
N80-14105

CATALANO, C. D.
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328

CERRULO, A.
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328

CHALK, C. R.
Comment on 'Handling quality criterion for heading control'
A80-17698

CHAMBERLIN, R.
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968

CHAMBLEE, C. E.
Application of the multistage axial-flow compressor time-dependent mathematical modeling technique to the TF41-A-1 modified block 76 compressor
[AD-A074478] N80-14134

CHEN, R. T. N.
Effects of primary rotor parameters on flapping dynamics
[NASA-TP-1431] N80-15138

CHENG, R. Y. K.
Soil analyses and evaluations at the impact dynamics research facility for two full-scale aircraft crash tests
[NASA-CR-159199] N80-15299

CHISUM, G. T.
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082

CHU, L.-C.
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307

CHU, Y.-Y.
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations
A80-18022

CINI, M.
Automation of flight on-line strategic control: The case of speed control on pre-established routes
N80-14070

CLARK, R. E.
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255

CLEMONS, A.
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan
[NASA-CR-134891] N80-15102
Quiet Clean Short-Haul Experimental Engine (QCSEE): Acoustic treatment development and design
[NASA-CR-135266] N80-15122

CNOSSEN, R.
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062

COAKLEY, T. J.
Experimental and computational study of transonic flow about swept wings
[AIAA PAPER 80-0005] A80-18235

COLLINSON, R. P. G.
Recent advances in fibre optics for high integrity digital control systems
N80-14025

COLONY, J. R.
Meteorological input to general aviation pilot training
N80-14634

COLTRIN, R. E.
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134

COOPER, L. P.
Effect of degree of fuel vaporization upon emissions for a premixed partially vaporized combustion system
[NASA-TP-1582] N80-14125

COPLIN, J. F.
Technology of the Rolls-Royce RB211 engine
A80-18864

CORZANI, T.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104

COTTER, L. B.
A strapdown inertial reference system for commercial airline use in navigation and flight control
A80-17558

COWARD, W. E.
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) engine acoustic design
[NASA-CR-135268] N80-14118

Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
CRITTENDEN, J. B.
Shipping by air - Is the value of your time worth it A80-20868
CUMPSTY, N. A.
Jet engine combustion noise - Pressure, entropy and vorticity perturbations produced by unsteady combustion or heat addition A80-20151
CYRUS, J.
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
CYRUS, J. D.
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301

D

DAHL, H.
Investigation of the oscillatory and flight behavior of rotor systems in relation with atmospheric turbulence
[BMVG-FBWT-79-5] N80-14142
DANESI, A.
Trajectory behaviour of a control configurated aircraft subjected to random disturbances N80-15171
DANIEL, B. R.
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
DAROLIA, R.
Feasibility of SiC composite structures for 1644 K (2500 F) gas turbine seal application
[NASA-CR-159597] N80-14122
DAT, R.
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086
DAVIES, D. L.
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques A80-17521
DEAL, P. L.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability
[NASA-TP-1538] N80-14136
DEFEO, A.
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
DEFINA, G.
Development trends of airport surface traffic control radar N80-14087
DEL, N.
Tracking algorithms for mono and multiradar N80-14074
DELERY, J.
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083
DERHAGOPIAN, J.
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery N80-14135
DESOPPER, A.
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow N80-15168
DESTUYNDER, R.
Problems of unsteady aerodynamics raised by the use of control surfaces as active controls N80-15167
DETHOMAS, A. P.
A flight control system using the DAIS architecture N80-14019
DETORR, J.
Tilt rotor - An effective V/STOL concept
[SAWE PAPER 1273] A80-20628
DIGHTON, R. D.
Designing to life cycle cost in the Hornet program
[SAWE PAPER 1293] A80-20638
DONOGHUE, P. J.
A strapdown inertial reference system for commercial airline use in navigation and flight control A80-17558
An integrated strapdown guidance and control system for launch vehicle application A80-17559
DREYFUS, M. G.
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111
DUTOUQUET, L.
Engine aerodynamic installation by numerical simulation
[AIAA PAPER 80-0108] A80-18271

E

EASTMAN, R. M.
Air cargo container utilization optimization through modeling A80-20870
ECHIN, A. I.
Unification of oils for aircraft gas-turbine engines A80-20690
EHEKIRCHER, S.
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations N80-15155
EHLERS, F. E.
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils
[NASA-CR-159141] N80-15052
ENDERS, J. H.
NASA technical advances in aircraft occupant safety
[NASA-TM-80851] N80-15060
ENGLIN, B. A.
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel A80-17675
ERDOS, J. I.
Conceptual design and performance estimates for a supersonic aerodynamic window for the ATA vacuum system aperture
[UCRL-15051] N80-15183
ERICKSON, G. E.
Effects of non-planar strake-wing on the vortex lift characteristics of a twin-jet fighter configuration
[AIAA PAPER 80-0329] A80-18318
ERZBERGER, H.
Constrained optimum trajectories with specified range A80-18538
ESCH, P.
Direct side force and drag control with the aid of pylon split flaps N80-15163
ESSOCK, D. M.
FRS composites for advanced gas turbine engine components
[AD-A074287] N80-15137

F

FALCIASECCA, G.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media N80-14104
FAN, A. T.
Design criteria for optimal flight control systems
[AD-A074092] N80-15139

FARINA, A.
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems A80-20867
FASCHING, W. A.
The CF6 jet engine performance improvement: New front mount
[NASA-CR-159639] N80-14127
FEAR, J. S.
NASA broad-specification fuels combustion technology program: Status and description
[NASA-TM-79315] N80-14126
FEILER, C. E.
Preparing aircraft propulsion for a new era in energy and the environment A80-17737
FERDANI, P.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media N80-14104
FERRI, U.
Simulation of a surveillance and control system of surface traffic in an airport N80-14073
FIELDS, R. A.
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068
FINGER, D. G.
Contact stress analysis of ceramic-to-metal interfaces
[AD-A074911] N80-14417
FISCHER, J. P.
Data reduction software for LORAN-C flight test evaluation
[NASA-CR-162730] N80-15064
FISHBACH, L. H.
Computer simulation of engine systems
[AIAA PAPER 80-0051] A80-18253
FISHBACK, L. H.
Computer simulation of engine systems
[NASA-TM-79290] N80-15132
FITZSIMMONS, R. D.
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971
FLAIG, J. W.
Small ship-based VTOL aircraft - A design exercise
[SAWE PAPER 1296] A80-20639
FLETCHER, B. G.
Development of aiding GPS/strapdown inertial navigation system N80-14031
FORD, M. J.
Laser-optical blade tip clearance measurement system
[NASA-TM-81376] N80-14128
FORD, R. L.
ATC and the airborne traffic-situation display A80-18724
FORMANIAK, J.
Investigation of the wear debris content in oil by measurements of the reluctance and eddy current loss in an electric circuit A80-19053
FORSHAW, S. E.
Investigation of noise hazards in the engine test cell, CFB Baden-Soellingen
[AD-A074391] N80-14147
FRANTZ, R. L.
Centralized ground power systems conserve energy A80-18000
FRASCHETTI, G.
Performance evaluation methods of a secondary radar network N80-14068
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar N80-14100
FRATACCI, G.
Technologies conceived for the utilization of ceramics in turboengines
[ONERA, TP NO. 1979-132] A80-20076
FREEMAN, D. S.
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report
[NASA-CR-135075] N80-15100
FREEMAN, L. M.
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696
FRIEDMANN, P.
Formulation of coupled rotor/fuselage equations of motion A80-17717
FROMME, J.
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels
[NASA-CR-3210] N80-14047
FROST, W.
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651
FRYE, G. W.
LOX/GOX mechanical impact tester assessment
[NASA-TM-74106] N80-15179
FUCHS, H. V.
Aeroacoustic measuring techniques in or outside turbulent flows N80-14876
FUJII, K.
A numerical approach to subsonic viscous-inviscid interaction A80-19070
FURTH, H. P.
Low-aspect-ratio limit of the toroidal reactor - The spheromak A80-17876

