NASA SP-7037 (59)



# AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 59

JULY 1975

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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

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NASA SP-7037 (59)

# AERONAUTICAL ENGINEERING

## A Special Bibliography

## Supplement 59

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in June 1975 in

- *Scientific and Technical Aerospace Reports (STAR)*
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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 Special Bibliography* (NASA SP-7037) lists 368 reports, journal articles, and other documents originally announced in June 1975 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.

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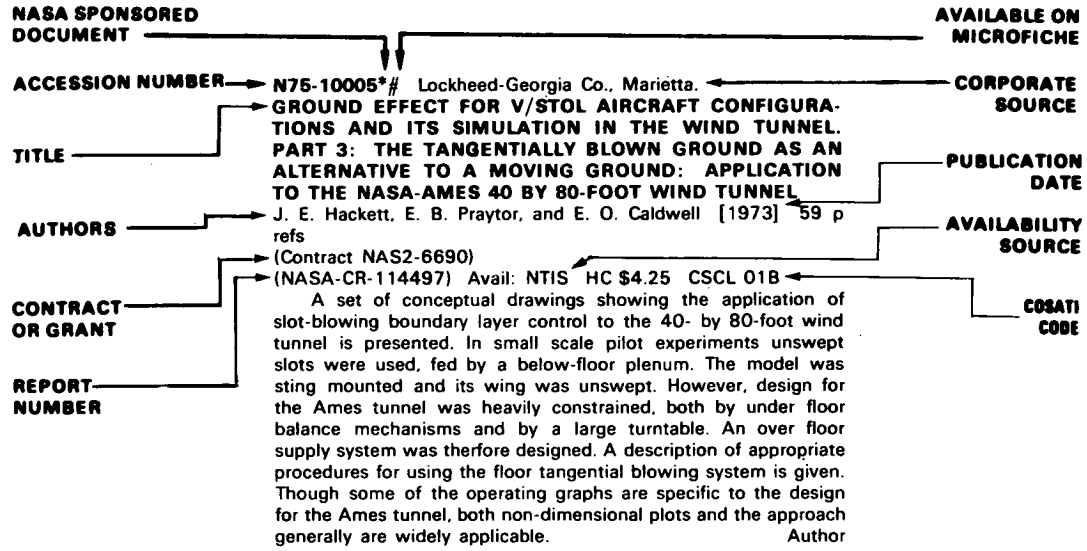
# TABLE OF CONTENTS


Page

IAA Entries ..... 243
STAR Entries ..... 261

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


## TYPICAL CITATION AND ABSTRACT FROM *STAR*

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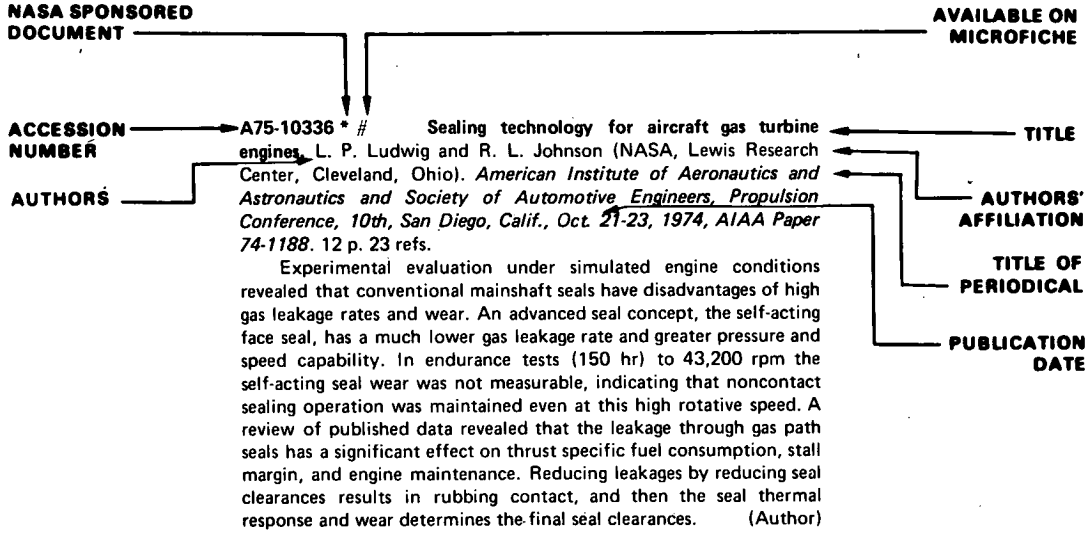


# AERONAUTICAL ENGINEERING

*A Special Bibliography (Suppl. 59)* JULY 1975


## IAA ENTRIES

**A75-26195** **A non-uniqueness of the hypersonic boundary layer.** S. N. Brown and K. Stewartson (University College, London, England). *Quarterly Journal of Mechanics and Applied Mathematics,* vol. 28, Feb. 1975, p. 75-90. 19 refs.

Using the tangent-wedge approximation to describe the inviscid portion of the flow field, Neiland (1970) discovered a nonuniqueness of the solution in the neighborhood of the leading-edge of a flat plate in free hypersonic flow. The nonuniqueness is associated with a single eigenvalue and eigenfunction occurring between certain terms of the power series that expresses the pressure. More accurate estimates of the eigenvalue are obtained by using the full inviscid equations instead of the tangent-wedge approximation. A unique eigensolution is obtained for the hypersonic boundary-layer equations, and the relationship between this eigensolution and the eigensolutions of the reduced Navier-Stokes equations in the limit is examined. V.P.

**A75-26212 *** **Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil.** U. B. Mehta (Illinois Institute of Technology, Chicago, Ill.; NASA, Ames Research Center, Computational Fluid Dynamics Branch, Moffett Field, Calif.) and Z. Lavan (Illinois Institute of Technology, Chicago, Ill.). *Journal of Fluid Mechanics,* vol. 67, Jan. 28, 1975, p. 227-256. 18 refs. Contract No. F44620-69-C-0022. Project THEMIS.

The stalling characteristics of an airfoil in a laminar viscous incompressible fluid are investigated. The governing equations in terms of the vorticity and stream function are solved using an implicit finite-difference scheme and point successive relaxation procedure. The development of the impulsively started flow, the initial generation of circulation, and the behavior of the forces at large times are studied. Following the impulsive start, the lift is at first very large and then it rapidly drops. The subsequent growth of circulation and lift is associated with the starting vortex. After incipient separation, the lift increases owing to enlargement of the separation bubble and intensification of the flow rotation in it. The extension of this bubble beyond the trailing edge causes it to rupture and brings about the stalling characteristics of the airfoil. Subsequently, new bubbles are formed near the upper surface of the airfoil and are swept away. The behavior of the lift acting on the airfoil is explained in terms of the strength and sense of these bubbles. (Author)

**A75-26234 #** **Development of acoustic disturbances in supersonic annular jets (Razvitye akusticheskikh vozmushchenii v sverkhzvukovykh kol'tsevykh struiakh).** M. G. Lebedev and G. F. Telenin. *Moskovskii Gosudarstvennyi Universitet, Institut Mekhaniki, Nauchnye Trudy,* no. 30, 1973, p. 182-199. In Russian.

The present work investigates theoretically the interaction of a supersonic jet issuing from an annular nozzle with an external acoustic field. The sound waves are taken to be traveling towards the nozzle, and the analysis concerns in particular the effect of the interior region between the nozzle end and the area where the ring jet comes together to form a single jet on the sound field. This interior region has certain resonating properties. The analysis is carried out in a linear approximation for both planar and cylindrical models and for the two cases when the disturbances on opposite sides of the jet are either in phase or antiphase. Expressions are derived for certain characteristic frequencies at which disturbances in the jet and the interior region significantly exceed those in the external field. P.T.H.

**A75-26312** **Eigenvalue/eigenvector assignment for multivariable systems.** S. Srinathkumar and R. P. Rhoten (Oklahoma State University, Stillwater, Okla.). *Electronics Letters,* vol. 11, Mar. 20, 1975, p. 124, 125.

A procedure is described which, through linear state feedback, both assigns pole locations (eigenvalues) and specifies parts of the closed-loop modal (eigenvector) structure. The technique is illustrated by synthesizing a controller for the lateral dynamics of a high-performance aircraft. (Author)

**A75-26410 #** **Nonlinear torsional vibrations of thin-walled beams of open section.** C. K. Rao (Andhra University, Waltair, India). *ASME, Transactions, Series E - Journal of Applied Mechanics,* vol. 42, Mar. 1975, p. 240-242. 10 refs.

An attempt has been made to derive and solve the governing differential equation of large amplitude torsional vibrations of simply supported doubly symmetric thin-walled beams of open section. Graphs indicating the influence of large amplitudes on nonlinear period of torsional vibrations for various nondimensional beam constants are presented. (Author)

**A75-26414 #** **The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number.** M. M. Zdravkovich (Salford, University, Salford, Lancs., England) and G. L. Hodge (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). *ASME, Transactions, Series I - Journal of Fluids Engineering,* vol. 97, Mar. 1975, p. 120-122. 5 refs.

The unexpected disappearance of the wake shock behind a cylinder in supersonic flow at a high Reynolds number was studied in a supersonic wind tunnel of the intermittent blow-down type. For a flow at a Mach number of 2.4 and a Reynolds number of 377,000 a detachable bow wave was found to form in front of a 3/4-in. diameter cylinder with a subsonic wake, while a wide wake without wake shocks formed behind the cylinder. Wake widening was similar to that observed in the transcritical range at subsonic flow. S.D.

**A75-26463** **The generation of sound by aerodynamic sources in an inhomogeneous steady flow.** M. S. Howe (Cambridge University, Cambridge, England). *Journal of Fluid Mechanics,* vol. 67, Feb. 11, 1975, p. 597-610. 19 refs. Research supported by Rolls Royce /1971/, Ltd.

**A75-26466** **The expansion of a hypersonic turbulent boundary layer at a sharp corner.** A. W. Bloy (Manchester, Victoria University, Manchester, England). *Journal of Fluid Mechanics,* vol. 67, Feb. 25, 1975, p. 647-655. 12 refs.

A sharp wedge expansion flap was tested in the von Karman Institute Longshot tunnel at Mach 16 and data on the wall pressure and heat transfer were obtained. Pitot pressure measurements in the boundary layer just ahead of the expansion flap were also made. The surface data are compared with predictions from a characteristics solution for the boundary-layer expansion and from a simple heat-transfer theory. (Author)

**A75-26469** **On the viscous flow about the trailing edge of a rapidly oscillating plate.** S. N. Brown and P. G. Daniels (University College, London, England). *Journal of Fluid Mechanics*, vol. 67, Feb. 25, 1975, p. 743-761. 13 refs.

The incompressible laminar flow in the neighborhood of the trailing edge of an aerofoil undergoing sinusoidal oscillations of high frequency and low amplitude in a uniform stream is described in the limit as the Reynolds number R tends to infinity. The aerofoil is replaced by a flat plate on the assumption that leading-edge stall does not take place. It is shown that, for oscillations of nondimensional frequency O(R to 1/4 power) and amplitude O(R to the negative 9/16 power), a rational description of the flow at the trailing edge is based on a subdivision of the boundary layer above the plate into five distinct regions. Asymptotic analytic solutions are found in four of these, whilst in the fifth a linearized solution yields an estimate for the viscous correction to the circulation determined by the Kutta condition. (Author)

**A75-26476** # **Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel (Analyse expérimentale et théorique des couches limites turbulentes tridimensionnelles dans un canal supersonique courbe).** J. Cousteix and R. Michel (Toulouse, Centre d'Etudes et de Recherches, Toulouse, France). *La Recherche Aérospatiale*, Jan.-Feb. 1975, p. 1-10. In French. Research supported by the Direction des Recherches et Moyens d'Essais.

The developing three-dimensional turbulent boundary layer on the side wall of a curved nozzle in supersonic flow is studied. Numerous measurements of the mean velocity and of the direction of the velocity in the boundary layer and surface flow visualizations constitute the experimental part of the study. A detailed determination of the wall static pressure field permits the calculation of the external streamlines by means of Euler's equations. These results are compared with those calculated by the method of characteristics. An integral prediction method is used to calculate the development of the boundary layer. The comparison between the experimental and theoretical results shows a good level of agreement. An attempt at channeling the boundary layer flow is realized by means of fences. (Author)

**A75-26477** # **A method for calculating unsteady forces due to interaction between tail surfaces (Méthode de calcul des forces instationnaires dues a l'interaction entre dérive et empennage horizontal).** Y. Akamatsu (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, Jan.-Feb. 1975, p. 11-20. In French.

A calculation programme of the unsteady aerodynamic forces on a set of surfaces including an horizontal elevator and a vertical fin, applying the potential method, has been written. This method differs from the classical ones in that the normal velocity is obtained by numerical derivation of the potential calculated on the lifting surfaces and in their immediate proximity. It permits a notable simplification of the programming and gain in computation time. The comparison of the results with those obtained by other methods presents a good agreement. (Author)

**A75-26479** # **Determination of the dynamic characteristics of a helicopter by the branch-modes method (Détermination des caractéristiques dynamiques d'un hélicoptère a partir des modes partiels).** H. Loiseau and J.-R. Nicolas (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, Jan.-Feb. 1975, p. 35-44. In French.

Experiments are related allowing an estimation of the precision required in data recording in order to obtain correct calculation results, and demonstrating the validity limits of the branch-modes method as applied to an actual helicopter. The mockup and the testing means used are described, and frequency graphs taken by rapid scanning are presented. It is concluded that it is necessary to: (1) assure that the modal characteristics of the fuselage are carefully measured, (2) respect as much as possible the linkage conditions of the rotor blades during the wall assay, (3) consider a number of modes that are sufficient for the subsystems, in particular the lowest-frequency modes, corresponding to the movements of the rigid body, and (4) obtain the generalized masses of the blades with maximum precision, as well as their masses and inertias. S.J.M.

**A75-26480** # **Unsteady lift forces on a vibrating cylinder in a supercritical flow (Portances instationnaires sur un cylindre vibrant dans un écoulement supercritique).** E. Szechenyi and H. Loiseau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, Jan.-Feb. 1975, p. 45-57. 11 refs. In French.

Results previously obtained on a clamped cylinder are reviewed, and the vibrating mockup and testing and measurement methods used in the present experiment are described. The present results are interpreted and autoexcitation conditions are deduced from them. It is found by comparison that the lift forces have similar behaviors as a function of reduced frequency in supercritical vs subcritical flows. On the other hand, in a transcritical regime, the quasi-aleatory turbulent flow is not as clearly coupled to the movements of the cylinder. S.J.M.

**A75-26498** **The aircraft accident (Der Flugunfall).** W. Politt. Braunschweig, Richard Carl Schmidt und Co., 1974. 210 p. 22 refs. In German. $13.65.

The investigation of aircraft accidents as a responsibility of the state is considered along with questions regarding the objectives of the investigation of accidents and disturbances. Details concerning the conduction of the investigation are examined, taking into account organizational aspects of accident investigations, studies conducted by experts, the equipment employed, and the various details which have to be attended to during the investigation. Specific investigative aspects applying in the case of glider accidents and military aircraft are discussed along with the determination of the causes of accident and regulations and laws related to aviation accidents. G.R.

**A75-26499** **Air Europe: The policy of cooperation among airline companies of the European Six (Air Europe: La politique de coopération entre les compagnies aériennes de l'Europe des Six).** C. Delepiere-Nys (Bruxelles, Université Libre, Brussels, Belgium). Brussels, Editions de l'Université de Bruxelles, 1974. 507 p. 83 refs. In French. $22.50.