G

GALEEV, SH. S.
Aircraft torque motors A80-19199
GARRICK, I. E.
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
GAULT, D. E.
Atmospheric effects on Martian ejecta emplacement A80-20192
GELLER, E. W.
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
GERMAIN, G.
The integrity of onboard computer programs: A solution N80-14028
GEROS, J. M.
Performance evaluation of image correlation techniques A80-17534
GERSCH, A.
Weight Integrated Sizing Evaluation /WISE/ - A tool for preliminary design
[SAWE PAPER 1312] A80-20646
GERSON, G.
Guidance system position update by multiple subarea correlation A80-17518
GERSTEN, K.
On the effect of wing wake on tail characteristics N80-15174
GERSTENMAIER, W.
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data
[NASA-TM-81410] N80-15364
GIFFIN, R. G.
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
GILBERT, G.
Design study of a low cost civil aviation GPS receiver system
[NASA-CR-159176] N80-15062
GILBERT, W. P.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability
[NASA-TP-1538] N80-14136
Control considerations for CCV fighters at high angles of attack N80-15160

GILMORE, J. P.
Modular strapdown guidance unit with embedded microprocessors
[AIAA PAPER 78-1239] A80-18534
GINTY, D. F.
Effect of weather conditions on airport operations N80-14638
GIULI, D.
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar N80-14100
GIUSHGENS, G. S.
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion A80-19374
GLISTA, A. S., JR.
Integrated circuit characteristics at 260 C for aircraft engine-control applications A80-20112
GLUECK, D.
On the effect of wing wake on tail characteristics N80-15174
GOLBERG, M.
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels
[NASA-CR-3210] N80-14047
GOLLOP, P. J.
A high accuracy flight profile determining system N80-14042
GOOD, D. E.
Model 540 rotor blade crack propagation investigation
[AD-A074734] N80-15081
GOODBLOOD, G. E.
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA N80-15142
GOODSON, R.
What brings us down tomorrow - Landing guidance systems for the 1980s A80-18725
GOODWIN, J.
Automation and air traffic control A80-18722
GOTO, N.
A statistical method applied to pilot behavior analysis in multiloop systems A80-18537
GOVINDARA, K. S.
Design criteria for optimal flight control systems
[AD-A074092] N80-15139
GRADY, P. J.
Protective coatings for aircraft composites in nuclear environments
[AD-A074889] N80-14199
GRAFTON, S. B.
Control considerations for CCV fighters at high angles of attack N80-15160
GRAHAM, R. W.
Impact of new instrumentation on advanced turbine research
[NASA-TM-79301] N80-15133
GRAZI, R.
Organization of an integrated global maintenance service N80-14069
GREEK, D. C.
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
GRENON, R.
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow N80-15168
GRIPPO, L.
Automation of flight on-line strategic control: The case of speed control on pre-established routes N80-14070
GRISHIN, V. I.
Determination of the stress intensity factor of composite structural members A80-17958
GRISWOLD, M.
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
GROBMAN, J. S.
Preparing aircraft propulsion for a new era in energy and the environment A80-17737
GRODZOVSKII, G. L.
Concerning the information efficiency of aerodynamic experiments A80-17671
GROESBECK, D.
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics A80-20952
GROSVELD, F.
Structural parameters that influence the noise reduction characteristics of typical general aviation materials
[AIAA PAPER 80-0038] A80-18248
GRUBE, K.
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
GULLY, S. W.
A nonlinear observer/command generator tracker approach to the XM-97 helicopter gun turret control law design A80-20879
GUROV, S. V.
Thermal state of structural members of aircraft engines A80-19412

H

HACKETT, J. E.
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072
HAGEDOORN, A. H.
Shipping by air - Is the value of your time worth it A80-20868
HAGUE, D. S.
Multiple tactical aircraft combat performance evaluation system
[AIAA PAPER 80-0189] A80-18358
HAIDL, G.
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(0)] N80-14140
HALSEY, N. D.
Conformal mapping analysis of multielement airfoils with boundary-layer corrections
[AIAA PAPER 80-0069] A80-18261
HAMED, A.
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299] A80-19316
HANCOCK, G. J.
Unsteady aerodynamics of two-dimensional spoilers at low speeds N80-15170
On the effects of gaps on control surface characteristics N80-15176
HANCOCK, J. P.
Exploratory studies of the cruise performance of upper surface blown configuration: Experimental program, high-speed force tests
[NASA-CR-159134] N80-15070
Exploratory studies of the cruise performance of upper surface blown configurations: Experimental program, high-speed pressure tests
[NASA-CR-159135] N80-15071

Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072
HANKE, D.
In-flight measured characteristics of combined flap-spoiler direct lift controls
N80-15165
HARDY, J. M.
Engine aerodynamic installation by numerical simulation
[AIAA PAPER 80-0108] A80-18271
HARGROVE, A.
Computer simulation of an air cargo small package sorting system
A80-20866
HARMAN, W. H.
Air traffic density and distribution measurements
[AD-A073229] N80-14064
HAYES, D. D.
Weather detection using airport surveillance radar
A80-19129
HEIDELBERG, L. J.
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
HEIDERGOTT, K. W.
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137
HELLER, R. A.
Fatigue life prediction of a bonded splice joint
[AIAA PAPER 80-0305] A80-18306
HENDRIX, R. A.
A flight control system using the DAIS architecture
N80-14019
HENNE, P. A.
An inverse transonic wing design method
[AIAA PAPER 80-0330] A80-18319
HIBBS, S.
Design study for ATA vacuum system aperture
[UCRL-15050] N80-15182
HIGHAM, K. W.
A simple design synthesis method used to estimate aircraft gross weight
[SAWE PAPER 1313] A80-20647
HISLOP, A.
The economics of air traffic control
A80-18723
HOLDEMAN, J. D.
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059
HOLLAND, R.
Code optimization for solving large 3D EMP problems
A80-19764
HOLME, A. H. E.
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730
HONNEIDA, A.
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery
N80-14135
HONYAK, L.
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
HOOKWAY, R. O.
Propulsion options for the HI SPOT long endurance drone airship
[AD-A074595] N80-14132
HOOPER, E. H.
The state-of-the-art of flutter substantiation procedures among US general aviation manufacturers
N80-15143
HORSTMANN, K. H.
Roll control by digitally controlled segment spoilers
N80-15156
HOUBOLT, J. C.
Effect of spanwise gust variations
N80-14639
HOWARD, D. F.
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary under the wing flight propulsion system analysis report
[NASA-CR-134868] N80-15088
Quiet Clean Short-haul Experimental Engine (QCSEE) preliminary over-the-wing flight propulsion system analysis report
[NASA-CR-135296] N80-15095
HOWARD, G. E., JR.
A light aircraft camera Pod - The Enviro-Pod
A80-20251
HOWLETT, J. T.
A study of partial coherence for identifying interior noise sources and paths on general aviation aircraft
[NASA-TM-80197] N80-15874
HUBBARTT, J. E.
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
HUBER, R. K.
Integration of flight and fire control
N80-14043
HUNT, J.
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects
A80-17402
HUNTER, H. F.
Comparison of international flutter requirements and flutter freedom substantiation of light aircraft in the USA
N80-15142
HUNTER, W. F.
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom
[NASA-TM-80153] N80-14055
HUTTON, J. G.
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627