Difficulties inherent in the present civil aviation company transportation system, air transport inside the CEE, air transport in areas outside of Europe (such as the U.S.), and perspectives on the proposed cooperation policy are discussed. It is shown how such a cooperation would be in the best economic interests of all nations concerned. The controversy that developed over Article 84 of the Rome agreement is described. Various past cooperational organizations, and the technical advances that accrued to them, are considered. S.J.M.

**A75-26533** **Analysis of wreckage.** K. F. Packer (Packer Engineering Associates, Naperville, Ill.) and C. R. Morin. *(Annual Air Law Symposium on Products Liability in Aviation Litigation, 8th, Dallas, Tex., Mar. 14-16, 1974.) Journal of Air Law and Commerce*, vol. 40, Summer 1974, p. 447-458.

The procedures and philosophy of accident investigation are discussed, taking into account case studies which illustrate the application of the general approach to be followed in the investigation. Recent advances in investigative techniques are examined, giving attention to the scanning electron microscope, the electron microprobe chemical analyzer, and infrared imaging. It is pointed out that the new techniques and instruments play an important role in determining aircraft accident causality. G.R.

**A75-26553 #** **Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode.** H. Kobayashi (National Aerospace Laboratory, Tokyo, Japan), H. Tanaka, and H. Maruta (Tokyo, University, Tokyo, Japan). *JSME, Bulletin*, vol. 18, Feb. 1975, p. 140-150. 11 refs.

The effects of interference between stationary and moving blade rows on the nonstall cascade flutter in flexural mode are studied experimentally under the actual operating conditions of an axial-flow compressor. Specially designed flexible stator vanes and rigid rotor blades were used. The pronounced aerodynamic effect of cascade interference on flutter is demonstrated. It is shown that the flutter speed is decreased by the effect of the rotor cascade upstream of the stator and is increased by its effect downstream of the stator. V.P.

**A75-26554 #** **Lift coefficients on a supercavitating jet-flapped foil between rigid walls.** T. Kida and Y. Miyai (Osaka Prefecture, University, Sakai, Japan). *JSME, Bulletin*, vol. 18, Feb. 1975, p. 151-158. 7 refs.

The method of matched asymptotic expansions is applied to the first-order theory on the flow past a two-dimensional supercavitating jet-flapped foil in a wall tunnel, and a solution (the slope of the jet) of the governing integro-differential equation is obtained and represented as the series expansion in ascending powers of delta and log delta multiplied by functions of the distance from the trailing edge, where delta is a small perturbation quantity proportional to the jet momentum coefficient. Moreover, the lift derivatives with respect to incidence and jet deflection are obtained as the series expansions in ascending powers of delta and log delta. (Author)

**A75-26589 *** **Miniature probes for use in gas turbine testing.** G. E. Glawe and L. N. Krause (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Automotive Engineering Congress and Exposition, Detroit, Mich., Feb. 24-28, 1975, Paper 750094.* 8 p. 7 refs.

Because of space limitations and system complexity in many applications associated with gas turbine testing, extremely small flow measuring probes have sometimes been required. This paper presents several examples of these miniature probes - null type as well as fixed position - which have proved useful in aircraft and space power systems component testing and are applicable to automotive gas turbine testing. These probes are used to determine component or system performance from the measurement of gas temperature as well as total and static pressure, and flow direction. Detailed drawings of the sensors are presented along with experimental data covering the flow characteristics over the range of intended use. (Author)

**A75-26591 *** **Tests of laser metal removal for future flexible rotor balancing in engines.** J. M. Tessarzik (Mechanical Technology, Inc., Latham, N.Y.) and D. P. Fleming (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Automotive Engineering Congress and Exposition, Detroit, Mich., Feb. 24-28, 1975, Paper 750170.* 11 p. 10 refs. Contracts No. F33614-72-C-1801; No. NAS3-14420.

This paper describes recent developments in the flexible rotor balancing technology area, with particular emphasis on methods for the addition and removal of correction weights. The currently existing multiplane-multispeed balancing procedure permits one-step balancing of final shaft-bearing assemblies simultaneously in a number of planes and at a number of speeds. Temporary addition of trial weights to the rotor, and the addition or subtraction of permanent corrections, are presently performed manually in the balancing process. The addition of a computer-controlled laser device to the balancing system shows promise of eliminating direct operator contact with the rotor in the balancing process, and thus could provide a considerable increase in the precision level at a critical step in the procedure. (Author)

**A75-26671 #** **Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity (Razrabotka i eksperimental'naia otsenka chislennogo metoda resheniia obratnoi osesimmetrichnoi zadachi v osevoi turbinnoi stupeni pri zadanii skorosti).** A. M. Topunov, B. A. Tikhomirov, and N. P. Nechaev. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan.-Feb. 1975, p. 145-156. 5 refs. In Russian.

**A75-26672 #** **Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied (Elementarnyi sposob graficheskogo perestroeniia kharakteristiki neokhlazhdaemogo turbokompressora pri izmenenii temperatury vsasyvaniia i chisla oborotov).** I. E. Rozenshtein. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Jan.-Feb. 1975, p. 171-173. In Russian.

**A75-26684** **The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate.** J. H. Gummer (Snowy Mountains Engineering Corp., Australia) and B. L. Hunt (Bristol, University, Bristol, England). *(Israel Conference on Mechanical Engineering, 8th, Haifa, Israel, Sept. 23, 24, 1974.) Israel Journal of Technology*, vol. 12, no. 3-4, 1974, p. 221-235. 16 refs.

The impingement flow produced by directing a supersonic, axisymmetric jet of air on to a perpendicular flat plate at small displacements has been investigated experimentally and theoretically for a total of eight different jets from conical nozzles operated underexpanded. Shadowgraph photographs of the impingement region and measured surface pressures are presented. The photographs show that a number of shock wave shapes are possible, depending on the conditions in the free jet. The surface pressure distributions are mostly similar to each other in form, with the plate sonic point lying in the neighborhood of the jet edge. Under some conditions, a stagnation bubble is found to exist in the shock layer. A new formulation of the single strip approximation of the method of integral relations is given. The results for shock shape and surface pressure obtained from this method agree quite well with the experimental results in the inner part of the shock layer but the calculation is less satisfactory in the region outside of the jet shock. An explanation is given for this discrepancy. (Author)

**A75-26685** **Heat transfer in separated and reattached flows - An annotated review.** L. S. Fletcher, D. G. Briggs, and R. H. Page (Rutgers University, New Brunswick, N.J.). *(Israel Conference on Mechanical Engineering, 8th, Haifa, Israel, Sept. 23, 24, 1974.) Israel Journal of Technology*, vol. 12, no. 3-4, 1974, p. 236-261. 275 refs. Contract No. F44520-68-C-0018.

This paper reviews more than 280 references dealing with theoretical and/or experimental studies of convective heat transfer at solid boundaries adjacent to regions of flow separation, in particular the base and reattachment surfaces. These studies are divided into four major categories: subsonic, two-dimensional supersonic, axisymmetric supersonic, and booster base heating, and are further divided into various model geometries. For each category, the theoretical studies are summarized and insofar as possible, results of the experimental investigations are correlated. Some theories are recommended for the prediction of heat transfer, and regions for further investigation are delineated. (Author)

**A75-26697 #** **A problem in supersonic jet theory (O problema de teoria jeturilor supersonice).** C. Iacob (Bucuresti, Universitatea, Bucharest, Rumania). *Studii si Cercetari Matematice*, vol. 27, no. 1, 1975, p. 47-66. 8 refs. In Rumanian.

Prandtl's problem of a supersonic jet in expansion in an atmosphere at rest is considered, where the pressure at the nozzle mouth is greater than the atmospheric pressure. The analysis is

carried out within the framework of Ackeret's approximate method of linear supersonic aerodynamics. The length of the first wave and the maximum width of the jet are obtained. A formula that relates wave length and average jet width is proposed, which can replace the formulae of Prandtl and Pack. P.T.H.

**A75-26700** # **The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential.** T. van Holten. Delft, Technische Hogeschool, Doctor in de technische Wetenschappen Thesis, 1975. 131 p. 11 refs.

The method of the velocity potential is examined and a description is given of the theory of the acceleration potential. Attention is given to the calculation of steady, two-dimensional aerofoil characteristics with the aid of the linearized pressure method, the classical lifting line theory, higher-order lifting line theory, the far pressure field of a wing, and the swept wing executing a harmonic pitching motion. The boundary conditions pertaining to the blade of a helicopter rotor in steady forward flight are discussed together with the solution of the boundary value problem for a helicopter blade. G.R.

**A75-26720** # **Digital avionics-overview - Airframe manufacturer's viewpoint.** R. Dunn (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-552.* 6 p.

The system requirements in new aircraft are related to changes regarding the criteria used to rate the worth of an aircraft. Aspects of aircraft economics, noise, and ecological considerations have become very important. Better performance at lower costs can be provided by a utilization of advanced digital technology in place of the analog systems employed in present aircraft. Research and development programs conducted in the area of digital technology by an American aerospace corporation are discussed. G.R.

**A75-26721** # **Digital avionics - An overview.** R. W. Meier (FAA, Systems Research and Development Service, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-553.* 4 p.

The use of digital systems in ATC operations is considered, giving attention to computations performed at far greater precision and lower cost than feasible with analog techniques. The introduction of digital systems in avionics is not to be confined to the area of navigation. It is pointed out that a system management onboard computer could have avoided a recent accident, in which an aircraft ran out of fuel before reaching its destination. G.R.

**A75-26723** # **Air Traffic Control demonstration aspects of the Applications Technology Satellite-6.** R. J. Hilton (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-562.* 8 p.

Air Traffic Control (ATC) demonstrations were included in the Applications Technology Satellite-6 (ATS-6) aeronautical experiments for the purpose of gaining practical knowledge in configuring and using voice and data links in satellite communications and surveillance for ATC. Demonstrations were performed involving the United States FAA, the European Space Research Organization (ESRO), and Canada. An airborne subsystem, a ground subsystem, and the interface necessary to establish the voice and data links through the satellite and satellite earth terminal were developed. Demonstration scenarios were developed to provide for voice and data communication through the satellite and recording of all communication and surveillance data was provided for future playback and analysis. This paper will describe the specific configuration of the subsystems, the details of the tests used for the demonstrations, and the techniques used to record voice and data as well as some preliminary results obtained during the ATC demonstrations. (Author)

**A75-26724** # **An experimental TDMA network for airborne warning and control systems interoperability demonstrations.** F. W. Lightfoot, W. B. Smith (Boeing Aerospace Co., Seattle, Wash.), S. G. Wilson (Boeing Commercial Airplane Co., Seattle, Wash.), and A. R. Petrino (Mitre Corp., Bedford, Mass.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-563.* 11 p.

An experimental Time Division Multiple Access (TDMA) Communications System operating on a single communications channel is developed for the System Integration Demonstration (SID) phase of the Airborne Warning and Control System (AWACS). The description covers the SID TDMA network with its airborne and ground terminals, the AWACS installation, the airborne relay station, and the spread spectrum modem. Tests show that the TDMA system is highly versatile in the dissemination of airborne and ground surveillance, command and control data in tri-services tactical exercises. S.D.

**A75-26725** # **Flight-critical digital control system evaluation.** L. E. Fairbanks (General Electric Co., Binghamton, N.Y.) and J. E. Templeman (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-566.* 15 p. 6 refs. Research sponsored by the U.S. Department of Transportation.

The flight controls development study task was developed to permit technology investigations into selected areas of triple-channel, fail-operational, analog and digital system designs. An application model based on a flight-critical control system is considered. A system description is given, taking into account the laboratory configuration and analog subsystem, the incremental control processor subsystem, and the whole word computer subsystem. Performance comparisons are discussed along with aspects of software development and control. Attention is also given to the preflight test/failure mode and effects studies. G.R.

**A75-26726** # **Flight test of a digital guidance and control system in a DC-10 aircraft.** S. S. Osder, D. C. Mossman, and B. T. Devlin (Sperry Rand Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-567.* 11 p.

A digital guidance and control system flight tested in a DC-10 aircraft in the summer of 1974 confirmed that system's monitoring techniques, certifiable control law software (including automatic landing), and automated maintenance management concepts. It also verified compatibility of the system architecture with the aircraft's guidance/navigation sensors and redundant electrohydraulic flight control actuators. System organization, in terms of redundancy and software-hardware monitoring is described. Computer memory and time requirements for the various control modes and other software functions are summarized. Flight results associated with autoland performance and the system's recognition and responses to inserted failures during autoland mode engagement are described. (Author)

**A75-26727** # **Self-testing digital flight control applications.** R. C. Hendrick and C. D. Hill (Honeywell, Inc., Minneapolis, Minn.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-568.* 10 p.

Applications are presented where digital computation is used to achieve self-test functions in flight control systems, generally being applied such that equipment redundancy is minimized. Various levels

of fault accommodation are considered, including fail-safe, single-fail-operative, and dual-fail-operative. The JA-37 automatic flight control system uses a single processor to perform continual testing to safely disable faulty equipment. The A-7 multimode development test system uses dual-redundant processors to obtain a degree of continued operation after certain electronic failures. Future fly-by-wire systems may triplicate elements to meet mission reliability and flight safety criteria. System configurations and related developments are described. (Author)

**A75-26728** # **New horizons in air traffic control.** G. A. Scott (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-569.* 7 p.

According to the FAA's latest air traffic forecasts, aviation in the United States will continue to grow into the indefinite future. To meet the demands of this continuing growth, the existing air traffic control (ATC) system must be improved. The goals of the future upgraded ATC system are: maintain or improve safety, constrain or reduce costs, and increase and improve performance. These goals will be met in part by the following new ATC features - Airport Surface Traffic Control System (ASTC), Discrete Address Beacon System (DABS), Air Traffic Control Automation, Intermittent Positive Control (IPC), Area Navigation (RNAV), Microwave Landing System (MLS), and Wake Vortex Avoidance System (WVAS). (Author)

**A75-26729** # **Digital computer design guidelines for a full authority fly-by-wire flight control system.** J. G. Allen (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-570.* 12 p. USAF-supported research.

The design of a digital computer for a full authority fly-by-wire flight control system is discussed with particular reference to the determination of the number of channels and the extent of coverage required, and the part played by the built-in test equipment (BITE) in a bit-by-bit voted system. Several baseline assumptions are made concerning computer definition as well as reliability and operational requirements. The design guidelines derived from the study of the analytical models developed for six different multicomputer systems require a minimum of three channels; the use of four channels would increase the safety margin beyond two orders of magnitude. It is found that BITE allows an extra fault to be tolerated when recovery from faults with bit-by-bit voting is not possible. S.D.

**A75-26732** # **What have we learned from applying digital technology to cabin/passenger multiplex systems.** J. Mohr (KLM - Royal Dutch Airlines, Amsterdam, Netherlands). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-574.* 4 p.

Use of digital time division multiplex systems in wide-body aircraft to provide individual passenger control of reading lights, call functions, and music channels is assessed. A typical MUX system is described, and the reliability and ownership costs of first and second generation systems are outlined. Cost comparisons are made between MUX and hand-wired systems, and it is shown that the higher operational costs of MUX systems are offset by their lower weight penalty costs. F.G.M.

**A75-26733** * # **Software engineering of a navigation and guidance system for commercial aircraft.** S. G. Lachmann and R. G. McKinstry (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-575.* 16 p. 5 refs. Contract No. NAS1-13267.

The avionics experimental configuration of the considered system is briefly reviewed, taking into account the concept of an advanced air traffic management system, flight critical and non-critical functions, and display system characteristics. Cockpit displays and the navigation computer are examined. Attention is given to the functions performed in the navigation computer, major programs in the navigation computer, and questions of software development. G.R.