I

IAPOLLA, N.
Filtering of synthetic-radar data
N80-14076
ILIFF, K. W.
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700
IRISH, L. A.
Application of RCS guidelines to weight effective aircraft design
[SAWE PAPER 1270] A80-20626

J

JACOBSON, M. J.
Sonic fatigue design data for bonded aluminum aircraft structures
[AIAA PAPER 80-0303] A80-18304
JAMESON, A.
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
JANUSZEWSKI, W.
An overvoltage safety system for direct current aircraft generators
A80-19051
JOHANNES, R. P.
AFFDL experience in active control technology
N80-15159
JOHN, H.
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(O)] N80-14058
JOHNSON, E. S.
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971
JOHNSON, F. T.
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696

JOHNSON, H. L.
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
JOHNSON, R. H.
Development of aiding GPS/strapdown inertial navigation system
N80-14031
JOHNSON, T. D., JR.
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309
JOHNSTON, D. E.
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699
JOHNSTON, E. A.
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report
[NASA-CR-135075] N80-15100
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle
[NASA-CR-135352] N80-15119
JONAS, K.
Roll control by digitally controlled segment spoilers
N80-15156
JONES, D.
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery
N80-14135
JONES, E.
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
JONES, H. E.
Computer program to prepare airfoil characteristic data for use in helicopter performance calculations
[NASA-TM-78627] N80-15031

K

KALEMARIS, S.
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656
KANDIL, O. A.
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307
KARAMCHETI, K.
An experimental study of the structure and acoustic field of a jet in a cross stream
[NASA-CR-162464] N80-15871
KARASHIMA, K.
A numerical approach to subsonic viscous-inviscid interaction
A80-19070
KASCAK, A. F.
Direct integration of transient rotor dynamics
[NASA-TP-1597] N80-15128
KEATING, R. F. A.
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls
N80-15153
KEHRER, W. T.
Flight control and configuration design considerations for highly maneuverable aircraft
N80-15154
KENT, J. S.
An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC)
[AD-A074390] N80-14063
KERKAM, B. F.
Installation effects on cycle selection for small turbo-fan engines
[AIAA PAPER 80-0106] A80-19280
KERREBROCK, J. L.
Flow in transonic compressors
[AIAA PAPER 80-0124] A80-18357
KIBLER, K. S.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability
[NASA-TP-1538] N80-14136
KIESSLING, F.
An empirical approach for checking flutter stability of gliders and light aircraft
N80-15144
KIRALY, L. J.
Digital system for dynamic turbine engine blade displacement measurements
[NASA-TM-81382] N80-14113
KIRIANOVA, A. A.
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel
A80-17675
KIRK, C. W.
An integrated strapdown guidance and control system for launch vehicle application
A80-17559
KITTINGER, D. C.
Aeronautical systems technology needs: Escape, rescue and survival
[AD-A074906] N80-14061
KLEEHAMMER, H.
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects
A80-17402
KLEIDER, A.
Wire obstacle warning system /WOWS/ - A real-time airborne sensor for automatic detection and recognition of wirelike objects
A80-17402
KLOPFER, G. H.
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
KNIGHT, D. D.
Improved numerical simulation of high speed inlets using the Navier-Stokes equations
[AIAA PAPER 80-0383] A80-18340
KNOX, C. E.
Preliminary test results of a flight management algorithm for fuel conservative descents in a time based metered traffic environment
[NASA-TM-80194] N80-14114
KOEGLER, J. A., JR.
A parametric wing design study for a modern laminar flow wing
[NASA-TM-80154] N80-15050
KOENIG, D. G.
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
KOENIG, K.
The loads at landing impact
A80-17723
KOERNER, H.
Theoretical aerodynamic methods for active control devices
N80-15150
KOOLE, R. C.
An analytical method of testing pavement strength
A80-17998
KOPELEV, S. Z.
Thermal state of structural members of aircraft engines
A80-19412
KORTE, U.
Stability and control aspects of the CCV-F104G
[MBB-UFE-1447(0)] N80-14141
KUBBAT, W. J.
Failure detection, isolation and indication in highly integrated digital guidance and control system
N80-14027
KUCHAR, A. P.
Scale model performance test investigation of exhaust system mixers for an Energy Efficient Engine /E3/ propulsion system
[AIAA PAPER 80-0229] A80-20968
KUENKLER, H.
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor
A80-17724
KUGLIN, C. D.
Map-matching techniques for terminal guidance using Fourier phase information
A80-17517

KUHLMAN, J. M.
Optimized aerodynamic design process for subsonic transport wing fitted with winglets
[NASA-CR-159180] N80-14054
KULINA, H.
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears detailed design report
[NASA-CR-134872] N80-15106
KUO, A. S.
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346

L

LABARRERE, M.
Automatic recovery after sensor failure onboard
N80-14024
LABOZZETTA, B.
Methodology for the evaluation of a radar site
N80-14067
LALANNE, M.
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery
N80-14135
LAMAR, J. E.
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
LAN, E.
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052
LANDINGHAM, G. M.
Aerodynamic data base users guide
[AD-A074448] N80-15983
LANDRUM, E. J.
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
LANSING, D. L.
Applications of diffraction theory to aeroacoustics
N80-14870
LASAGNA, P. L.
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028
LAZARICK, R. T.
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301
LE DIUZET, P.
Separation due to shock wave-turbulent boundary layer interaction
[ONERA, TP NO. 1979-146] A80-20083
LEE, A. M.
The YC-14 upper surface blown flap: A unique control surface
N80-15157
LEE, M.
Constrained optimum trajectories with specified range
A80-18538
LEE, N.
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303
LEVINE, S. R.
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303
LEVY, M.
Practical method of fatigue crack growth analysis for damage tolerance assessment of aluminum structure in fighter type aircraft
[AIAA PAPER 80-0405] A80-18346
LIANG, D. F.
Development of aiding GPS/strapdown inertial navigation system
N80-14031
LIU, C. M.
Applications of diffraction theory to aeroacoustics
N80-14870
LIU, C. T.
Fatigue life prediction of a bonded splice joint
[AIAA PAPER 80-0305] A80-18306
LIUTERMOZA, J. P.
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques
A80-17521
LO, T. K.
Guidance system position update by multiple subarea correlation
A80-17518
LOEBERT, G.
Stability and control aspects of the CCV-F104G
[MBB-UFE-1447(0)] N80-14141
LOEWY, R. G.
Composite structural materials
[NASA-CR-162578] N80-15076
LORINCZ, D. J.
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft
N80-15172
LUCERTINI, M.
Tactical analysis of conflicts in an air traffic control system: Design and implementation of a provisional model
N80-14072
LUEBS, A. B.
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
LUMMUS, J. R.
The criticality of engine exhaust simulations on VSTOL model-measured ground effects
[AIAA PAPER 80-0230] A80-18276
LUTZE, F. H.
Experimental determination of pure rotary stability derivatives using curved and rolling flow wind tunnel
[AIAA PAPER 80-0309] A80-18308
LYMAN, V.
Exploratory studies of the cruise performance of upper surface blown configurations: Program analysis and conclusions
[NASA-CR-159136] N80-15072

M

MABEY, D. G.
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds
N80-15169
MACK, R. J.
Studies of leading-edge thrust phenomena
[AIAA PAPER 80-0325] A80-18315
MACKALL, K. G.
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028
MACMILLER, C. J.
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073
MAESTRELLO, L.
Experimental and numerical results of sound scattering by a body
N80-14873
MAINE, R. E.
Estimation of the accuracy of dynamic flight-determined coefficients
[AIAA PAPER 80-0171] A80-17700
MAISEL, M. D.
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan
[NASA-TM-78562] N80-15067
MANIA, L.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104
MARCY, W. L.
Propulsion options for the HI SPOT long endurance drone airship
[AD-A074595] N80-14132

MAY, M. E.
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259
MCARDLE, J. G.
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
MCAULAY, J. E.
Engine component improvement program - Performance improvement
[AIAA PAPER 80-0223] A80-19300
MCCALL, D. L.
Loran digital phase-locked loop and RF front-end system error analysis
[NASA-CR-162731] N80-15065
MCCRACKEN, R. C.
Quiet short-haul research aircraft familiarization document
[NASA-TM-81149] N80-14108
MCCULLEY, G.
Evaluation of approximate methods for the prediction of noise shielding by airframe components
[NASA-TP-1004] N80-15129
MCFALLS, R. A.
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1
[NASA-CR-134849] N80-15083
Quiet Clean Short-haul Experimental Engine (QCSEE). Aerodynamic and aeromechanical performance of a 50.8 cm (20 inch) diameter 1.34 PR variable pitch fan with core flow
[NASA-CR-135017] N80-15087
MCKINNON, N.
Recent developments in flight simulation techniques A80-20907
MCKINNON, R. A.
Flight and wind tunnel test results of the mechanical jet noise suppressor nozzle
[AIAA PAPER 80-0165] A80-20971
MCLARTY, T. T.
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response A80-17716
MCLAUGHLIN, A. L.
Reflection cracking of bituminous overlays for airport pavements: A state of the art
[AD-A073484] N80-14144
MCOWAT, D. M.
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds N80-15169
MEADOWS, J. B.
Verification of digital autopilot microprocessor hardware and software via hardware-in-the-loop simulation A80-20901
MEDVEDEV, B. M.
Determination of the stress intensity factor of composite structural members A80-17958
MELLO, J. F.
Correlation of F-15 flight and wind tunnel test control effectiveness N80-15152
MENDRUL, G. M.
A method of evaluation of gas turbine engines A80-20064
MERCATANTI, M.
Simulation of a surveillance and control system of surface traffic in an airport N80-14073
MERCER, J. E.
A computer code to model swept wings in an adaptive wall transonic wind tunnel
[AIAA PAPER 80-0156] A80-19287
MERLO, U.
Performance evaluation methods of a secondary radar network N80-14068
MEURZEC, J. L.
Dynamic identification of light aircraft structures and their flutter certification N80-15145
MEYER, W. L.
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
MEYERS, J. A.
The transfer of carbon fibers through a commercial aircraft water separator and air cleaner
[NASA-CR-159183] N80-14359
MEYN, C.
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303
MICHAEL, C.
On the effects of gaps on control surface characteristics N80-15176
MICHAS, R. D.
Determination of the repeatability of PEC
[AFTE-PR-79/36] N80-14109
MILES, J. H.
Dispersion of sound in a combustion duct by fuel droplets and soot particles A80-20953
MILLER, D. S.
Assessment of analytic methods for the prediction of aerodynamic characteristics of arbitrary bodies at supersonic speeds
[AIAA PAPER 80-0071] A80-19308
MILLER, E. I.
A method of simplifying weight and balance for small aircraft
[SAWE PAPER 1278] A80-20630
MILLER, R. A.
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303
MISEL, O. W.
Quiet Clean Short-haul Experimental Engine (QCSEE) main reduction gears test program
[NASA-CR-134669] N80-15103
MITCHELL, D. G.
Effects of the aerodynamic cross-coupling and lateral acceleration derivatives on airplane dynamic characteristics
[AIAA PAPER 80-0170] A80-17699
MITCHELL, G. A.
Summary of advanced methods for predicting high speed propeller performance
[AIAA PAPER 80-0225] A80-20966
MITCHELL, S. C.
Quiet Clean Short-haul Experimental Engine (QCSEE) composite fan frame design report
[NASA-CR-135278] N80-15110
MOEHRING, W.
Sound generation in a flow near a compliant wall A80-20153
MOFFETT, R. N.
Exhaust emission reduction for intermittent combustion aircraft engines
[NASA-CR-159757] N80-14130
MOORE, A. S.
Static test-stand performance of the YF-102 turbofan engine with several exhaust configurations for the Quiet Short-Haul Research Aircraft (QSRA)
[NASA-TP-1556] N80-14121
MOORE, W. A.
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft N80-15172
MORRIS, M. A.
Application of parametric weight and cost estimating relationships to future transport aircraft
[SAWE PAPER 1292] A80-20637
MORRIS, R. E.
Hypersonic cruise aircraft propulsion integration study, volume 1
[NASA-CR-158926-VOL-1] N80-15074

Hypersonic cruise aircraft propulsion integration study, volume 2
[NASA-CR-158926-VOL-2] N80-15075
MORRISON, R. B.
Oblique detonation wave ramjet
[NASA-CR-159192] N80-14131
MORWAY, P. E.
Visual accommodation responses in a virtual image environment
[AD-A074415] N80-15082
MOYNES, J. F.
Flaperon control: The versatile surface for fighter aircraft
N80-15158
MUKHAMEDOV, F. A.
Designing light airplanes
A80-19414
MULCARE, D. B.
An assessment of and approach to the validation of digital flight control systems
N80-14036
MUNK, M. M.
The minimum induced drag of aerofoils
[NACA-121] N80-15038
The aerodynamic forces on airship hulls
[NACA-184] N80-15039
Elements of the wing section theory and of the wing theory
[NACA-191] N80-15040
MUTHUKRISHNAN, M.
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245

N

NAKAMURA, Y.
Rotational noise of helicopter rotors
A80-17718
NASTROM, G. D.
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059
NEALE, D. H.
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
NEALE, D. H., SR.
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311
NEIHOF, R. A.
Microbial deterioration of hydrocarbon fuels from oil shale, coal, and petroleum. 1: Exploratory experiments
[AD-A073761] N80-14259
NELSON, J. P.
Airport noise, location rent, and the market for residential amenities
A80-17720
NELSON, W. E., JR.
Flaperon control: The versatile surface for fighter aircraft
N80-15158
NEPPERT, H.
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics
N80-15178
NESS, W. G.
An assessment of and approach to the validation of digital flight control systems
N80-14036
NEUMANN, H. E.
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134
NEWMAN, F. M.
The physical and chemical characterization of ten military turbine engine lubricants
[AD-A074073] N80-15265
NGUYEN, L. T.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability
[NASA-TP-1538] N80-14136
Control considerations for CCV fighters at high angles of attack
N80-15160
NIBLETT, L. T.
A flutter-speed formula for wings of high aspect ratio
N80-15147
NIEDBAL, N.
A simplified ground vibration test procedure for sailplanes and light aircraft
N80-15146
NIEDZIALEK, B.
Experimental investigation of the characteristics of pneumatic transfer lines
A80-19052
NIELSEN, J. N.
Euler solutions for wing and wing-body combination at supersonic speeds with leading-edge separation
[AIAA PAPER 80-0126] A80-18359
Nonlinear aerodynamics of all-movable controls
N80-15173
NIESZ, D. E.
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062
NORED, D. L.
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737
NORUM, T. D.
Applications of diffraction theory to aeroacoustics
N80-14870
NOVOSARTOV, G. T.
Unification of oils for aircraft gas-turbine engines
A80-20690

O

ODOARDI, F.
Visual displays for air traffic control data
N80-14077
OFFERMANS, R. P.
Methods for strap-down attitude estimation and navigation with accelerometers
N80-14034
OGBURN, M. E.
Simulator study of stall/post-stall characteristics of a fighter airplane with relaxed longitudinal static stability
[NASA-TP-1538] N80-14136
OGDEN, J. S.
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062
OKABAYASHI, M.
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876
ONAT, E.
A pre-design code for predicting engine acquisition costs
[AIAA PAPER 80-0055] A80-19269
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135
ORLOFF, K. L.
Effect of tip planform on blade loading characteristics for a two-bladed rotor in hover
[NASA-TM-78615] N80-14049
ORTH, P.
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106
OSTGAARD, M. A.
Technical evaluation report on the 28th Guidance and Control Panel Symposium on Advances in Guidance and Control Systems Using Digital Techniques
[AGARD-AR-148] N80-15140
OWEN, F. K.
Control of forebody three-dimensional flow separations
N80-15164