**A75-26734** # **Digital flight control systems - Considerations in implementation and acceptance.** W. B. Yopp and J. D. McDonnell (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-577.* 6 p.

The current state-of-the-art with respect to the implementation of digital systems in commercial air transport aircraft is discussed. Current activity includes industry flight and laboratory evaluation programs. The more significant potential benefits offered by digital flight control are discussed. These include improved computational precision, reliability, self-monitoring and integral maintenance monitoring as well as reduced component cost and weight and ease of design change implementation. Potential problem areas associated with the implementation of digital flight control systems are discussed in some detail. These range from a lack of 'intuitive' understanding of digital processes to the need for development of fault analysis concepts for digital systems. (Author)

**A75-26738** # **Application of digital systems to Army avionics.** J. A. Dasaro, M. J. Fisher, L. J. Youngblood, Jr., and G. G. Chandler, Jr. (U.S. Army, Avionics Laboratory, Fort Monmouth, N.J.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-587.* 6 p.

Recent trends in the development of digital computer hardware and their application to Army avionics equipment has forced a re-evaluation of the system integration methods used in the development of an Army Avionic package. A review of current data processing hardware development efforts in the areas of navigation, communications, and displays is presented to demonstrate trends in avionics subsystems. The need for a flexible system integration technique, based on the application of digital technology is discussed. Finally, the Army's Digital Modular Avionics Program (DLMAP) is outlined as a coordinated three phase program to accomplish the desired objective. (Author)

**A75-26739** # **Digital avionics information system /DAIS/ integrated test bed development.** F. A. Scarpino (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio) and R. Goodstein (Boeing Aerospace Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-588.* 7 p.

The United States Air Force Advanced Development Program for low cost, standardized avionics for future aircraft is entitled Digital Avionics Information System (DAIS). The analysis and design of an integrated test bed consisting of prototype hardware and software, to be assembled by the Air Force Avionics Laboratory (AFAL), are described. The status of the program, its basic concepts, and its design goals are reviewed. Progress towards low cost avionics through standardization, modularity, and interchangeability can be achieved with current technology subsystems. (Author)

**A75-26744** # **Instrumentation displays for future naval aircraft.** W. G. Mulley (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-599.* 5 p.

The Advanced Integrated Modular Instrumentation System (AIMIS) is described. The functions of the display indicators (status/advisory, horizontal situation, vertical situation, and head-up) and the electronics units (data, signal, and display processors and scan converter/refresh units) are outlined. Other features of the system mechanization and improvements in operational effectiveness over present cockpit instrumentation are noted. It is shown that AIMIS will reduce cockpit clutter and provide multifunction display and control, refined information and display interaction for pilot decision making, building-block capability for applying the complete system or its components to various weapons systems, and reduction in logistics support, training, and documentation. F.G.M.

**A75-26745** # **Design of the DAIS control and display core element.** N. A. Kopchick (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio), D. E. Dewey, and W. Willich (Boeing Aerospace Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-600.* 11 p.

The present paper discusses the system configuration, critical design tradeoff results, and past task simulation results to date concerning the advanced development program on digital avionics information system (DAIS). Two major design tradeoff areas are emphasized: (1) dedicated vs shared processing for the control and display core element, and (2) electronic map display implementation approaches. Conclusions drawn from various efforts indicate that with minimum technical risk, the control and display core element of the DAIS hot bench can be implemented to meet overall program objectives. S.J.M.

**A75-26849** * **Ride quality evaluation. I.** L. G. Richards and I. D. Jacobson (Virginia, University, Charlottesville, Va.). *Ergonomics,* vol. 18, Mar. 1975, p. 129-150. 5 refs. Grant No. NGR-47-005-181.

As part of a larger effort to assess passenger comfort in aircraft, two questionnaires were administered: one to ground-based respondents, the other to passengers in flight. Respondents indicated the importance of various factors influencing their satisfaction with a trip, the perceived importance of various physical factors in determining their level of comfort, and the ease of time spent performing activities in flight. The in-flight sample also provided a rating of their level of comfort and of their willingness to fly again. Comfort ratings were examined in relation to (1) type of respondent, (2) type of aircraft, (3) characteristics of the passengers, (4) ease of performing activities, and (5) willingness to fly again. (Author)

**A75-26879** # **Determination of load factors for the impact of a profile against the surface of a liquid (Opredelenie peregruzok pri udare profilia o poverkhnost' zhidkosti).** G. L. Boiko and V. A. Eroshin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 35-38. 7 refs. In Russian.

The two-dimensional problem of the impact of thin-section twisted wing against the surface of an ideal incompressible fluid is discussed, assuming that the leading edge always remains above the unperturbed free surface. Expressions for calculating the hydrodynamic forces and load factors for such impacts are derived. The analytical results obtained for a flat plate are verified experimentally. V.P.

**A75-26880** # **A method of profiling short two-dimensional nozzles (Ob odnom metode profilirovaniia korotkikh ploskikh sopl).** N. A. Podsypanina and E. G. Shifrin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 54-58. 12 refs. In Russian.

A method of profiling wind-tunnel nozzles is proposed. By choosing a nozzle with a straight sonic line, the subsonic and supersonic sections of the nozzle can be designed separately. The problem is solved numerically in the hodograph plane. The Dirichlet problem in a rectangle, one side of which is the sonic line, is formulated in the subsonic region of the hodograph plane, and is solved for the Chaplygin equation. V.P.

**A75-26881** # **A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier (Metod rascheta konturov aerodinamicheskikh sopl s perekhodom cherez skorost' zvuka).** A. M. Ovsiannikov and U. G. Pirumov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 68-72. 5 refs. In Russian.

**A75-26882** # **Supersonic flow past intersecting surfaces (Obtekanie sverkhzvukovym potokom peresekaiushchikhsia poverkhnostei).** N. F. Vorob'ev and V. P. Fedosov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 73-81. 12 refs. In Russian.

The problem of the supersonic flow past slightly twisted intersecting surfaces, whose tangential planes form at each point small angles with the oncoming flow velocity, is analyzed in linear formulation. The problem is reduced to the solution of a wave equation for the velocity potential with boundary conditions prescribed at the fairings and at the characteristic bow surface. The solution is obtained by the Volterra method. V.P.

**A75-26888** # **Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas (Chislennoe issledovanie teploobmena v kriticheskoi tochke sfery, obtekaemoi giperzvukovym potokom uglekislogo gaza).** N. E. Afonina and V. G. Gromov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 117-120. 5 refs. In Russian.

**A75-26891** # **A subsonic axisymmetric wake in a viscous gas (Dozvukovoi osesimmetrichenyi sled v viazkom gaze).** B. D. Kovalev and V. I. Myshenkov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 148-151. 5 refs. In Russian.

**A75-26894** # **Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow (O raschete teploobmena na liniiakh rastekaniia trekhmernogo pogranichnogo sloia v neodnorodnom vneshnem potoke).** B. A. Zemlianskii. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 160-162. 5 refs. In Russian.

A method, based on local substitution of an equivalent uniform flow for a nonuniform flow, proposed for taking into consideration the transverse nonuniformity of the external viscous flow on the boundary layer is extended to the lines of flow of a three-dimensional boundary layer over a 'cloud' body situated in nonuniform inviscid flow. The extended method is applied as an example to (DABS), Air Traffic Control Automation, Intermittent Positive Control (IPC), Area Navigation (RNAV), Microwave Landing System (MLS), and Wake Vortex Avoidance System (WVAS). (Author)

**A75-26895** # **Cavitating flow past a vibrating thin-section wing profile (Kavitatsionnoe obtekanie tonkogo kolebliushchegosia profila).** I. I. Efremov and V. N. Semenenko. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 163-166. 8 refs. In Russian.

The potential flow of an imponderable incompressible fluid past a thin-section slightly twisted wing is analyzed, assuming that the

cavern covers the suction side of the wing and that it trails off from the trailing edge. The condition for the solvability of Neumann's external boundary value problem for the velocity potential is taken as the condition for the determination of the cavity length. The problem is reduced to the solution of a system of integral equations. V.P.

**A75-26896** # **Hypersonic flow past pointed and blunt bodies with a concave generatrix (Obtekanie ostrykh i zatuplennykh tel s vognutoi obrazuiushchei giperzvukovym potokom).** S. L. Vishnevetskii and Z. S. Pakhomova. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Jan.-Feb. 1975, p. 176-180. 5 refs. In Russian.

**A75-26898** **Sound welds in wing boxes assured by three techniques.** *Metal Progress,* vol. 107, Apr. 1975, p. 67, 68.

Electron-beam welding is used in assembling the wing boxes of the F-14 fighter. The wing boxes are tested by three nondestructive methods: ultrasonic inspection, radiography, and die-penetrant inspection. The strict quality-control methods have cut rejects from 30% to 15%. A.T.S.

**A75-26900** **A pilot's report concerning the VTOL VAK 191 B (Pilot report des Senkrechtstarters VAK 191 B).** L. Obermeier. *Flug Revue/Flugwelt International,* Apr. 1975, p. 18-22. In German.

Development and investigative work concerned with an evaluation of the advantages and drawbacks of various configurations of V/STOL aircraft is briefly considered, taking into account investigations in the U.S. and in Western Europe. As a result of the evaluations interest was expressed by the U.S. Navy to continue tests with the VTOL aircraft VAK 191 B, which had been developed by a West German aerospace corporation. A technical description of the VAK 191 B is given and details regarding the flight tests conducted with the new aircraft are discussed. G.R.

**A75-26948** # **Important aspects of international air cargo.** R. M. Jackson (Seaboard World Airlines, Inc., Kennedy International Airport, N.Y.). *Astronautics and Aeronautics,* vol. 13, Apr. 1975, p. 50-53.

Questions of the significance of air-freight operations for the economy are examined, taking into account prospects concerning the development of a new pure-cargo aircraft. Aspects of air-freight rate-making are considered and proposals are made for improved international rate-making procedures. The relationship between regularly scheduled service rates and charter rates is discussed along with problems of the intermodal air/truck transport era and the effects of increased fuel costs on the economy of air transportation. G.R.

**A75-27052** **Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer.** L. M. Liamshev, M. G. Puzino, and S. A. Salosina (Akademiia Nauk SSSR, Akusticheskii Institut, Moscow, USSR). *(Akusticheskii Zhurnal,* vol. 20, Sept.-Oct. 1974, p. 733-737.) *Soviet Physics - Acoustics,* vol. 20, Mar.-Apr. 1975, p. 444-446. 10 refs. Translation.

**A75-27073** * **A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins.** A. P. Moreci, A. Furst (San Francisco, University, San Francisco, Calif.), and J. A. Parker (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Fire and Flammability, Combustion Toxicology Supplement,* vol. 2, Feb. 1975, p. 34-63. 17 refs.

Male Swiss albino mice were exposed to the pyrolysis products of two fire-retardant materials, a chlorinated aromatic polyamide and a copolymer of vinylidine fluoride and hexafluoropropene. Comparison tests were made with cotton and a 50/50 cotton-polyester composite. In addition, tests were conducted under the presence of CO, and mice were injected intraperitoneally or intramuscularly with aqueous solutions containing dissolved effluents from the pyrolysis of cotton or of chlorinated aromatic polyamide. Results indicate that unique thermodecomposition products of the polymeric materials are more toxic to mice than are other products from cotton under similar controlled conditions. S.J.M.

**A75-27178** # **Aircraft guidance for automatic collision avoidance.** J. A. Sorensen, A. W. Merz, T. B. Cline, and J. S. Karmarkar. *International Federation of Automatic Control, Symposium on Automatic Control in Space, 6th, Tsakhkadzor, Armenian SSR, Aug. 26-31, 1974, Paper.* 16 p. U.S. Department of Transportation Contract No. TSC-535.

This paper is concerned with the development of the guidance system requirements for automatic prevention of aircraft collisions. The guidance commands can be computed on the ground, as part of the air traffic control function, or in the air, by means of an independent airborne collision avoidance system. The general problem is divided into three parts: (1) the determination of the most effective maneuvers required for avoiding the conflict; (2) the development of computer algorithms to estimate the relative state of a threatening aircraft from noisy measurements, and to generate the evasive maneuvers based on these estimates; and (3) the determination of the effect of dynamic and measurement errors on the performance of the system. (Author)

**A75-27180** # **A concept of flight dynamics control.** M. Vukobratovic and D. Stokic. *International Federation of Automatic Control, Symposium on Automatic Control in Space, 6th, Tsakhkadzor, Armenian SSR, Aug. 26-31, 1974, Paper.* 22 p. 7 refs.

Contrary to hierarchical control systems that are based on 'algebraic levels', the control concept described is based on the introduction of a 'level of nominal dynamics' (algorithmic level) and an 'adaptation level' (level of perturbed regimes). A novel feature of the control is the introduction of the concept of 'prescribed artificial synergy', using which the synthesis of nominal dynamic regimes can be greatly simplified. The application of the control under consideration to the selection of a flight trajectory in the presence of strong disturbances is demonstrated. V.P.

**A75-27182** # **Adaptive digital system for aircraft control (Adaptivnaia tsifrovaia sistema upravleniia samoleta).** Iu. A. Nikolaev, E. D. Teriaev, and B. M. Shamrikov. *International Federation of Automatic Control, Symposium on Automatic Control in Space, 6th, Tsakhkadzor, Armenian SSR, Aug. 26-31, 1974, Paper.* 12 p. 5 refs. In Russian.

The problem of designing an adaptive digital system for steering-wheel control of the longitudinal motion of an aircraft is discussed that will ensure prescribed controllability characteristics for each of the design modes. Solutions are obtained which help to overcome the contradictory plant and control requirements, to use effectively the a-priori information on the plant, and to take into consideration the specific requirements placed on the type of systems studied. The synthesis of the adaptive control law is outlined. V.P.

**A75-27367** **Fly-by-wire and control configured vehicles - Rewards and risks.** B. R. A. Burns (British Aircraft Corp., Ltd., Military Aircraft Div., Preston, Lancs., England). *Aeronautical Journal,* vol. 79, Feb. 1975, p. 51-58. 6 refs.

The fly-by-wire concept implies full authority command of aircraft motion by means of electrical control stick/pedal transducers whose outputs are summed with the outputs of aircraft-motion sensors and electrically connected to the control-surface actuators. A control configured vehicle utilizes the aerodynamic forces available from its movable surfaces to change or redistribute the overall

aerodynamic forces in such a way as to improve aerodynamic, structural, and operational efficiency. The characteristics of the fly-by-wire concept are discussed along with details regarding the system structure involved, the sensors, problems of signal processing, and questions of actuation. Attention is given to the power supplies, aspects of artificial longitudinal stability, maneuver load control, automatic configuration management, gust alleviation, aeroelastic mode stabilization, direct force control, active flutter prevention, and questions of mission-performance design. G.R.

**A75-27368 'By the application of power' /21st Cayley Memorial Lecture/.** J. L. Edwards (Rolls-Royce /1971/, Ltd., Derby, England). *Aeronautical Journal,* vol. 79, Feb. 1975, p. 59-84. 23 refs.

A description is given of the technical development of the aircraft engine. Questions concerning the advances made with respect to reciprocating engines are considered, taking into account the period from 1903 to 1918, the time between the two world wars, and the second world war. Attention is given to the use of the gas turbine in aviation, the evolution of the gas producer, bypass and ducted fan engines, approaches to obtain vertical lift, evolution by component, compressors, combustion problems, turbine developments, and aspects of thrust augmentation. Questions related to the power plant and supersonics are discussed along with aspects of noise and noise suppression. Industrial and marine application of gas turbines are also examined. G.R.