P

PALKUTI, L. J.
Integrated circuit characteristics at 260 C for aircraft engine-control applications
A80-20112

PAO, J. L.
The quasi-vortex-lattice method for wings with edge vortex separation
[NASA-CR-162530] N80-14052

PARDINI, S.
A survey of the stochastic filtering techniques for data processing in air-traffic control and surveillance systems
A80-20867
Tracking algorithms for mono and multiradar
N80-14074

PARDUE, R. E.
Aircraft fuel system simulator tests with antimisting kerosene (jet A fuel with FM-9 additive)
[AD-A073237] N80-14256

PARRIS, B. L.
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15069

PAYNE, B. W.
The minimum cost approach to flutter clearance
N80-15148

PEAKE, D. J.
Control of forebody three-dimensional flow separations
N80-15164

PEARSON, D. S.
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730

PEARSON, J. J.
Map-matching techniques for terminal guidance using Fourier phase information
A80-17517

PELEGRIN, M.
Automatic recovery after sensor failure onboard
N80-14024

PELLEGRINI, P. F.
An air traffic channel simulation by means of ray-tracing techniques
N80-14088
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092

PELLMAN, A.
Non-contacting electro-optical contouring of helicopter rotor blades
[AD-A070806] N80-14111

PENT, M.
Onboard collision avoidance system: Environmental influence on the tracking algorithm requirements
N80-14105

PERIN, J.
The avionics computer program: Practical experiences with a methodology
N80-14037

PERKINS, P. J.
Simultaneous cabin and ambient ozone measurements on two Boeing 747 airplanes, volume 1
[NASA-TM-79166] N80-15059

PERKINS, R. G., JR.
Navy V/STOL - A continuing initiative
[SAWE PAPER 1325] A80-20655

PERRY, G. E.
The Russian satellite navigation system
A80-20982

PETERSEN, R. J.
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303

PETOT, D.
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086

PETRASH, D. A.
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737

PETRIOLI, R.
Filtering of synthetic radar data
N80-14076

PHILLIPS, W. H.
Altitude response of several airplanes during landing approach
[NASA-TM-80186] N80-14139

PIATTELLI, M.
Development trends of airport surface traffic control radar
N80-14087

PIAZZOLI, G.
Dynamic identification of light aircraft structures and their flutter certification
N80-15145

PIRCHER, M.
Automatic recovery after sensor failure onboard
N80-14024

PISCOPO, P. P.
Fuel conservation benefits and critical technologies of recuperative and advanced conventional cycle turboshaft engines
[AIAA PAPER 80-0224] A80-19301

POVINELLI, L. A.
An analytical and experimental study of a short S-shaped subsonic diffuser of a supersonic inlet
[AIAA PAPER 80-0386] A80-20970
An analytical and experimental study of a short s-shaped subsonic diffuser of a supersonic inlet
[NASA-TM-81406] N80-15134
Computation of three-dimensional flow in turbofan mixers and comparison with experimental data
[NASA-TM-81410] N80-15364

POWERS, S. A.
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317

PRANDTL, L.
Applications of modern hydrodynamics to aeronautics. Part 1: Fundamental concepts and the most important theorems. Part 2: Applications
[NACA-116] N80-15034

PRINCE, J. L.
Integrated circuit characteristics at 260 C for aircraft engine-control applications
A80-20112

PRODAN, J.
The T-28 thunder/hailstorm penetration aircraft
N80-14640

PUTNAM, T. W.
Landing approach airframe noise measurements and analysis
[NASA-TP-1602] N80-15028

Q

QUINN, D. W.
The analysis of sound propagation in jet engine ducts using the finite difference method
[AD-A074233] N80-14853

R

RABIEGA, W. A.
Models for freight access to air terminals
A80-20869

RACHOWITZ, B. I.
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636

RADCHENKO, E. D.
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel
A80-17675

RAPTOPOULOS, D. D.
Dispersion of sound in a combustion duct by fuel droplets and soot particles
A80-20953

RAHMAN, S.
Sound generation in a flow near a compliant wall
A80-20153

RAILEY, J. M.
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026

RAO, D. M.
Investigation of leading-edge devices for drag reduction of a 60-deg. delta wing at high angles of attack
[AIAA PAPER 80-0310] A80-18309

RAPTIS, D.
Recent developments in flight simulation techniques A80-20907
RAVENHALL, R.
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108
REARDON, L. F.
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068
REDDY, C. S.
Analytical investigation of aerodynamic characteristics of highly swept wings with separated flow A80-17697
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
Theoretical study of aerodynamic characteristics of wings having vortex flow
[NASA-CR-159184] N80-14053
REDEKER, G.
Flight testing of the buffeting behavior of combat aircraft
[ESA-TT-523] N80-14143
REGELSON, E.
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303
REID, D. B.
Development of aiding GPS/strapdown inertial navigation system N80-14031
RICCIARDELLI, S.
Radar data utilization in automating the sequencing of aircrafts in terminal areas N80-14071
RICE, E. J.
Comparison of inlet suppressor data with approximate theory based on cutoff ratio
[AIAA PAPER 80-0100] A80-20964
RICE, R. K.
Flight certification of the Cessna TU206G amphibious floatplane A80-18186
RICHMOND, L. D.
Application of finite element analysis to derivation of structural weight
[SAWE PAPER 1271] A80-20627
RINALDI, G.
Radar data utilization in automating the sequencing of aircrafts in terminal areas N80-14071
RIX, O.
In-flight measured characteristics of combined flap-spoiler direct lift controls N80-15165
RIZZO, F. J.
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136
ROGERS, H.
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328
ROSE, H. J.
Covariance simulation of BCAS - An aircraft collision avoidance system A80-20915
ROSENBLUTH, M. N.
Low-aspect-ratio limit of the toroidal reactor - The spheromak A80-17876
ROSKAM, J.
Structural parameters that influence the noise reduction characteristics of typical general aviation materials
[AIAA PAPER 80-0038] A80-18248
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356
ROSS, A. J.
A survey of experimental data on the aerodynamics of controls, in the light of future needs N80-15151
ROUSE, W. B.
Adaptive allocation of decisionmaking responsibility between human and computer in multitask situations A80-18022
RUBLE, J. H.
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255
RUGGLES, C. L.
Quiet Clean Short-Haul Experimental Engine (QCSEE) Under-The-Wing (UTW) graphite/PMR cowl development
[NASA-CR-135279] N80-14119
RUISI, R.
L-band measurements in the air traffic channel to characterize secondary radar systems N80-14092
RYNASKI, E. G.
Design criteria for optimal flight control systems
[AD-A074092] N80-15139

S

SABLA, P. E.
Quiet Clean Short-haul Experimental Engine (QCSEE). Double-annular clean combustor technology development report
[NASA-CR-159483] N80-15121
SACCO, V.
Antireflection techniques for detecting false tracks in air traffic surveillance with secondary radar N80-14100
SAINI, J. K.
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
SAINT JOHN, R. H.
Code optimization for solving large 3D PNP problems A80-19764
SAINT JOHN, R. S.
Advanced technology effects on V/STOL propulsive system weight
[SAWE PAPER 1300] A80-20640
SALEMME, C. T.
Quiet Clean Short-haul Experimental Engine (QCSEE) under-the-wing engine composite fan blade design report
[NASA-CR-135046] N80-15108
SALIBA, M.
Simulation of a surveillance and control system of surface traffic in an airport N80-14073
SANDERS, B. W.
Dynamic response of a Mach 2.5 axisymmetric inlet and turbojet engine with a poppet-value controlled inlet stability bypass system when subjected to internal and external airflow transients
[NASA-TP-1531] N80-14123
Turbojet-exhaust-nozzle secondary-airflow pumping as an exit control of an inlet-stability bypass system for a Mach 2.5 axisymmetric mixed-compression inlet
[NASA-TP-1532] N80-14124
SANDERSON, R.
Some investigations concerning the effects of gaps and vortex generators on elevator efficiency and of landing flap sweep on aerodynamic characteristics N80-15178
SANKAR, N. L.
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238
SASSANO, A.
Radar data utilization in automating the sequencing of aircrafts in terminal areas N80-14071
SATTLER, D. P.
The rational design of an airfoil for a high performance jet trainer
[AIAA PAPER 80-0328] A80-18317
SATZER, W.
Vocabulary specification for automatic speech recognition in aircraft cockpits
[AD-A073703] N80-14303

SCHEMENSKY, R. T.
Development of a vortex-lift-design method and application to a slender maneuver-wing configuration
[AIAA PAPER 80-0327] A80-18316
SCHMIDT, A. H.
Preliminary weight estimation of engine section structure
[SAWE PAPER 1311] A80-20645
SCHMITT, V.
Aerodynamic interaction on a close-coupled canard wing configuration
N80-15175
SCHMITZ, F. H.
Acoustically swept rotor
[NASA-CASE-ARC-11106-1] N80-14107
SCHULTZ, P. H.
Atmospheric effects on Martian ejecta emplacement
A80-20192
SCHUTZ, D.
Review of investigations into aeronautics related fatigue Federal Republic of Germany
[LBF-S-142] N80-14422
SCOLATTI, C. A.
Control integration technology impact
N80-15162
SEBASTIAN, J. D.
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
SEKERCIOGLU, I.
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062
SFORZA, P. M.
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376
SHAH, P. C.
Linear systems analysis program, L224(QR). Volume 1: Engineering and usage
[NASA-CR-2861] N80-14137
SHIPPY, D. J.
Thermo-mechanical stress analysis of advanced turbine blade cooling configuration
[AD-A074098] N80-15136
SHORT, J. J.
An evaluation of the bird/aircraft strike hazard at Barksdale Air Force Base, Louisiana (SAC)
[AD-A074390] N80-14063
SHOWALTER, T. W.
The effects of motion and g-seat cues on pilot simulator performance of three piloting tasks
[NASA-TP-1601] N80-15069
SHUMPERT, P. K.
An experimental model investigation of turbofan engine internal exhaust gas mixer configurations
[AIAA PAPER 80-0228] A80-19302
SIDDALINGAPPA, S. R.
Unsteady aerodynamics of two-dimensional spoilers at low speeds
N80-15170
SIDES, J.
Unsteady effects of a control surface in two dimensional, subsonic and transonic flow
N80-15168
SIDORENKO, M. K.
Evaluation of the intensity of beat-induced vibrations
A80-17965
SIEGEL, W. H.
Loading tests of a wing structure for a hypersonic aircraft
[NASA-TP-1596] N80-15068
SIEMIRADZKI, I.
An overvoltage safety system for direct current aircraft generators
A80-19051
SIMPSON, L.
Code optimization for solving large 3D EMP problems
A80-19764
SKOW, A. M.
Enhanced departure/spin recovery of fighter aircraft through control of the forebody vortex orientation
[AIAA PAPER 80-0173] A80-18352
Forebody vortex blowing: A novel control concept to enhance departure/spin recovery characteristics of fighter and trainer aircraft
N80-15172
SMETANOV, V. A.
Unification of oils for aircraft gas-turbine engines
A80-20690
SMITH, C. A.
Nonlinear aerodynamics of all-movable controls
N80-15173
SMITH, H. M.
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
SMITH, P. H.
Discontinuous registration of industrial radiographs using profile analysis and piecewise correlation techniques
A80-17521
SMOLKA, S.
Trajectory behaviour of a control configurated aircraft subjected to random disturbances
N80-15171
SMORTO, M. J.
Streamwise development of the flow over a delta wing
[AIAA PAPER 80-0200] A80-18376
SMYTH, R. K.
State of the art for digital avionics and controls, 1978
N80-14018
SOHST, H.
Development aspects of a dynamically tuned gyro for strapdown - AHRS
A80-17553
SOLIGNAC, J. L.
Experimental study of confluence with separation on an afterbody of revolution
[ONERA, TP NO. 1979-151] A80-20088
SONNLEITNER, W.
Wind tunnel investigation of controls for DF on a fighter-type configuration of higher angles of attack
N80-15166
SOWERS, H. D.
Quiet, Clean, Short-Haul, Experimental Engine (QCSEE) Under-The-Wing (UTW) engine acoustic design
[NASA-CR-135267] N80-14117
Quiet, Clean, Short-Haul Experimental Engine (QCSEE) Over-The-Wing (OTW) engine acoustic design
[NASA-CR-135268] N80-14118
Quiet Clean Short-haul Experimental Engine (QCSEE). Core engine noise measurements
[NASA-CR-135160] N80-15093
STALNAKER, W. A.
A computerized method for calculating flutter characteristics of a system characterized by two degrees of freedom
[NASA-TM-80153] N80-14055
STAVINOHA, L. L.
The physical and chemical characterization of ten military turbine engine lubricants
[AD-A074073] N80-15265
STECURA, S.
Thermal barrier coatings for aircraft gas turbines
[AIAA PAPER 80-0302] A80-18303
STEININGER, H.
Excitation and analysis technique for flight flutter tests
[MBB-UF-1446(O)] N80-14140
STEPANENKO, N. D.
Damping capacity of plastic compressor blades
A80-19868
STEPHENS, R. E.
Problems associated with cargo airplanes having aft mounted engines
[SAWE PAPER 1314] A80-20648
STERNBERGER, N.
The modular life cycle cost model - An overview
[SAWE PAPER 1290] A80-20636
STEVENS, M. L.
Surface conforming thermal/pressure seal
[NASA-CASE-MSC-18422-1] N80-14400
STEVENSON, C. A.
An adaptation and validation of a primitive variable mathematical model for predicting the flows in turbojet test cells and solid fuel ramjets
[AD-A074187] N80-14133

STEWART, W.
Avionics installation (AVSTALL) cost model for user equipment of NAVSTAR global positioning system
[AD-A073681] N80-14106

STEWART, W. L.
Preparing aircraft propulsion for a new era in energy and the environment
A80-17737

STIMPERT, D. L.
Quiet Clean Short-Haul Experimental Engine (QCSEE) acoustic and aerodynamic tests on a scale model over-the-wing thrust reverser and forward thrust nozzle
[NASA-CR-135254] N80-14115
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 1
[NASA-CR-134849] N80-15083
Demonstration of short-haul aircraft aft noise reduction techniques on a twenty inch (50.8) diameter fan, volume 2
[NASA-CR-134850] N80-15084
Demonstration of short haul aircraft aft noise reduction techniques on a twenty inch (50.8 cm) diameter fan, volume 3
[NASA-CR-134851] N80-15085
Acoustic analysis of aft noise reduction techniques measured on a subsonic tip speed 50.8 cm (twenty inch) diameter fan
[NASA-CR-134891] N80-15102
Quiet Clean Short-haul Experimental Engine (QCSEE) Over-The-Wing (OTW) propulsion systems test report. Volume 4: Acoustic performance
[NASA-CR-135326] N80-15118

STOHLER, S. L.
LOX/GOX mechanical impact tester assessment
[NASA-TM-74106] N80-15179