**A75-27495 # Influence of sound upon separated flow over wings.** F. G. Collins and J. Zelenevitz (Texas, University, Austin, Tex.). *AIAA Journal,* vol. 13, Mar. 1975, p. 408-410. 11 refs. NSF Grant No. GK-42133.

A description is given of a technique for increasing the lift coefficient and stall angle and decreasing the drag coefficient of a wing at moderate Reynolds numbers by radiating the airstream with sound. The sound waves cause premature boundary-layer transition, which reduces separated flow regions and suppresses stall. It is expected that the technique will be most useful at low Reynolds numbers. The magnitude of the effect of the sound depends on the sound frequency and the sound pressure level. G.R.

**A75-27496 # Interpretation of merged layer behavior for wedges.** J. R. Baron (MIT, Lexington, Mass.). *AIAA Journal,* vol. 13, Mar. 1975, p. 410-412. 7 refs. USAF-sponsored research.

It is pointed out that implicit in the wedge analysis conducted by Shorenstein (1972) is a generalization of the plate behavior involving an implication that a strong interaction follows always the merged region. The investigation reported is concerned with a clarification of the considered assumptions, giving attention to the specific parameter ranges involved and to general qualitative relations. G.R.

**A75-27526 The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height.** B. Ellis, G. J. Burrell, J. H. Wharf, T. D. F. Hawkins, and D. V. Peters (Royal Aircraft Establishment, Space Dept., Farnborough, Hants., England). *SID, Proceedings,* vol. 15, 4th Quarter, 1974, p. 150-160. 9 refs.

A red GaAs/P LED display, designed for use in aircraft cockpits, has been tested at illuminances up to 80,000 lux. Each of the 371 subjects who took part in the experiment read 120 random characters. The results are analyzed in terms of the error rates and omission rates as a function of illuminance level and their dependences upon the age, eyesight and sex of the subjects are also examined. From the error rates for particular characters some deficiencies of the character found are identified and from the results of timed tests some inferences concerning the extent to which the subjects found the display 'comfortable' are drawn. (Author)

**A75-27596 The 'definition' of the motorsegler.** H. Zacher (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aerodynamik, Munich, West Germany). *Aero-Revue,* no. 8, 1974, p. 479-481. 8 refs. (DFVLR-SONDDR-424)

A new parameter is suggested for the purpose of distinguishing motorseglers (auxiliary-powered sailplanes) from light airplanes: W/b squared, or the ratio of weight to the square of span. This parameter combines the important characteristics of wing loading and aspect ratio (it is their quotient). Diagrams are given showing that motorseglers fall below a W/b squared value of 3 kg/sq m, while lightplanes generally have W/b squared equal to or greater than 4. S.J.M.

**A75-27695 Characterization of advanced composite materials for structural design.** M. E. Waddoups (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *(National Science Foundation and Consiglio Nazionale delle Ricerche, United States-Italy Cooperative Symposium on Advanced Polymer Mechanics - Composite Materials and Ultra-High-Modulus Fibers, 1st, Santa Margherita Ligure, Italy, May 27-31, 1974.) Polymer Engineering and Science,* vol. 15, Mar. 1975, p. 160-166. 21 refs.

Composite material strength characteristics are studied with a view toward obtaining improved aircraft components. The data obtained show that the addition of high-modulus fibers into a polymeric matrix produced a physically distinct material with substantial advantage over nonreinforced polymers. Since the properties of composites depend strongly on fiber orientation, two design concepts for quasi-brittle materials are considered. Buffer strips thus developed allow connection in a beam without net section stress concentration and without arrestment of dynamic fracture. S.D.

**A75-27777 # On the future of jet propulsion in subsonic transport aviation.** M. Roy. *Periodica Polytechnica, Transportation Engineering,* vol. 2, no. 1, 1974, p. 49-59.

Parametric development potential studies on the thermodynamic cycle of transport aviation turbofan engines show that substantial weight and consumption savings can be obtained, without increasing turbine inlet temperatures, from the expected improvements in compressor turbine efficiencies. It is shown that improvements may be obtained by increasing the dilution to roughly mu = 12, while ejector-induced tertiary flow over special wing-flap combinations may provide short takeoff and landing distances and significant noise reduction. V.P.

**A75-27838 # Organization of centralized maintenance of aircraft assemblies (Organizatsiia tsentralizovannogo remonta agregatov samoletov).** S. N. Malkov. Moscow, Izdatel'stvo Transport, 1974. 180 p. 30 refs. In Russian.

The present work examines theoretical and practical considerations for setting up a steady production basis and rational organization for centralized repair operations on aircraft assemblies. Methods are set forth for determining repair requirements, optimal production allocation and program planning, and the implementation of typical technology and complex, mechanized work flow lines for group repair of assemblies. P.T.H.

**A75-27839 Reliability life cycle of a complex electronic airborne equipment.** S. P. Mercurio (General Electric Co., Aerospace Equipment Div., Utica, N.Y.) and J. M. Black (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *IEEE Transactions on Reliability,* vol. R-24, Apr. 1975, p. 2-7.

A good reliability program through design and production results in excellent equipment performance in the field. A full life cycle under controlled failure reporting and analysis procedures is covered. An excess of 48,000 flight hours over 27,000 missions with 303 failures reported from five reporting maintenance shops constitutes the field reporting phase. In addition, details and supporting documentation of the overall reliability program during the design phase, demonstration phase, production phase and field use phase are presented. (Author)

**A75-27852** # **Comparison of airport measurements of approach noise produced by jet aircraft.** D. E. Bishop (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). *Acoustical Society of America, Meeting, 88th, St. Louis, Mo., Nov. 4-8, 1974, Paper.* 16 p. 5 refs.

The present paper discusses field noise measurements made at the Detroit Metropolitan Airport in 1971 during an evaluation of proposed changes in the glide slope intercept altitudes. The Detroit measurements, interpreted in terms of noise level vs distance curves, are compared with the so-called 'standard' noise level curves often used for noise exposure forecast (NEF) and day/night average level (DNL) calculations. The comparison indicates no large or systematic underestimation of approach noise using the 'standard' noise level curves. S.J.M.

**A75-27853** * # **Noise of model target type thrust reversers for engine-over-the-wing applications.** J. R. Stone and O. A. Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 88th, St. Louis, Mo., Nov. 4-8, 1974, Paper.* 23 p. 19 refs.

The present work reports on experiments concerning the noise generated by V-gutter and semicylindrical target reversers with circular and short-aspect-ratio slot nozzles having equivalent diameters of about 5 cm. At subsonic jet velocities of interest for engine-over-the-wing (OTW) powered-lift aircraft, the reversers were noisier than the nozzles alone and had a more uniform directional distribution and more high-frequency noise. Reverser shape was more important than nozzle shape in determining the reverser noise characteristics. An estimate is made of perceived noise level along the 152-m sideline for a hypothetical OTW powered-lift airplane. S.J.M.

**A75-27854** * # **Spinning mode sound propagation in ducts with acoustic treatment.** E. J. Rice (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 88th, St. Louis, Mo., Nov. 4-8, 1974, Paper.* 35 p. 16 refs.

Recent acoustic data have shown larger noise attenuations than predicted for acoustically treated aircraft engine inlets without splitter rings. These data have stimulated a more detailed theoretical study of the acoustic propagation of spinning modes in acoustically treated open circular ducts. In addition, the suppressor with splitter rings was modeled by using the rectangular approximation to the annular duct. The theoretical models were used to determine optimum impedance and maximum attenuation for several spinning lobe numbers from 0 to 50. It is found that for circular ducts the maximum possible attenuation and the optimum wall impedance are strong functions of the lobe number. For annular ducts the attenuation and optimum wall impedance are insensitive to the spinning lobe number for well cut-on modes. The results help explain why suppressors with splitter rings have been quite effective in spite of the lack of detailed information on the noise-source modal structure. Conversely, effective use of outer-wall treatment alone will require expanded knowledge of the noise-source structure. Approximate solutions are presented to help interpret the more exact theoretical results. (Author)

**A75-27859** # **Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality.** T. F. W. Embleton and J. E. Piercy (National Research Council, Div. of Physics, Ottawa, Canada). *Acoustical Society of America, Meeting, 88th, St. Louis, Mo., Nov. 4-8, 1974, Paper.* 9 p.

**A75-27861** * # **Unified analysis of ducted turbomachinery noise.** W. E. Zorumski and H. C. Lester (NASA, Langley Research Center, Hampton, Va.). *Acoustical Society of America, Meeting, 88th, St. Louis, Mo., Nov. 4-8, 1974, Paper.* 26 p. 8 refs.

An approach for an analysis of ducted turbomachinery noise is developed by combining features of the analysis of fan stator noise reported by Hanson (1973) with results obtained by Zorumski (1974). Hanson's analysis is briefly examined and a formula is derived for the far-field pressure due to a dipole pulse. Questions of transmission and reflection are discussed and attention is given to the radiation from ducted dipoles. G.R.

**A75-27877** **High-temperature alloys and the aircraft gas turbine.** W. Betteridge (International Nickel, Ltd., London, England). In: The Nimonic alloys and other nickel-base high-temperature alloys /2nd edition/. New York, Crane, Russak and Co., Inc., 1974, p. 1-6. 16 refs.

Nimonic and other high-temperature alloys used in aircraft gas turbines are reviewed. Creep deformation of these alloys at elevated temperatures is discussed along with aircraft jet-engine requirements. It is seen that improved materials are presently available to secure increased output and reliability of aircraft gas-turbine engines. S.D.

**A75-27912** # **Adaptive control system with reference model (Adaptivni regulatory s referencnim modelem).** Z. Pech and J. Frouz (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). *Automatizace,* vol. 18, Feb. 1975, p. 35-42. 9 refs. In Czech.

The present work describes a general approach to the synthesis of an adaptive control system with reference model by means of analog simulation. An initial system with adaptation of all three control system coefficients is described, which is evaluated as being impractical on account of its small stability range, long adaptation time, and structural complexity. Therefore, a single-loop adaptive controller is proposed, which features adaptive capability only in the gain circuit. Increased stability range and decreased adaptation time were thereby obtained. Further modifications resulted in an adaptive controller with automatic gain control. P.T.H.

**A75-27919** **Stability analysis of stochastic composite systems.** A. N. Michel (Iowa State University of Science and Technology, Ames, Iowa). *IEEE Transactions on Automatic Control,* vol. AC-20, Apr. 1975, p. 246-250. 19 refs. Research supported by the Iowa State University of Science and Technology; NSF Grant No. GK-33739.

New results for asymptotic stability and exponential stability with probability for several classes of continuous parameter and discrete parameter stochastic composite systems are established. In all cases the objective is to analyze composite systems in terms of their lower order subsystems and in terms of their interconnecting structure. The results are applied to three specific examples. (Author)

**A75-27926** # **Theoretical and experimental studies of discrete-tone rotor-stator interaction noise.** G. F. Homicz, G. R. Ludwig, and J. A. Lordi (Calspan Corp., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-443.* 19 p. 37 refs. Contract No. F33615-73-C-2046.

A theoretical and experimental study is conducted on the discrete-tone noise caused by interaction between rotor and stator blade rows of subsonic axial-flow fans and compressors. A compressible two-dimensional analysis of the generated aerodynamic forces is matched, on a strip-theory basis, to the three-dimensional annular duct acoustic modes. Expressions are derived for both the mean square pressure at any position in the duct, and for the total power radiated at harmonics of blade passage frequency in terms of the fan/compressor operating conditions and geometry. The sound pressure level at the outer wall is calculated theoretically, and the resulting predictions are compared with the acoustic data for two different rotor-stator configurations. The discrepancy between theoretical and experimental findings is discussed in detail. S.D.

**A75-27927** # **The role of rotor blade blockage in the propagation of fan noise interaction tones.** M. G. Philpot (National

Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-447.* 12 p. 15 refs.

Experimental studies indicate that forward propagation of the tone noise caused by rotor/OGV combinations is inhibited by the blocking effect of the rotor - in some cases to a considerable extent. The physics of this mechanism and the available two-dimensional theoretical treatments of it are reviewed. To enable fans of low hub/tip ratio to be analyzed, a method, based on strip-theory principles, of extending such treatments to three dimensions is outlined. This is used in conjunction with one of the simpler theories to predict the blockage effects for four different research fans. Generally good agreement with experiment is obtained and it is concluded that the approache forms a viable basis for prediction. The implications of the findings are discussed briefly in the context of turbofan engine design. (Author)

**A75-27928** # **Radiation of duct noise out through a jet flow.** H. E. Plumblee (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-457.* 16 p. 12 refs. Research supported by the Lockheed-Georgia Internal Research and Development Fund.

The investigation reported forms the basis for a study of the radiation field of an arbitrary acoustic distribution at the termination of an engine inlet or exhaust. A description of a physical model is presented and a mathematical model is considered. The theoretical relations are based on assumptions introduced in the linearization of the transport equations. The theoretical investigation is supplemented by an experimental study. The experiments cover an extensive range of jet velocity and frequency. The experimental data are compared with the theoretical results. G.R.

**A75-27929** # **An investigation of the noise from a scale model of an engine exhaust system.** W. D. Bryce and R. C. K. Stevens (National Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-459.* 16 p. 14 refs.

To assist in the identification and understanding of the noise sources which contribute to the exhaust noise of aircraft gas-turbine engines, controlled experiments have been carried out to study the noise characteristics of a model turbojet exhaust system. The noise data have been related to measurements of the aerodynamic conditions in the model and, with the aid of specific diagnostic tests, the predominant noise mechanisms are considered to have been recognized. The noise radiation, above that of the jet, is attributed primarily to dipole sources generated by the turbine outlet struts, the transmission of this noise being modified by duct propagation and nozzle impedance effects. (Author)

**A75-27930** # **Subsonic jet noise in flight based on some recent wind-tunnel tests.** B. J. Cocking and W. D. Bryce (National Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-462.* 20 p. 24 refs.

The mixing noise produced by a cold subsonic air jet has been measured under simulated flight conditions in a large open-jet wind tunnel which has been modified for acoustic work. At a noise emission angle of 90 degrees to the jet axis, the overall sound pressure level reduces approximately in proportion to the fifth power of the relative jet velocity and the noise reductions in the rear are increase steadily as the jet axis is approached. These results are compared with theory, and together with some limited data obtained from a coaxial jet, are used as the basis for a discussion on the prediction of jet noise in flight. (Author)

**A75-27931** # **Propulsive-lift noise of an upper surface blown flap configuration.** N. N. Reddy (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-470.* 7 p. 7 refs.

The radiated sound and the flow characteristics of a scaled model of an upper surface blown-flap configuration are experimentally investigated. The acoustic results consist of the radiation pattern and spectral distribution of radiated sound in two planes. The two planes considered are the nozzle exit plane and the plane perpendicular to the wing surface passing through the jet centerline. The flow measurements include mean flow and the turbulence intensity distribution on the wing/flap (wall jet) and in the trailing-edge wake. These results indicate that a dominant noise is generated in the vicinity of the trailing edge. Radiated sound in the direction perpendicular to the flap trailing edge correlates with the trailing-edge velocity raised to the power 5, and the spectra correlate with the wall-jet thickness and velocity at the trailing edge. Turbulence close to the surface is amplified as the flow is convected past the trailing edge, while more distant turbulence is not affected by the surface. (Author)

**A75-27932** # **Effect of forward speed on jet wing/flap interaction noise.** W. V. Bhat (Boeing Commercial Airplane Co., Seattle, Wash.) and D. Gallo Rosso (Aeritalia S.p.A., Naples, Italy). *American Institute of Aeronautics and Astrcnautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-475.* 8 p. 10 refs.

A series of model tests has been conducted to assess the problem of jet wing/flap interaction noise for low-aspect-ratio D-shaped nozzles located on the upper surface of a wing. The measurements have been made using far-field and near-field wing-mounted flush microphones. A prediction procedure for static interaction noise has been formulated from far-field low-frequency interaction-noise measurements obtained under static conditions. The effect of forward speed on interaction noise has been investigated experimentally using an open-jet tunnel. These test data show that both far-field noise and the near-field wing trailing-edge pressure fluctuations are reduced by the simulated forward speed. (Author)

**A75-27933** # **Developments in jet noise modeling - Theoretical predictions and comparisons with measured data.** B. J. Tester (Lockheed-Georgia Co., Marietta, Ga.) and C. L. Morfey (Southampton, University, Southampton, England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-477.* 14 p. 21 refs. Contract No. F33615-73-C-2032.

Spectral information on the sound radiated from turbulent shock-free jets is now available over a wide range of Strouhal numbers, for jet densities ranging from 0.3 to 2 times the ambient density and jet velocities ranging from 0.3 to 2 times the ambient sound speed. The unexpected nature of some of the data has led to a fundamental re-examination of aerodynamic sound theory in general, by Lilley (1972) and Morfey (1973), and jet-noise modeling in particular. Two areas of significant progress are described: (1) the effects of nonuniform density which arise with hot jets, and (2) the effects of high Mach number on the radiation from 'isothermal' jets (density ratio = 1). The jet-noise models presented are based on solutions to Lilley's equation. (Author)

**A75-27936** # **Supersonic jet noise suppression with multitube nozzle/ejectors.** J. Atvars, C. P. Wright, and C. D. Simcox (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-501.* 9 p. 7 refs. U.S. Department of Transportation Contract No. FA72WA-2893.

An environmentally acceptable SST will have to be able to achieve noise levels comparable to those of other large commercial

aircraft operating in the same time period. Recently conducted high velocity jet-noise suppression research has demonstrated that noise reductions of 16 PNdB can be achieved statically for less than 1% thrust loss by use of multitube nozzles and acoustically lined ejectors. The paper describes the acoustic design philosophy behind a set of multitube suppressor nozzles. The results of a model-scale and full-scale test program are given which demonstrate the latest advances in jet-noise suppressor technology. (Author)

**A75-27937** # **Some recent developments in supersonic jet noise reduction.** D. S. Dosanjh (Syracuse University, Syracuse, N.Y.), K. K. Ahuja, M. R. Bassiouni, and P. K. Bhutiani. *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-502.* 31 p. 29 refs. U.S. Department of Transportation Contract No. OS-20094.

Attention is given to the results obtained in a new large jet facility for a two-nozzle coaxial arrangement. A description is presented of some preliminary attempts concerning the development of prediction schemes for noise from coaxial jets. The effects of lip (base) thickness on the coaxial jet flows and radiated noise are considered along with results obtained with a two-nozzle coaxial arrangement in a case in which an inner convergent-divergent jet designed for M=1.46 was heated to 850 F and the outer convergent jet was operated cold. G.R.

**A75-27938** # **Noise generation and transmission in duct combustors.** D. W. Lindley and H. A. Hassan (North Carolina State University, Raleigh, N.C.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-527.* 15 p. 16 refs. U.S. Department of Transportation Contract No. 05-40056.

Using a well-stirred reactor model to describe the combustion of a propane-air mixture, the effect of flow nonuniformities on the transmission of noise from hard and lined ducted combustion systems is considered. It is shown that for the range of Mach numbers, pressures, and temperatures considered, flow non-uniformities have little influence on the frequency that characterizes combustion noise in ducted combustors. On the other hand, for the end impedence employed, the duct length has the greatest influence on the characteristic frequency. The characteristic frequencies predicted by the theory are in good agreement with available experiment. (Author)

**A75-27939** # **The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility.** D. L. Martlew (National Gas Turbine Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-529.* 10 p. 5 refs.

The new, large scale, Noise Test Facility, consisting of a large anechoic chamber and a flow duct for absorber testing, has been commissioned in support of an aircraft-engine noise-reduction program. Extensive experience has been gained in the use of groups of Hartmann generators as sources of high intensity sound for the flow duct. The development of these sources and their performance are described. This type of noise generator has a tonal spectrum, and methods of testing and analyzing data are outlined which take this into account. It is concluded that, where suitable air supplies are available, the Hartmann generator is a convenient noise source with which accurate measurements of absorption can be obtained. (Author)

**A75-27943** # **Classification problems of aircraft noise (Klassifizierungsprobleme des Fluglärmes).** V. Chalupova. *Hungarian Optical, Acoustical and Filmtechnical Society, Conference on Noise Abatement, 2nd, Budapest, Hungary, May 6-10, 1974, Paper.* 7 p. In German.

Some aspects of far-field measurements of the noise generated by a stationary source are examined. Particular attention is given to the determination of the acoustic power, noise level, and acoustic pressure level in the individual frequency bands to identify the noise characteristics of an engine operating in a specific mode. The determination of the directional pattern of an aircraft, involving the determination of the maximum noise level, is also studied. V.P.

**A75-27978** **Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973 (Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrbuch 1973).** Edited by H. Blenk and W. Schulz. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974. 348 p. In German and English. $30.40.

Shock waves are considered along with the Airbus A 300, the development of European aeronautics and astronautics, the solar wind and the magnetosphere of the earth, peculiar objects of X-ray and gamma-ray astronomy, air cushion landing systems for aircraft, high-speed trains, and the aircraft television system. Other topics explored are related to the flight tests conducted with the V/STOL experimental aircraft VAK 191 B, the Alpha Jet program, the nonlinear behavior of solar paddle elements, the statical computation of circular cylindrical sandwich-type shells, the bending of sandwich plates, the origin of lift, and gliding processes on the liquid surface. G.R.

**A75-27980** **Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests (Airbus A 300 - Vergleich der durch Theorie und Windkanalversuche ermittelten Flugleistungen und Flugeigenschaften mit den Ergebnissen der Flugerprobung).** R. Beteille (Airbus Industrie, Paris, France). In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974, p. 41-52. In German.

The airbus is a two-engine short-haul and medium-range aircraft. The number of passengers carried by the aircraft will be in the range from 240 to 345, depending on the comfort provided. The aerodynamic investigations were conducted in close cooperation between British, French, and German aerospace firms. The flight range of the aircraft under various conditions is discussed and the aircraft flight characteristics at low speeds are examined. Attention is given to devices for increasing the lift, the maximum lift coefficients, and takeoff and landing characteristics. The flight performance and flight characteristics at high flight speeds are also considered. It is found that the performance shown by the aircraft in the flight tests is even slightly better than expected on the basis of theoretical calculations and wind tunnel tests. G.R.

**A75-27981** **European aeronautics and astronautics at the crossroads (Die europäische Luft- und Raumfahrt am Scheideweg).** L. Bölkow (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 6th, and Österreichische Gesellschaft für Weltraumforschung und Flugkörpertechnik, Jahrestagung, 11th, Innsbruck, Austria, Sept. 25-28, 1973.)* In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974, p. 53-63. In German.

A brief historical review of the development of aviation and the aerospace industry is presented, taking into account new developments in aviation and the current technological and economical situation in this field. Difficulties of the European aerospace industry compared to the conditions existing for the U.S. in the field of aviation are examined along with approaches for the European industry to overcome problems arising from the current lack of specialization of aerospace firms in specific areas. Long-term planning required for developments in aviation make it imperative for the European countries involved to make now a decision concerning

their policy with respect to the development of new aircraft in Europe. Such a decision should take into account the strength represented by the creativity of European research and development personnel which made it possible to develop weapons systems at one third of the price which would have been required for such developments in the U.S. G.R.

**A75-27983** **Air cushion landing systems for aircraft.** B. H. Goethert (Tennessee, University, Tullahoma, Tenn.). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 6th, and Österreichische Gesellschaft für Weltraumforschung und Flugkörpertechnik, Jahrestagung, 11th, Innsbruck, Austria, Sept. 25-28, 1973.)* In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974, p. 85-101. 14 refs.

Difficulties which in the case of large aircraft are related to the small support area of the wheels of conventional landing gears can be eliminated by making use of an air cushion system. In an experimental design a normal ground clearance of about one quarter of an inch was obtained with the aid of such a system. Basic principles of operation of an air cushion system are discussed along with questions of system design, the various types of feasible air cushion landing systems, problems of shock absorption during landing impact, handling on the ground, the weight of conventional and air cushion landing systems, and the design goals for demonstration aircraft with air cushion landing system. G.R.

**A75-27985** **Flight tests with the V/STOL experimental aircraft VAK 191 B (Erprobung des V/STOL-Experimentalflugzeugs VAK 191 B).** R. Riccius (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 6th, and Österreichische Gesellschaft für Weltraumforschung und Flugkörpertechnik, Jahrestagung, 11th, Innsbruck, Austria, Sept. 25-28, 1973.)* In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974, p. 125-146. 11 refs. In German.

Three VAK 191 B experimental aircraft were built in connection with plans for the development of a German-Italian military aircraft for the high subsonic speed range and low flight altitudes. The VAK 191 B is a single-seat aircraft for a wide spectrum of combat missions including reconnaissance operations. A technical description of the aircraft is given, taking into account its VTOL capability, questions of aircraft control and stabilization, the bleed-air system, and the fly-by-wire principle used. The aircraft development test program is considered along with the flight test program. Attention is given to the range of the aircraft, dynamical characteristics of longitudinal and lateral control, hover and vertical flight characteristics, and the transition from VTOL to conventional-flight operation. G.R.

**A75-27990** **The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface (Über den Gültigkeitsbereich zweier alter Arbeiten. I - Auftriebsentstehung. II - Stoss- und Gleitvorgänge an der Flüssigkeitsoberflächen).** H. Wagner. *(Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 6th, and Österreichische Gesellschaft für Weltraumforschung und Flugkörpertechnik, Jahrestagung, 11th, Innsbruck, Austria, Sept. 25-28, 1973.)* In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1973.
Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1974, p. 250-260. 17 refs. In German.

The analysis regarding the origin of circulation around a wing in a frictionless liquid conducted by Wagner (1925) is considered, giving attention to objections raised by other investigators who point out the importance of friction in the investigated process. It is shown that the problem studied belongs to a case in which the flow outside the thin boundary layers can be computed without regard for friction effects. The second old investigation considered has been reported by Wagner in 1932. The justification of objections made against certain aspects of this investigation is discussed. G.R.

**A75-28095** **Critical analysis and improvement of the source-panel method.** V. Losito and L. G. Napolitano (Napoli, Università, Naples, Italy). *L'Aerotecnica - Missili e Spazio,* vol. 54, Feb. 1975, p. 5-12. Consiglio Nazionale delle Ricerche Contract No. 73,00339,07.

The source-panel (SP) method developed by Smith and coworkers (1958, 1962, 1967) for the evaluation of two-dimensional potential flow fields about arbitrary bodies is critically analyzed to find ways of improving its lift prediction capability. Numerical experiments are carried out to reveal the possible causes of error in the evaluation of the lift coefficient by the SP method. An improved source-panel (ISP) method is proposed on the basis of the results obtained. It is shown that the ISP method yields highly accurate values for the lift coefficient even with a comparatively small number of panels. S.D.

**A75-28096** **Survey on two calculation methods in transonic regime.** R. Marazzi (Aeronautica Macchi S.p.A., Milan, Italy). *L'Aerotecnica - Missili e Spazio,* vol. 54, Feb. 1975, p. 13-23. 11 refs.

The flow about a nonlifting airfoil and the flow in De Laval's nozzle are solved using two different computational methods. Murman's (1972) method solves the transonic small-disturbance equation. The finite-difference scheme changes in type if the flow is locally subsonic or supersonic. The notion of parabolic discretization is introduced in order to properly represent the flow crossing the upstream branch of the sonic line. A change of coordinates is made in order to have a smaller integration step near the airfoil. The solution is obtained by successive approximations. Euler's equations are solved in the nozzle problem. A change of coordinates is made and the integration domain is transformed in a rectangular one. The numerical calculation is carried out in this new nonphysical coordinate system. A third-order explicit scheme, like Riethmyer's two-step scheme, is used. No artificial viscosity is needed to damp the nonlinear instability. Iterations are needed to reach a steady state. (Author)

**A75-28194** **Extension of the lifting line model for the helicopter rotor (Erweiterung des Traglinienmodells beim Hubschrauberrotor).** R. Hille (Hamburg, Universität, Hamburg, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 23, Mar. 1975, p. 77-95. 12 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

The lifting line model of the propeller in asymmetrical flow is extended for the helicopter rotor in forward flight by taking the wing flapping motion and the nonconstant flow rate through the rotor plane into account. Using measurement results for the S 58 helicopter, investigations are conducted on the problem whether the computations of thrust and circulation can be improved in this way. Such improvements can be observed, though the agreement of computation results and measurement results is not yet fully satisfying. Finally, a correction term for the consideration of the compressibility effect at the rotor in forward flight is calculated. (Author)

**A75-28201** # **Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data.** D. G. Gould and W. S. Hindson (National Aeronautical Establishment, Flight Research Laboratory, Ottawa, Canada). *(NATO, AGARD, Specialists Meeting on Aircraft State and Parameter Identification Techniques, NASA Langley Research Center, Hampton, Va., Nov. 5-8, 1974.) Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin,* no. 4, 1974, p. 1-20. 10 refs.

Stability derivatives for the Bell 205 helicopter have been derived from flight data using a least squares quasilinearization technique. The aircraft model, which included a first order representation of rotor response characteristics was based on fundamental parameters descriptive of the particular design. A conglomerate analysis procedure which produced estimates based on data from several similar manoeuvres was used to increase the confidence in the results obtained. Data from the CL-84 V/STOL aircraft were also analyzed, indicating the validity of certain a priori longitudinal stability derivatives for the aircraft, and yielding estimates of others. The results indicate the need to use a more elaborate modelling technique, such as was used for the Bell 205, which takes into account the particular complexities of the aircraft. (Author)

**A75-28222** # **Problem of aircraft noise in the vicinity of airports (Sul problema del rumore degli aeroplani nei dintorni degli aeroporti).** D. Priolo. *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 22nd, Genoa, Italy, Oct. 7-12, 1974, Paper.* 35 p. 16 refs. In Italian.

The present paper considers problems involved in airport planning, including the relationship of the airport to its surroundings, especially with regard to the protection of the neighboring area from the harmful effects of noise. A basic introduction is given to the problem of measuring noise and sonic disturbance. The factors affecting sound intensity and propagation, the units used to measure sound quantity and quality, and the evaluation of disturbance, as distinct from sound, are considered. The West German law on noise, which took effect in 1971, is discussed. Various noise standards are applied in different zones in relation to the airport. Noise can be controlled by regulating the flight maneuvers and trajectories of aircraft near airports. The contributions of the terrain and passive measures to noise suppression are considered. A.T.S.

**A75-28223** # **Noise certification of aircraft (Certificazione acustica degli aeromobili).** V. Fiorini (Registro Aeronautico Italiano, Rome, Italy). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 22nd, Genoa, Italy, Oct. 7-12, 1974, Paper.* 16 p. 9 refs. In Italian.

The criteria involved in aircraft noise certification are discussed. Special attention is given to Annex 16 of the ICAO convention on civilian aviation and the conflicts between its noise standards and those of FAR 36. The future prospects of noise regulation are considered. A.T.S.