STOLOV, L. I.
Aircraft torque motors
A80-19199

STOTLER, C. L., JR.
Quiet Clean Short-haul Experimental Engine (QCSEE). Composite fan frame subsystem test report
[NASA-CR-135010] N80-15098
Quiet Clean Short-haul Experimental Engine (QCSEE) Under-The-Wing (UTW) composite nacelle subsystem test report
[NASA-CR-135075] N80-15100

STRACK, S. L.
Fleet hardness variation
[AD-A074849] N80-15029

STRAHLE, W. C.
Estimation of noise source strengths in a gas turbine combustor
[AIAA PAPER 80-0034] A80-18245
Mach 3 hydrogen external/base burning
[AIAA PAPER 80-0280] A80-19311

STUCKENBERG, N.
An observer system for sensor failure detection and isolation in digital flight control systems
N80-14023

STUDNEV, R. V.
Aircraft aerodynamics - Dynamics of longitudinal and lateral motion
A80-19374

STURGEON, W. R.
Controllers for aircraft motion simulators
[AIAA PAPER 80-0050] A80-18252

SULKOSKE, R. A.
Regression techniques applied to parametric turbine engine simulations
[AIAA PAPER 80-0053] A80-18255

SWEETMAN, B.
The next supersonic transport
A80-20214

T

TABAKOFF, W.
Optimization of turbine nozzle cooling by combining impingement and film injection
[AIAA PAPER 80-0299] A80-19316

TANGLER, J. L.
Analysis of low-speed helicopter flight test data
[AD-A074141] N80-15079

TANGORRA, A.
Problems related to the design and construction of a radar network
N80-14066

TASSA, Y.
Reynolds number and compressibility effects on dynamic stall of a NACA 0012 airfoil
[AIAA PAPER 80-0010] A80-18238

TERRIS, D.
Navigation error using rate of change of signal time of arrival from space vehicles
A80-20904

THEODORSEN, T.
General potential theory of arbitrary wing sections
[NACA-452] N80-15046
General theory of aerodynamic instability and the mechanism of flutter
[NACA-496] N80-15047

THOMAS, H. H. B. M.
A survey of experimental data on the aerodynamics of controls, in the light of future needs
N80-15151

TIERNEGO, M. J. L.
Methods for strap-down attitude estimation and navigation with accelerometers
N80-14034

TINOCO, E. N.
Application of a higher order panel method to realistic supersonic configurations
[AIAA PAPER 79-0274] A80-17696

TISCHLER, M. B.
Determination of the spin and recovery characteristics of a typical low-wing general aviation design
[AIAA PAPER 80-0169] A80-18351

TODD, A. M. M.
Low-aspect-ratio limit of the toroidal reactor - The spheromak
A80-17876

TOLLE, F. P.
An extension of engine weight estimation techniques to compute engine production cost
[AD-A074454] N80-15135

TONDL, A.
On the dynamics of compressor surge
A80-17900

TONSKOTTER, H.
On the influence of steady state temperature and pressure distortion on the flow characteristics in an installed multistage jet engine compressor
A80-17724

TOWNE, C. E.
Numerical simulation of supersonic inlets using a three-dimensional viscous flow analysis
[AIAA PAPER 80-0384] A80-20969

TRAMBUSTI, M.
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092

TRAN, C. T.
A phenomenological model of the dynamic stall of a helicopter blade profile
[ONERA, TP NO. 1979-149] A80-20086

TROMPETTE, P.
On the use of vibration self-damping materials in the manufacture of parts for rotating machinery
N80-14135

TUCKER, M. I.
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038

TURKEL, B. S.
Current research on aviation weather (bibliography), 1979
[NASA-CR-3214] N80-14651

TURNER, D. R.
Advanced materials and the Canadair Challenger
[SAWE PAPER 1284] A80-20632

V

VAN DAM, C. P. G.
Correlation of predicted longitudinal aerodynamic characteristics with full-scale wind tunnel data on the ATLIT airplane
[AIAA PAPER 80-0186] A80-18356

VANKEUK, G.
Target tracking using Doppler-information in sensor oriented coordinates with a three dimensional array radar
[REPT-270] N80-14325
VATALARO, F.
Automatic systems for airport surface mobile media surveillance based on the use of secondary media
N80-14104
VAUSE, R.
Acoustically swept rotor
[NASA-CASE-ARC-11106-1] N80-14107
VENTURI, V.
L-band measurements in the air traffic channel to characterize secondary radar systems
N80-14092
VESELIANSKAIA, V. M.
Effect of naphthenic aromatic hydrocarbons on the oxidizability of hydrogenated jet fuel
A80-17675
VILENKIN, A. V.
Unification of oils for aircraft gas-turbine engines
A80-20690
VINCENT, M. C.
Application of RCS guidelines to weight effective aircraft design
[SAWE PAPER 1270] A80-20626
VISSER, W.
An analytical method of testing pavement strength
A80-17998
VON GLAHN, U.
Assessment at full scale of exhaust nozzle-to-wing size on STOL-OTW acoustic characteristics
A80-20952
Acoustic considerations of flight effects on jet noise suppressor nozzles
[AIAA PAPER 80-0164] A80-20965
VOUSDEN, P. R.
A high accuracy flight profile determining system
N80-14042

W

WALKER, D. J.
Fin design with ACT in the presence of strakes
N80-15161
WARNBRODT, W.
Formulation of coupled rotor/fuselage equations of motion
A80-17717
WATSON, J. H.
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026
WATTS, P. R.
Gas turbine carcase and accessory vibration - Problems of measurement and analysis
A80-17730
WEATHERILL, W. H.
Analysis of transonic flow about harmonically oscillating airfoils and wings
[AIAA PAPER 80-0149] A80-18367
An investigation of several factors involved in a finite difference procedure for analyzing the transonic flow about harmonically oscillating airfoils and wings
[NASA-CR-159143] N80-14056
A users guide for A344: A program using a finite difference method to analyze transonic flow over oscillating airfoils
[NASA-CR-159141] N80-15052
WEBBY, J. P.
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
WEGER, D.
Investigation of the oscillatory and flight behavior of rotor systems in relation with atmospheric turbulence
[BMVG-FBWT-79-5] N80-14142
WEHREND, W. R., JR.
Pilot control through the TAFCOS automatic flight control system
[NASA-TM-81152] N80-14138
WEIBERG, J. A.
NASA/Army XV-15 tilt rotor research aircraft wind-tunnel test program plan
[NASA-TM-78562] N80-15067
WEIDNER, J. P.
Propulsion/airframe integration considerations for high altitude hypersonic cruise vehicles
[AIAA PAPER 80-0111] A80-18272
WELSH, B. L.
Aerodynamic characteristics of moving trailing-edge controls at subsonic and transonic speeds
N80-15169
WELTE, D.
Wind tunnel measurements and analysis of some unusual control surfaces on two swept wing fighter configurations
N80-15155
WERNER, K.
High angle of attack characteristics of different fighter configurations
[MBB-UFE-1443(O)] N80-14058
WERTH, J.
Two dimensional aerodynamic interference effects on oscillating airfoils with flaps in ventilated subsonic wind tunnels
[NASA-CR-3210] N80-14047
WESCOTT, P. L.
Experience in producing software for the ground station of a remotely piloted helicopter system
N80-14038
WHITMOYER, R. A.
AFFDL experience in active control technology
N80-15159
WHITTLEY, D. C.
Large scale model tests of a new technology V/STOL concept
[AIAA PAPER 80-0233] A80-19303
WIBERLY, S. E.
Composite structural materials
[NASA-CR-162578] N80-15076
WILLIAMS, J. G.
Modification of axial compressor streamline program for analysis of engine test data
[NASA-TM-79312] N80-14051
WILLIAMSON, W. E., JR.
A comparison of first and second order techniques for computing optimal horizontal gliding trajectories
[AIAA PAPER 80-0061] A80-18260
WILLIS, W. S.
Quiet Clean Short-haul Experimental Engine (QCSEE)
[NASA-CR-159473] N80-15120
WILLS, R. R.
Comparative resistance of Beta-Si3N4 solid solutions to molten silicon attack
A80-18062
WINKELMANN, A. E.
The effects of leading edge modifications on the post-stall characteristics of wings
[AIAA PAPER 80-0199] A80-18375
WITSHEER, A. J.
Performance evaluation of image correlation techniques
A80-17534
WOOD, C. D.
The Russian satellite navigation system
A80-20982
WOODRUFF, R. R.
Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator
[AD-A071410] N80-15180
WOODWARD, D. S.
Some wind tunnel measurements of the effectiveness at low speeds of combined lift and roll controls
N80-15153
WRIGHT, H. E.
Photon correlation laser velocimeter measurements in highly turbulent flow fields
[AIAA PAPER 80-0344] A80-18328
WU, F. T.
Infrared sensor system performance simulations
A80-20900
WU, J. J.
Recent development of a jet-diffuser ejector
[AIAA PAPER 80-0231] A80-18277
WUENNENBERG, H.
Roll control by digitally controlled segment spoilers
N80-15156
Direct side force and drag control with the aid of pylon split flaps
N80-15163