**A75-28227** # **Jet noise suppressors for turbojet engines.** M. Marini (Fiat S.p.A., Turin, Italy). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 22nd, Genoa, Italy, Oct. 7-12, 1974, Paper.* 33 p. 8 refs. In Italian.

The present paper considers the problems involved in noise suppression, for the purposes of certification, in low- and medium-power turbojet engines, whose acoustic characteristics are dominated by exhaust-jet noise. This is a broad group, including the engines used in executive jets and transports such as the Boeing 707. The design of a noise-suppression device must take into account the structure of a typical exhaust jet, which comprises the central core, the mixing region, and a region of fully developed turbulent flux downstream of the mixing region. The methods of reducing jet noise include reducing the length of the mixing region and diminishing the exhaust velocity. General considerations concerning the geometry of lobed silencers and the losses they entail are outlined. An 8-lobed silencer designed by Fiat is described. The unit was tested successfully on a twin-engine HS. 125 aircraft. A.T.S.

**A75-28228** # **Development of air transport and environmental requirements (Lo sviluppo delle comunicazioni aeree e le esigenze ambientali).** G. Maoli (Fiat S.p.A., Turin, Italy). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 22nd, Genoa, Italy, Oct. 7-12, 1974, Paper.* 77 p. 33 refs. In Italian.

The present paper discusses the chemical and noise pollution produced by aircraft and the implications of environmental considerations for the future of commercial aviation. The levels of carbon monoxide, unburned hydrocarbons, oxides of nitrogen, and smoke emitted by present aircraft engines are tabulated, and it is noted that none of the engines meets the 1979 standards set by the Environmental Protection Agency. Operational and technological methods for reducing engine emissions are discussed. The consideration of aircraft noise includes an explanation of the relevant regulations contained in FAR Part 36. The noise produced by aircraft engines is a complex mixture of various types of fan, jet, tailpipe, and turbine noise. Changes in landing, takeoff, and ground operations are being considered to reduce noise near airports. Possible changes in engine design, including the use of external noise suppressors, sound-absorbent linings, and above-the-wing engine mounts, are discussed. A.T.S.

**A75-28236** **Stress intensity factors for some through-cracked fastener holes.** A. F. Grandt, Jr. (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *International Journal of Fracture,* vol. 11, Apr. 1975, p. 283-294. 23 refs.

A stress intensity factor solution is developed for a large plate containing radial hole cracks loaded with arbitrary crack face pressure. When the pressure is defined as the unflawed hoop stress surrounding a mechanical fastener, stress intensity factor calibrations are readily computed by the linear superposition principle. Results obtained in this manner agree well with previous solutions determined for open holes loaded in remote tension. The potential usefulness of the present analysis is further demonstrated with application to specific fastener configurations, including interference fit fasteners, pin-loaded plates, and cold-worked holes. (Author)

**A75-28348** * # **An experimental study of the structure and acoustic field of a jet in a cross stream.** I. Camelier (Instituto Tecnológico de Aeronáutica, São José dos Campos, São Paulo, Brazil), K. Karamcheti, and B. Hodder (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-460.* 37 p. 16 refs. Grants No. NGR-05-020-526; No. NsG-2007.

The investigation reported is related to studies of the noise generated by a lifting jet in forward motion such as in the case of a V/STOL aircraft. The investigation involved experiments in a subsonic wind tunnel. The two-microphone cross-correlation method used for measuring the acoustic intensity provides data concerning the noise directly radiated from the source, practically free from any reflection effects. The theoretical basis of the two-microphone method is discussed along with the experimental apparatus, the characteristics of the flow inside the jet, and the features of the acoustic field. G.R.

**A75-28349** * # **Effects of friction and heat conduction on sound propagation in ducts.** P. Huerre and K. Karamcheti (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, 2nd, Hampton, Va., Mar. 24-26, 1975, Paper 75-520.* 35 p. 23 refs. Grants No. NGR-05-020-526; No. NsG-2007.

A theoretical formulation of the propagation of sound in a viscous and heat conducting medium is presented. The problem is reduced to the determination of two scalar potentials related to pressure and entropy fluctuations respectively, and a vector potential related to vorticity fluctuations. The particular case of a two-dimensional duct of constant width is thoroughly investigated in the low, high, and very high frequency ranges. It is shown that three distinct families of modes may propagate along the duct axis, namely, pressure, entropy, and vorticity dominated modes. Perturbation methods are used to study the variations of attenuation rates, phase velocities, and mode shapes, as a function of frequency and duct width. (Author)

**A75-28400** **Ratio of peak frequencies of jet self and shear noise spectra.** J. R. McCartney (Ulster, New University, Coleraine, Northern Ireland). *Journal of Sound and Vibration*, vol. 39, Mar. 22, 1975, p. 269-272. 7 refs. National Research Council of Canada Grant No. A-2003.

**A75-28432** **Design of a digital-stability augmentation and control system with gust alleviation and modal suppression.** M. Healey and H. M. S. Al-Bahrani (University College, Cardiff, Wales). *Institution of Electrical Engineers, Proceedings*, vol. 122, Apr. 1975, p. 437-440. 8 refs.

A stochastic, discrete, implicit model-following control law is developed for a stability augmentation and control system for the pitch axis of a flexible-bodied aircraft. Particular attention is paid to the choice of weighting matrices in the quadratic i.p. so as to give a compromise between handling, gust alleviation and modal suppression. (Author)

**A75-28466** # **Digital avionics from the viewpoint of ATA.** F. C. White (Air Transport Association of America, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-551.* 5 p. 6 refs.

The application of digital technology to air-ground communications is considered, taking into account the supporting role of an automation data base. A system approach to civil aircraft navigation using digital technology is discussed along with digital flight control systems considerations related to implementation and acceptance. Aspects of software engineering of a navigation and guidance system for commercial aircraft are examined and a possible airline point of view is presented. G.R.

**A75-28467** # **Interaction of military/civil position location and reporting systems.** H. Gumbel (Philco-Ford Corp., Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-561.* 10 p.

This paper presents a comparative analysis of civil navigation and air traffic control systems and corresponding military systems. Very different requirements have led to independent developments by the DoD and the FAA in their respective spheres of responsibilities. These developments could result in the implementation of systems incompatible on a hardware level. The cost of redundant use of both systems could be prohibitively costly to the military, not to speak of cockpit crowding and electronic complications. Civil systems under consideration include ATCRBS, DABS, and IPC and military systems reviewed include AIMS, SEEK BUS, LORAN and GPS. The paper presents an approach to an integrated system which would satisfy the requirements of civil air traffic control for military users in peace time. (Author)

**A75-28468** # **SEEK BUS - A time division multiple access system.** D. D. Neuman (Mitre Corp., Bedford, Mass.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-564.* 5 p.

The system SEEK BUS is being developed for the U.S. Air Force as an aid in improving the effectiveness of its air operations. In aircraft, SEEK BUS provides the data required for operations related to collision avoidance, station-keeping, rendezvous, air-to-air coordination, identification, navigation, and instrument landing. The network architecture is considered along with questions of system feasibility, aircraft position determination, system performance, system capacity, and questions of signal structure. G.R.

**A75-28469** # **System approach to civil aircraft navigation using digital technology.** T. A. Ellison (United Air Lines, Inc., San Francisco, Calif.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-572.* 7 p. 14 refs.

**A75-28470** # **F-15 computational subsystem.** T. V. McTigue (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-590.* 8 p.

A description is given of the computational subsystem used in the F-15 weapon system. The consolidated computational design approach is discussed in which the mission-oriented computations are performed in a single central computer, and the sensor-oriented computations are carried out in special processors in various sensor and display equipment. Major characteristics of the central computer hardware and software design are described. Finally, the multiplex communications system between the central computer and the interfacing peripheral avionics equipment is outlined. S.D.

**A75-28472** # **The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment.** J. R. Sebring (Bendix Corp., Communications Div., Baltimore, Md.). *American Institute of Aeronautics and Astronautics, Digital Avionics System Conference, Boston, Mass., Apr. 2-4, 1975, Paper 75-607.* 7 p.

A scanning beam system which uses a time reference signal format is considered. Basic requirements for the new microwave landing system (MLS) are discussed along with the MLS signal format and the installation on a typical runway. A description is given of the airborne equipment involved, taking into account the envelope processor, the angle processor, aspects of angle function acquisition, the time gate tracker, and time gate acquisition logic. G.R.

**A75-28522** # **The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations.** R. H. Wickens (National Aeronautical Establishment, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 21, Mar. 1975, p. 81-98. 11 refs.

This paper describes the aerodynamic characteristics of lifting propellers and wing-propeller configurations, with particular reference to the concept of a powered-lift system, and its complex flows downstream in the wake. The propeller, when inclined to large angles, and at high advance ratios, is a singular example of a powered-lift system in which lift is derived partly by deflecting and energizing a stream tube of air, and in part, by a wing-like vortex flow in which the propeller disc can be thought of as a low aspect ratio wing of circular plan form. The trailing wake is characterized by mixed regions of propulsive and vortex flow in which concentrations of vorticity may induce downwash and sidewash velocities of considerable magnitude in the surrounding fluid. The propulsive stream tube, or slipstream, is an integral part of this wake, and deforms with it, ultimately rolling up with the trailing vortices. (Author)

**A75-28529** **Metallurgical factors affecting high strength aluminum alloy production.** D. S. Thompson (Reynolds Metals Co., Richmond, Va.). *(Symposium on Advances in the Physical Metallurgy of Aluminum Alloys, Philadelphia, Pa., May 29-June 1, 1973.) Metallurgical Transactions A - Physical Metallurgy and Materials Science*, vol. 6A, Apr. 1975, p. 671-683. 73 refs. Contracts No. F33615-72-C-1202; No. F33615-71-C-1805.

With the advent of linear elastic fracture mechanics, the detailed effects of processing and microstructure on toughness can be evaluated. The effect of microstructure on plane stress and plane strain fracture toughness is considered in detail together with strength, fatigue behavior and corrosion resistance. It is concluded that second phase particles in all size ranges can influence toughness. Increasing the size and amount of particles or decreasing precipitate coherency all lead to decreases in toughness. Grain structure is also shown to play a prominent role in determining plane stress fracture toughness; at a given strength level, a fibrous grain structure and the prevention of recrystallization are desirable. Thermomechanical processing is considered to offer a possible route to achieving a desirable balance of toughness, strength and corrosion resistance. (Author)

**A75-28626** **Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation.** Edited by H. T. Nagamatsu (GE Research and Development Center, Schenectady, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics Series. Volume 38); Cambridge, Mass., MIT Press, 1975. 524 p. Members, $19.; nonmembers, $30.

Fan, STOL, and boundary layer origins of aircraft noise pollution are considered, as well as certain sonic boom problems, and some means of measuring noise pollution are discussed. Topics covered include broadband noise generation by airfoils and axial flow fans, inlet geometry and axial Mach number effects on fan noise propagation, source noise suppression of subsonic tip speed fans, surface pressure fluctuations in hypersonic turbulent boundary layers, distortion of weak shock waves by turbulence in a stratified still atmosphere, and hypersonic flow velocity measurements using the laser velocimeter.

S.J.M.

**A75-28629** **Aeroacoustics: Jet and combustion noise; duct acoustics.** Edited by H. T. Wagamatsu (GE Research and Development Center, Schenectady, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics Series. Volume 37); Cambridge, Mass., MIT Press, 1975. 556 p. Members, $19.; nonmembers, $30.

Jet and combustion sources of aircraft noise pollution are investigated, and some aspects of duct acoustics are examined. Subjects studied include the relationship between acoustic energy density flux near the jet axis and far-field acoustic intensity, the effect of temperature on supersonic jet noise, jet noise suppression by swirling the jet flow, noise generation by ducted combustion systems, core engine noise, sound interaction with a ducted helical flow, use of a relaxation technique in nozzle wave propagation problems, and a theoretical and experimental study of sound attenuation in an annular duct. S.J.M.

**A75-28650** # **Part load specific fuel consumption of gas turbines.** J. Jerie (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). *ASME, Transactions, Series A - Journal of Engineering for Power*, vol. 97, Apr. 1975, p. 303, 304.

An analysis is made of the effect of various thermodynamic and design conditions on the feasibility of improving the part load specific fuel consumption (PLSFC) of gas turbines. It is shown that appropriate control of compressor and turbine characteristics is important in practically all developments of gas turbines aimed at improving the PLSFC. A.T.S.

**A75-28651** # **Theory of transonic flow around a profile (K teorii transzvukovykh techenii okolo profilia).** Iu. B. Lifshits. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 1-8. 8 refs. In Russian.

The characteristics of transonic flow of an ideal gas around three different wing profiles are investigated. The change in flow parameters is studied during the transition from a computational regime characterized by isentropic compression in the local supersonic zone to a flow with a shock wave. The location and form of the shock waves are analyzed. P.T.H.

**A75-28652** # **Calculation of the flow around blunted, nonsymmetric cones with large aperture angle (Raschet obtekaniia zatuplennykh nesimmetrichnykh konusov s bol'shim uglom rastvora).** A. P. Bazzhin and S. V. Pirogova. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 9-17. 6 refs. In Russian.

A finite difference method is used to compute the supersonic flow across blunt axisymmetric and nonaxisymmetric bodies formed from a 120-degree cone by spherically blunting the nose section and rounding off the side edge. Various mixed gas flows are calculated, differing in Mach number, body geometry, gas properties, and angle of attack. P.T.H.

**A75-28653** # **Hypersonic, viscous gas flow around a wing of small aspect ratio (Giperzvukovoe viazkoe techenie gaza okolo kryla malogo udlineniia).** A. I. Ruban and V. V. Sychev. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 18-25. In Russian.

The critical stage of a hypersonic flow around a slightly elongated plate at high Reynolds number is investigated. A class of self-similar solutions is found, and it is shown that perturbations in the symmetry plane of the wing propagate along the boundary layer up to the leading edge. The nature of this propagation is investigated numerically. P.T.H.

**A75-28654** # **The three-dimensional character of a cross flow around a circular cylinder (O trekhmernom kharaktere poperechnogo obtekaniia krugovogo tsilindra).** A. I. Korotkin. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 26-33. 6 refs. In Russian.

Results of wind tunnel investigations of the three-dimensional flow around the surface of a circular cylinder in the region of flow separation at Reynolds numbers corresponding to subcritical and supercritical flow regimes are presented. The characteristic size of the cell structure of the flow along the cylinder generatrix in the separation zone is compared with known experimental data for the corresponding size in the wake behind the cylinder. P.T.H.

**A75-28658** # **Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour (Issledovanie dvukh giperzvukovykh osesimmetrichnykh profilirovannykh sopl s gladkim konturom).** N. V. Denisova, I. I. Mezhirov, and Iu. I. Chistov. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 56-64. 7 refs. In Russian.

The present work describes the aerodynamic design and experimental investigation of two hypersonic, axisymmetric nozzles, calculated with account for the effect of viscosity on the establishment of a nearly uniform flow at Mach numbers 13.45 and 15.45. The isentropic contours of the nozzles have continuous derivatives up to the third, inclusively. The experimental nozzles secured a flow close to that calculated, with variations within the limits of plus or minum 1%. Smooth flow buildup was obtained without significant Mach number perturbations along the axis. P.T.H.

**A75-28665** # **Interaction between a sonic boom N-wave and an obstacle near corner points (Vzaimodeistvie N-volny zvukovogo udara s prepiatstviem v okrestnosti uglovykh tochek).** K. B. Sokolov. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 104-109. 9 refs. In Russian.

A conical shock tube is used to study the impact of a sonic-boom wave on the upper portion of a model structure (parallelepiped) to determine the time-behavior of the pressure acting on a building. The effects of diffraction and reflection of the N-wave at the corners and roof of the model are taken into consideration. The effect of the low-pressure wave arising at an upper corner of the building on the pressure distribution over the wall exposed to the shock wave is evaluated. The pressure on the building near the apex of a triangular corner is plotted against time. S.D.

**A75-28668** # **Influence of fuselage flexibility on the stress-strain state of the wing (O vliianii podatlivosti fiuzeliazha na napriazhenno-deformirovannoe sostoianie kryla).** V. A. Belous. *TsAGI, Uchenye Zapiski*, vol. 4, no. 5, 1973, p. 119-124. In Russian.

Some aspects of the calculation of the stresses and strains in a wing, in the case where the middle surface of the wing is arbitrarily spaced from the neutral line of the fuselage. A panel/girder scheme for the solution of the problem is proposed, and is applied to wing stress calculations for low-wing, midwing, and high-wing monoplane. The stresses caused by plane deformation of the wing middle surface are compared to stresses arising due to wing twist. V.P.

**A75-28671** # **Nonlinear problem of the unsteady flow past an airfoil lattice (Nelineinaia zadacha o nestatsionarnom obtekanii reshetki profilei).** V. P. Riabchenko. *TsAGI, Uchenye Zapiski*, vol. 4, no. 6, 1973, p. 8-16. 7 refs. In Russian.

A numerical method is proposed for solving the nonlinear problem for an airfoil lattice which, starting from rest, performs arbitrary motions in ideal incompressible potential flow. The solution is obtained in time steps, at each of which the problem becomes a linear one. The method is essentially an extension of a method proposed by Riabchenko and Saren (1972) for the linear problem of the flow past a vibrating lattice of arbitrary airfoils. As an example, the method is applied to the synchronous harmonic in-phase and out-of-phase vibrations of airfoils. V.P.

**A75-28676** # **Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion (Kachestvennoe issledovanie semeistva ekstremalei v odnoi zadache optimal'nogo upravleniia dvizheniem samoleta).** V. F. Illarionov and V. T. Pashintsev. *TsAGI, Uchenye Zapiski,* vol. 4, no. 6, 1973, p. 58-65. In Russian.

An energy method is applied to the problem of optimizing flight control for minimum fuel consumption over a prescribed range. A procedure is proposed for determining, in the altitude-velocity plane, the loci of points corresponding to moments at which instantaneous steady optimum-trust modes are realized and for establishing the direction in which the phase point moves. V.P.

**A75-28680** # **An example of boundary layer flow with two instability regions (Primer techeniia v pogranichnom sloe s dvumia oblastiami neustoichivosti).** V. M. Lytovinov. *TsAGI, Uchenye Zapiski,* vol. 4, no. 6, 1973, p. 88-93. 8 refs. In Russian.

The stability of the boundary layer flow on a wing is analyzed in a direction normal to the mainstream for the case where S-shaped velocity profiles with two points of inflection may occur beyond the line of minimum pressure. Numerical calculations indicate that for such velocity profiles, the region of instability is bounded by two intersecting neutral curves. It is shown that the phase velocity of the disturbances near the critical Reynolds number is close to the velocity at the point of inflection situated nearer to the wall. The minimum Reynolds number along a second neutral curve is found to be noncritical. S.D.

**A75-28687** # **Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing (Uchet uprugoi deformatsii kryla v svoei ploskosti pri raschete antisimmetrichnykh kolebanii samoleta s krylom malogo udlineniia).** V. A. Mosunov. *TsAGI, Uchenye Zapiski,* vol. 4, no. 6, 1973, p. 131-137. In Russian.

**A75-28717** * **New evidence of the mechanisms of noise generation and radiation of a subsonic jet.** L. Maestrello and S. P. Pao (NASA, Langley Research Center, Hampton, Va.). *Acoustical Society of America, Journal,* vol. 57, Apr. 1975, p. 959, 960.

**A75-28769** # **Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context.** J. H. H. Grover (Miles-Phoenix, Ltd.). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings.
London, Royal Aeronautical Society, 1975. 12 p.

Criteria defining adequate aircraft performance during takeoff are assessed, and the Miles-Phoenix runway distance indicator (RDI) is recommended as a highly effective safety measure. This instrument shows aircraft speed and runway distance remaining in relation to a decision point, at which takeoff (good performance) or deceleration (poor performance) courses can be chosen. It is suggested that an accident occurring at Anchorage, Alaska in 1970 could have been averted if this equipment had been in use. S.J.M.

**A75-28770** # **A specialised recording system for the measurement of helicopter rotor blade performance in flight.** F. B. Moulang (Royal Aircraft Establishment, Bedford, Hants., England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings.
London, Royal Aeronautical Society, 1975. 12 p.

Flight measurements of the detailed aerodynamic performance of helicopter aerofoil sections have been made at the Royal Aircraft Establishment, Bedford as part of a continuing program to increase overall helicopter rotor performance. This paper describes a complete system designed for the acquisition and analysis of large numbers of blade surface pressures. The large amount of data involved in these measurements demands an automatic processing method. The data is therefore recorded on magnetic tape and is processed via a complex hybrid computing installation to give a final output in the form of graphic displays (which may be hard copy) and tabulated coefficients. (Author)

**A75-28771** # **Application of a new slip-ringless propeller blade measurement system.** M. J. Walker (National Aviation Facilities Experimental Center, Atlantic City, N.J.). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 10 p.

A propeller-mounted blade vibration data system has been used for the acquisition of propeller-operating stress data for single and twin engine general aviation aircraft in flight. The system overcomes the difficulties of traditional slip-ring and brush assemblies. Tests have proven it to be highly accurate, and results obtained with it have been reproducible. S.J.M.

**A75-28774** * # **A new flight test data system for NASA aeronautical flight research.** K. C. Sanderson (NASA, Flight Research Center, Edwards, Calif.). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 17 p. 10 refs.

The airborne integrated flight test data system (AIFTDS) is described. This system integrates an airborne digital computer with a high-bit-rate pulse code modulation system. Its design was influenced by in-house technical experience with similar modules and by the multiproject environment in which it was expected to operate. The present work describes events leading to the development of the system, reviews factors that influenced the objectives for the system and the resulting design, and describes the elements themselves. Block diagrams supplement the text. S.J.M.

**A75-28778** # **Development of an R.F. telemetry system.** H. W. Redhead. In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 7 p.

A multi-channel miniature telemetry system designed to obtain dynamic stress and temperature data from engine rotors is described. Data recording and analysis, system construction, the module test sequence, system build, engine installation, running experience, and system development are discussed. Emphasis in design was placed on presentation of th data in a form readily assimilable by the engineer. S.J.M.

**A75-28781** # **Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments.** C. G. Wildey, J. M. Ley, and J. S. Mitchell (Electro Optic Developments, Ltd., Brentwood, Essex, England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 9 p. 7 refs. Research supported by the Royal Aircraft Establishment.

The present work describes a wide-bandwidth (approximately 100 MHz) laser telemetry link developed to provide a telemetry facility in intense electromagnetic pulse environments. The equipment was intended for ground testing of aircraft subsystems subjected to electrically simulated nuclear environments. The optical system discussed has important advantages over microwave transmitters for this purpose. S.J.M.

**A75-28785** # **A new centralised warning display for aircraft.** S. Beddoe (Plessey Co., Ltd., Titchfield, Hants., England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings.
London, Royal Aeronautical Society, 1975. 9 p. Research supported by the Ministry of Defence (Procurement Executive).

The present work outlines the development of a new improved central warning display for aircraft. The project was undertaken because it was considered that significant improvements in both performance and reliability could be achieved over existing designs. The new design uses an assembly of miniature electromagnetic indicators of improved construction in association with an original process of low-level lighting. Various tests were carried out to assist in making the decision to employ electromagnetic indicators rather than the more common semiconductor interface displays. S.J.M.

**A75-28786** # **Integrated avionics - Controls and displays for helicopter IFR operation.** F. J. Winter, Jr. (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 11 p.

A flight research effort has been established to investigate all aspects of helicopter instrument flight rule (IFR) operations ranging from lift-off through transition to cruise and approach to hover and landing. The basic purpose is to evaluate recent developments in rotary wing instrument flight capability. These developments center around vehicle controllability through both control/display and stability augmentation systems. The configuration to be first evaluated was designed from the results documented by actual pilot performance during typical rotary wing IFR maneuvers. The maneuver profiles were designed and flown to record pilot activity and aircraft attitude. Several subject pilots flew the designed profiles to establish in what areas improvements were required. Each pilot's performance was then computerized to create a 'mean' value of pilot ability to perform prescribed tasks. The analysis of the data gathered determined in what areas pilot performance could most likely be improved through refined helicopter controls and displays. (Author)

**A75-28787** **A new J band pulsed radar altimeter.** W. P. Northen (Plessey Co., Ltd., Ilford, Essex, England) and I. D. Longstaff (Royal Radar Establishment, Malvern, Worcs., England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 12 p.

A new pulsed radar altimeter has been developed for small helicopter and light aircraft applications. A number of improvements on current altimeters have been possible through the choice of a high resolution system operating at J band. The aerials have been combined into the same box as the T/R Unit. High resolution has allowed the use of a simplified leading edge tracker. A technique of continuous reference tracking has been adopted to improve accuracy and integrity. Flight testing has shown that the system performance is suited to many low level applications. (Author)

**A75-28788** # **Altimeters - The way ahead.** A. N. Du Feu (Smiths Industries, Ltd., Wembley, Middx., England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings.
London, Royal Aeronautical Society, 1975. 14 p. 12 refs.

Four key features responsible for the present form of the altimeter and determining its future course of development are examined: pilot's display (presentation), accuracy and performance, reliability, and operating principle. It is concluded that no great change is foreseen in the display presentation of altimeters (that the counter/pointer type will become almost universal); that servo altimeters will gradually replace mechanical ones; that baro altitude will continue to be the main altitude reference up to altitudes of at least 50,000 feet; and that radio altimeters will expand their role of providing accurate landing references. S.J.M.

**A75-28790** # **Airborne equipment for use with the microwave landing system.** J. P. Birchenough and K. Lawson (Plessey Co., Ltd., Ilford, Essex, England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 11 p.

Several proposed alternatives to the instrument landing system (ILS) presently in use, which fall under the heading 'microwave landing system' (MLS), are reviewed. Disadvantages of the ILS, general requirements for the MLS, the Doppler MLS design, ground guidance installations, the 'ILS replacement' airborne receiver, the comprehensive modular receiver, and airborne equipment integrity are considered. S.J.M.

**A75-28791** # **Characteristics of MLS signals and their effect on flight control systems.** G. McConville (Smiths Industries, Ltd., Wembley, Middx., England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 11 p.

A three-part study was undertaken to assess MLS performance. The study simulated maneuvers executed to exercise the aircraft/autopilot combination in the appropriate modes. The elevation 1 MLS model assumed the aircraft to be initially flying at a constant height of 2000 ft.; the azimuth study had the plane initially flying in heading steering mode to give a 45 deg intercept with the ILS radial; and the elevation 2 MLS model supposed that the aircraft was initially established on a 3 deg glide path. Means by which the integrity of an AFCS can be influenced by the MLS are discussed. S.J.M.

**A75-28792** # **The range of airborne processing available to the future user of the Doppler MLS.** P. Barton, F. G. Overbury, and P. K. Blair (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 12 p.

The Doppler MLS operational parameters and range of application are considered. The principles of Doppler scanning signal generation, the basis of airborne processing, narrow-band filtering, time gating and tracking methods, the fixed-course discriminator, the selectable course discriminator, the sine-cosine tracker for wide coverage azimuth or elevation 1 systems and the high-performance elevation processor for low-angle coverage are discussed and described. S.J.M.

**A75-28793** # **Astrolabe - A synthetic circular aperture system for landing and navigation.** J. Dorey and G. Garnier (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings.
London, Royal Aeronautical Society, 1975. 14 p.

The new Astrolabe MLS is described in terms of its theoretical properties and preliminary reexperimental results. In this system, the two angular coordinates (elevation and azimuth) are obtained by two-dimensional phase modulation of a microwave carrier induced by the continuously rotating motion of an isotropic antenna. It is

explained how, by using quasi-holographic techniques in signal processing, it is possible to obtain a multifunctional system for both the air-derived and ground-derived configurations. This multifunctional system combines (1) takeoff, approach and landing aid, (2) display of the external situation for navigational aids, and (3) zone navigation. S.J.M.

**A75-28797** # **The development of a serial P.C.M. instrumentation system.** M. J. Taylor (Hawker Siddeley Aviation, Ltd., Woodford, Essex, England). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 14 p.

The current work covers progress from specification to test work on a PCM instrumentation system. It also describes some of the experiences and results from its use during 70 hours of development flying for the Victor K.Mk.2 tanker aircraft. Photographs and diagrams supplement the text. Specifications include large input capacity, flexible sampling rate, and computerized data recovery. S.J.M.

**A75-28801** # **The benefits of real time computer analysis of experimental aircraft flight test data.** R. P. LeCann (Grumman Data Systems Corp., Bethpage, N.Y.). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 12 p.

The process of multidiscipline or integrated testing used in conjunction with real-time computer analysis is described, and its benefits to flight testing are indicated. Its effect is most noticeable during the initial development phase of envelope expansion. Flying qualities testing, a flight loads program, performance testing, propulsion testing, and limit checking with this process are considered. S.J.M.

**A75-28802** # **Testing the MLS Doppler concept.** A. E. Brindley and L. C. Calhoun (IIT Research Institute, Chicago, Ill.). In: International Aerospace Instrumentation Symposium, 8th, Cranfield, Beds., England, Mar. 24-27, 1975, Proceedings. London, Royal Aeronautical Society, 1975. 12 p.

The present paper describes an experimental program conducted to develop and MLS to replace existing ILS equipment in the 1980s. The program is deemed to have been successful, and it selected the Doppler technique rather than the scanning beam method for further testing. Instrumentation design, data reduction, data acquisition, field tests, results of a concept validation program, and a multipath investigation are described. The following features of the flexibly designed data collection and reduction system made for simplicity in programming: (1) standard variable names, (2) standard input, output, and conversion program, and (3) use of FORTRAN IV and a standard plotting language. S.J.M.

**A75-28866** # **Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate (Soprotivlenie duraliumina D16T ustalostnomu razrusheniiu pri normal'noi i povyshennoi temperaturakh v zavisimosti ot skorosti tsiklicheskogo nagruzheniia).** A. V. Karlashov, V. V. Sazonov, and V. P. Tokarev (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Problemy Prochnosti,* Feb. 1975, p. 84-87. 9 refs. In Russian.