WYKES, J. H.
Analyses and tests of the B-1 aircraft structural mode control system
[NASA-CR-144887] N80-15073

Y

YATES, E. C., JR.
Hybrid vortex method for lifting surfaces with free-vortex flow
[AIAA PAPER 80-0070] A80-19307
YEAKLEY, P. L.
Evaluation of the aerodynamic characteristics of a 1/20-scale A-10 model at Mach numbers from 0.30 to 0.75
[AD-A074867] N80-15055
YEN, J. G.
Analysis of rotor-fuselage coupling and its effect on rotorcraft stability and response
A80-17716
YORK, E. H.
Fleet hardness variation
[AD-A074849] N80-15029
YORK, P.
Weight impact of VTOL
[SAWE PAPER 1326] A80-20656
YOUSEY, W. J.
Redundancy management considerations for a control-configured fighter aircraft triplex digital fly-by-wire flight control system
N80-14026

Z

ZAPPA, G.
Tracking algorithms for mono and multiradar
N80-14074
ZINN, B. T.
Acoustic radiation from axisymmetric ducts - A comparison of theory and experiment
[AIAA PAPER 80-0097] A80-18268
ZYKOV, B. N.
Aircraft torque motors
A80-19199

CONTRACT NUMBER INDEX

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AF PROJ. 329A
N80-15055
AF PROJ. 1123
N80-15180
AF PROJ. 2307
N80-15136
AF PROJECT 14710130
A80-18304
AF-AFOSR-2824-79
N80-15136
BCS-G0061 N80-14137
DA PROJ. 1F2-62209-AH-76
N80-15081
DA PROJ. 1L1-61102-AH-45
N80-15031
DA PROJ. 1L2-62209-AH-76
N80-15079
DAAB07-77-C-2167
A80-17402
DAAJ02-77-C-0022
N80-15079
DAAK40-76-C-1193
A80-17517
DAAK50-78-C-0008
N80-14111
DAAK70-79-C-0142
N80-15265
DFG-SFB-83 A80-17724
DGRST-75-7-0968
N80-14135
DNA001-77-C-0098
N80-14199
DNA001-78-C-0138
N80-15029
DNA001-78-C-0345
A80-19764
DOT-FA-77WA-4077
A80-18245
DOT-FA77WAI-817
N80-14064
DOT-FA78WAI-925
N80-14256
DOT-TS-14698 A80-20915
E(11-1)-3237 A80-17876
EY-76-C-02-3073
A80-17876
FAA PROJ. 052-241-04
N80-14064
F04701-78-C-0124
N80-14106
F08635-76-C-0306
A80-18534
F30602-77-C-0049
A80-17518
F33615-75-C-3016
A80-18304
F33615-75-C-3144
A80-18304
F33615-76-C-1300
A80-17534
F33615-76-C-3072
A80-17699
F33615-77-C-3036
N80-14026
F33615-78-C-3000
A80-18358
F33615-78-C-3008
A80-18340
F33615-78-C-3422
A80-20626
F33615-78-C-3604
A80-17699
F40600-79-C-001
A80-19287
F49620-77-C-0066
A80-18268
NASW-2691 N80-14018
NAS1-13175-16
A80-18308
NAS1-13871 N80-15070
N80-15071
N80-15072
NAS1-14193 N80-14053
N80-15299
NAS1-14193-48
A80-17697
NAS1-15057 N80-15074
N80-15075
NAS1-15128 A80-18367
N80-14056
N80-15052
NAS1-15238 N80-14359
NAS1-15343 N80-15062
NAS1-15344 N80-14131
NAS1-15346 N80-14137
NAS3-18021 N80-14115
N80-14116
N80-14117
N80-14118
N80-14119
N80-14120
N80-15083
N80-15084
N80-15085
N80-15086
N80-15087
N80-15088
N80-15089
N80-15090
N80-15091
N80-15092
N80-15093
N80-15094
N80-15095
N80-15096
N80-15097
N80-15098
N80-15099
N80-15100
N80-15101
N80-15102
N80-15103
N80-15104
N80-15105
N80-15106
N80-15107
N80-15108
N80-15109
N80-15110
N80-15111
N80-15112
N80-15113
N80-15114
N80-15115
N80-15116
N80-15117
N80-15118
N80-15119
N80-15120
N80-15121
N80-15122
N80-15123
N80-15124
N80-15125
N80-15126
NAS3-19754 N80-14130
NAS3-20057 N80-14129
NAS3-20082 N80-14122
NAS3-20629 N80-14127
NAS4-2519 N80-15073
NAS7-100 A80-18062
NAS8-32692 N80-14651
NGL-05-020-526
N80-15871
NGL-33-018-003
N80-15076
NGR-36-009-017
N80-15063
N80-15064
NGR-39-009-017
N80-15065
NGR-50-007-001
N80-14355
NSG-1357 N80-14054
NSG-1537 N80-14052
NSG-1560 A80-19307
NSG-1570 A80-18351
A80-18375
NSG-1578 A80-17717
NSG-2007 N80-15871
NSG-2119 A80-18022
NSG-2140 N80-14047
NSG-6026 N80-15058
NSR-09-051-001
A80-20192
N00014-74-C-0050
N80-15173
N00014-78-C-0155
N80-15139
N00014-78-C-0547
N80-14417
N00014-78-C-0692
N80-14303
N00019-75-C-0396
N80-15077
N00019-77-C-0318
N80-15030
N62269-77-C-0217
N80-15137
N62269-78-C-0286
N80-15135
N62269-79-C-0204
N80-14132
SF54592201 N80-15137
W-7405-ENG-48
N80-15182
N80-15183
WR041010101 N80-15082
ZF57571004 N80-14259
505-02-54 N80-15068
505-03 N80-14125
505-04 N80-14124
N80-15128
505-06-31 N80-14047
505-06-63-03 N80-14136
505-09-41 N80-15069
505-10-23-03 N80-15031
505-33-53-03 N80-15874
505-34-33-02 N80-14139
513-52-01-16 N80-14114
535-03-14 N80-15028
744-01-01 N80-15067
769-02 N80-14121

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (121)		

4. Title and Subtitle	5. Report Date
AERONAUTICAL ENGINEERING A Continuing Bibliography (Supplement 121)	April 1980
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D. C. 20546	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

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17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerodynamics Aeronautical Engineering Aeronautics Bibliographies	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	134	$5.00 HC

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