# STAR ENTRIES

**N75-19127*** Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
**EFFECTS OF VISUAL FLIGHT DISPLAY DYNAMICS ON ALTITUDE TRACKING PERFORMANCE IN A FLIGHT SIMULATOR**
E. F. Weener, R. M. Howe, and R. W. Pew *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 3-8

CSCL 05E

The effects were studied of visual display dynamics on pilot tracking performance in a simulator. The tracking task consisted of maintaining the piloted aircraft at the same altitude as two aircraft positioned three-hundred feet ahead; as would be required in level formation flying. The two leading aircraft were represented symbolically along with the horizon on a CRT display. Vertical position of these aircraft with respect to the horizon indicated the altitude of the subject's aircraft, which was disturbed by atmospheric turbulence. Various bandwidths of second-order dynamics were interposed between the true aircraft altitude and the displayed altitude, whereas no dynamics were interposed in the attitude display. Experiments were run using two experienced pilots and two substantually different longitudinal dynamics for the piloted aircraft. Preliminary results indicate a significant decrease in altitude tracking performance for display dynamics with natural frequencies below ten radians per second. Author

**N75-19128*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**A STUDY ON AIRCRAFT MAP DISPLAY LOCATION AND ORIENTATION**
D. L. Baty, T. E. Wempe, and E. M. Huff *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 9-24 refs

CSCL 01D

Six airline pilots participated in a fixed-base simulator study to determine the effects of two Horizontal Situation Display (HSD/map) panel locations relative to the Vertical Situation Display (VSD), and of three map orientations on manual piloting performance. Pilot comments and opinions were formally obtained. Significant performance differences were found between wind conditions, and among pilots, but not between map locations and orientations. The results also illustrate the potential tracking accuracy of such a display. Recommendations concerning display location and map orientation are made. Author

**N75-19131*** Ohio State Univ., Columbus. Dept. of Aviation.
**A TACTUAL PILOT AID FOR THE APPROACH-AND-LANDING TASK: INFLIGHT STUDIES**
Richard D. Gilson and Robert E. Fenton *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 49-53 refs

CSCL 01C

A pilot aid -- a kinesthetic-tactual compensatory display -- for assisting novice pilots in various inflight situations has undergone preliminary inflight testing. The efficacy of this display, as compared with two types of visual displays, was evaluated in both a highly structured approach-and-landing task and a less structured test involving tight turns about a point. In both situations, the displayed quantity was the deviation (alpha sub 0 - alpha) in angle at attack from a desired value alpha sub 0. In the former, the performance with the tactual display was comparable with that obtained using a visual display of (alpha sub 0 - alpha), while in the later, substantial improvements (reduced tracking error (55%), decreased maximum altitude variations (67%), and decreased speed variations (43%)), were obtained using the tactual display. It appears that such a display offers considerable potential for inflight use. Author

**N75-19132*** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**EVALUATION OF TACTUAL DISPLAYS FOR FLIGHT CONTROL**
William H. Levison, Robert B. Tanner, and Thomas J. Triggs *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 55-71 refs Sponsored in part by ARPA

(Contract N00014-73-C-0031)
CSCL 01C

Manual tracking experiments were conducted to determine the suitability of tactual displays for presenting flight-control information in multitask situations. Although tracking error scores are considerably greater than scores obtained with a continuous visual display, preliminary results indicate that inter-task interference effects are substantially less with the tactual display in situations that impose high visual scanning workloads. The single-task performance degradation found with the tactual display appears to be a result of the coding scheme rather than the use of the tactual sensory mode per se. Analysis with the state-variable pilot/vehicle model shows that reliable predictions of tracking errors can be obtained for wide-band tracking systems once the pilot-related model parameters have been adjusted to reflect the pilot-display interaction. Author

**N75-19133*** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
**PITCH PAPER PILOT REVISITED**
John D. Arnold, Robert B. Johnson, and James D. Dillow *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 75-81 refs
CSCL 01C

Two methods are described for predicting the handling qualities of an aircraft in pitch. Both methods are based on minimizing a pilot rating expression with respect to free pilot parameters. In one case the pilot rating expression was developed from a set of moving base simulation data. In the other case, the pilot rating expression was developed from a set of fixed base simulation data. In both cases pilot rating is primarily a function of pitch attitude and pitch rate; however, in the moving base case, the pilot rating is more sensitive to pitch rate than in the fixed base case. For each method, predicted pilot ratings and performance measures agree well with the measured data corresponding to that case. Both methods are used to predict pilot ratings for a set of flight test configurations and the results of the two methods agree to within one half a rating unit. The predicted ratings in both cases correlate well with the actual pilot ratings from the flight tests. Author

**N75-19134*** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
**ROLL PAPER PILOT**
Flynoy R. Naylor, James D. Dillow, and Russell A. Hannen *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 83-92 refs
CSCL 01C

A mathematical model for predicting the pilot rating of an aircraft in a roll task is described. The model includes: (1) the lateral-directional aircraft equations of motion; (2) a stochastic gust model; (3) a pilot model with two free parameters; and (4) a pilot rating expression that is a function of rms roll angle and the pilot lead time constant. The pilot gain and lead time constant are selected to minimize the pilot rating expression. The pilot parameters are then adjusted to provide a 20% stability margin and the adjusted pilot parameters are used to compute a roll paper pilot rating of the aircraft/gust configuration. The roll paper pilot rating was computed for 25 aircraft/gust configurations. A range of actual ratings from 2 to 9 were encountered and the roll paper pilot ratings agree quite well with the actual ratings. In addition there is good correlation between predicted and measured rms roll angle. Author

**N75-19135*** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
**PAPER PILOT PONDERS SUPERSONIC TRANSPORTS**

John R. Stone *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 95-101 refs

CSCL 01C

The application is described of the digital program Pitch Paper Pilot to a presimulation analysis of a large delta wing aircraft similar to the Concorde supersonic transport. Pilot acceptance (in terms of Cooper-Harper ratings), pilot model parameters, and pilot-vehicle performance were predicted by Paper Pilot and compared to actual inflight measures. Results are good and illustrate the value of using the Paper Pilot concept during the planning stages of simulation. Author

**N75-19137*** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**A DISPLAY EVALUATION METHODOLOGY APPLIED TO VERTICAL SITUATION DISPLAYS**
Sheldon Baron and William H. Levison *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 121-132 refs

(Contract NAS2-6652)
CSCL 01D

An approach to display evaluation based on the optimal-control or state-variable model of the human operator is described. The approach evolved over the past several years, and is believed to have significant advantages for display evaluation. The foundations of the methodology are briefly described, and results are presented of its application to the analysis of vertical situation displays for STOL approach. This analysis includes the effects of both status and command displays on pilot workload and system performance. Author

**N75-19138*** McDonnell-Douglas Corp., Long Beach, Calif.
**A CONFORMAL HEAD-UP DISPLAY FOR THE VISUAL APPROACH**
J. M. Naish *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 133-145 refs

CSCL 01D

The degree of conformity used in matching a superimposed display to its visual background is considered in relation to the information available for vertical guidance and control during a purely visual approach. The information may be represented by individual symbols or combined in a single symbol, and the relative merits of these methods are discussed. A fully conformal display format is developed for the purpose of showing both the position and direction of the flight path, with provision for the effects of disturbances, ILS compatibility, and control needs. The field of view needed for all conditions and phases of the visual approach with a fully conformal display is studied in relation to the limitations of conventional collimator systems. Methods are discussed which depend on deviation of the sight line, and on windshield reflection of the uncollimated image of a simple pointer. Limited flight tests show some promise for the uncollimated method. Author

**N75-19140*** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**A MODEL BASED TECHNIQUE FOR THE DESIGN OF FLIGHT DIRECTORS**
William H. Levison *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 163-172 refs

(Contract NAS2-6652)
CSCL 01C

A new technique for designing flight directors is discussed. This technique uses the optimal-control pilot/vehicle model to determine the appropriate control strategy. The dynamics of this control strategy are then incorporated into the director control laws, thereby enabling the pilot to operate at a significantly lower workload. A preliminary design of a control director for maintaining a STOL vehicle on the approach path in the presence of random air turbulence is evaluated. By selecting model parameters in terms of allowable path deviations and pilot workload levels, a set of director laws is achieved which allows improved system performance at reduced workload levels. The pilot acts essentially as a proportional controller with regard to the director signals, and control motions are compatible with those appropriate to status-only displays. Author

**N75-19141*** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
**IMPROVEMENTS IN PILOT/AIRCRAFT-INTEGRATION BY ADVANCED CONTACT ANALOG DISPLAYS**
V. Wilckens *In* MIT Proc. of the 9th Ann. Conf. on Manual Control 1973 p 175-192 refs

CSCL 01D

Several expert statements selected from literature and concerning the qualities of modern information displays lead to the definition of a number of requirements which should be covered by the displays of the future. It is shown that abstract displays principally cannot fulfill all these demands and that simply superimposing abstract symbols with the natural view of the outside world or with it's artificial equivalent will not result in an optimum solution. Some test results are shown for confirmation of the concept; special and general problems are touched. Author

**N75-19165** Polish Academy of Sciences, Warsaw.
**COMPUTATION OF AIRFOIL DRAG PROFILES [OBLICZENIA OPORU PROFILOW LOTNICZYCH]**
Zenon Nowak 1974 39 p refs In POLISH
(Rept-35/1974) Avail: Issuing Activity

An algorithm is described for the automatic calculation of the drag coefficients of airfoil profiles at an angle of attack value not greater than a few degrees, a given value of the Reynolds number, and the value of the Mach number near zero. The computation also supports the classical theory of boundary layers. A computer program is presented in ALGOL 1204 language together with a description of its usage. Transl. by M.J.S.

**N75-19166** Stanford Univ., Calif.
**FLAPPING RESPONSE CHARACTERISTICS OF HINGELESS ROTOR BLADES BY A GENERALIZED HARMONIC BALANCE METHOD Ph.D. Thesis**
David Allen Peters 1974 175 p
Avail: Univ. Microfilms Order No. 74-27083

Linearized equations of motion for the flapping response of flexible rotor blades in forward flight are derived in terms of generalized modal coordinates using the Rayleigh-Ritz method. The equations are sufficiently general to apply to hingeless or articulated rotors (with hinge offset and root spring restraint), including variable section properties and pitch-flap coupling. The aerodynamic model includes the reversed flow region, compressibility, and radial and azimuthal variations in the lift-curve slope. The basic physical characteristics of hingeless rotor response derivatives are examined. First, approximate expressions for certain rotor derivatives are obtained (with some simplifications and assumptions) to gain direct insight into hingeless rotor response mechanisms. Second, numerical results are presented to illustrate the relationships between basic rotor parameters and rotor response characteristics. Rotor response derivatives are then calculated using a variety of mathematical modeling assumptions to determine the sensitivity of the results to modeling approximations. Dissert. Abstr.

**N75-19167** Stanford Univ., Calif.
**ROTATION IN VIBRATION, OPTIMIZATION, AND AEROELASTIC STABILITY PROBLEMS Ph.D. Thesis**
Krishna Rao Venkata Kaza 1974 193 p
Avail: Univ. Microfilms Order No. 74-27045

The governing equations of motion for the study of vibration and dynamic stability of a rapidly rotating deformable body are developed starting from the nonlinear theory of elasticity. Vibration frequencies in perpendicular planes of a rotating uniform beam inclined at an arbitrary angle of the axis of rotation are calculated. A stability analysis of this beam is performed with the angle of inclination and rotational speed as parameters.

Optimum depth and the optimum mass distribution of a rotating beam with a fundamental flapping frequency and rotational speed is calculated using a numerical iterative method to solve the resulting two-point nonlinear boundary-value problem. The effect of steady coning angle and internal damping at the blade flapping hinge on whirl flutter stability in prop-rotors is investigated. The developed mathematical equations and their analyses are applied to wind tunnel models. The results indicate that these new parameters have a marked influence on stability, and that they change the critical flutter mode. The destabilizing effect of damping at the blade flapping hinge is discovered to be analogous to the effects of internal damping in gyroscopic systems.
Dissert. Abstr.

**N75-19168** Cincinnati Univ., Ohio.
**ANALYSIS OF THICK TURBULENT JET FLOWING ROUND: A CIRCULAR CYLINDER Ph.D. Thesis**
Sulaiman Owolabi Talabi 1974 123 p
Avail: Univ. Microfilms Order No. 74-27147

Analytical and experimental investigations of the flow of a thick, turbulent, and incompressible jet over a circular cylinder are carried out. A mathematical model which uses the concept of equivalent uniform velocity profile is constructed. Based on this model, radial and surface pressure distributions over the surface of the cylinder are predicted. Fekete and Guitton's empirical relation of the growth rate of turbulent jets flowing over curved surfaces is used in conjunction with some of the present experimental data to propose an analytical relation between the exit jet height and the angle of separation. Properties of the jet are studied and are graphically illustrated. Data on the separation angles for large ratios of exit jet height to radius of cylinder are also presented. Experimental data show that, at high Reynolds numbers, the separation angle is very sensitive to the ratio of exit height to cylinder radius when that ratio is about 0.33.
Dissert. Abstr.

**N75-19169** Tennessee Univ., Knoxville.
**STUDY OF TRANSONIC FLOW OVER VARIOUS BODIES Ph.D. Thesis**
Heinz Hermann Venghaus 1974 121 p
Avail: Univ. Microfilms Order No. 74-27245

Several inviscid transonic flow problems were analyzed and solved, by utilizing the high speed computer. The inviscid transonic flow over various frontbody-cylinder configurations, including small angles of attack, was calculated by the nonlinear-linear stretching scheme. A transonic flow theory for a conical flare was developed to determine the flow over a flared part of a body configuration in the lower transonic regime. The inviscid transonic flow field over a long cavity was calculated by a mixed finite difference scheme. An inverse computation method was applied to a compressible subsonic flow over a long cavity, to calculate the inviscid streamline to a given experimental surface pressure distribution. The method of characteristics was applied to an under-expanded jet exhaust flow for the determination of the plume boundary.
Dissert. Abstr.

**N75-19170** Pennsylvania State Univ., University Park.
**THE DYNAMIC RESPONSE OF AIRCRAFT ENCOUNTERING AIRCRAFT WAKE TURBULENCE Ph.D. Thesis**
Robert Charles Nelson 1974 170 p
Avail: Univ. Microfilms Order No. 74-28974

This investigation deals with the dynamic behavior of an airplane encountering aircraft wake turbulence. A digital computer simulation was developed to study the response of an aircraft flying into a trailing vortex wake. The simulation includes the complete six degree of freedom equations of motion, a description of the vortex velocity field, unsteady aerodynamics, and pilot control input. The parameters, varied in this simulation, include the penetration angle, separation distance, aircraft size (for both the penetrating and generating aircraft), and pilot control input (single- or multi-axes). Predicted vortex induced motions are presented for a variety of probe aircraft. The probe aircraft selected are representative of general aviation, business, and light jet transport type aircraft. The aircraft used to generate the vortex wakes are representative of the commercial transport fleet. The computer predictions indicate that relatively large aircraft (light jet transport) can experience unacceptable vortex-induced roll excursions.
Dissert. Abstr.

**N75-19171** Arizona Univ., Tucson.
**UNSTEADY VISCOUS FLOW PAST A LIFTING PLATE Ph.D. Thesis**
Robert Anthony Schmall 1974 200 p
Avail: Univ. Microfilms Order No. 74-28305

A technique for the analysis of unsteady viscous fluid flows past aerodynamic shapes is reported. The utility of this technique, called the vorticity source method, is demonstrated by application to the two-dimensional, constant property flow created by a finite chord flat plate that is impulsively accelerated from rest to a constant velocity. The plate is maintained at a constant angle of attack alpha, as measured between the plate chord and the velocity vector of the plate. The flow field development with time is calculated, using numerical solutions to the vorticity transport equation. The fluid far from the plate is at rest. Adopting elements of inviscid aerodynamic theory, the velocity field is related to the vorticity field through the Biot-Savart Law. The method also allows the numerical computations to be confined to the region of non-zero vorticity near the plate. This latter consideration is an advantage not found in conventional approaches based on the stream function.
Dissert. Abstr.

**N75-19172*#** Iowa State Water Resources Research Inst., Ames. Engineering Research Inst.
**INVISCID TO TURBULENT TRANSITION OF TRAILING VORTICES**
James D. Iversen Nov. 1974 30 p refs
(Grant NsG-2040; ERI Proj. 1146-S)
(NASA-CR-142298; ISU-ERI-Ames-74241) Avail: NTIS HC $3.75 CSCL 01A

The characteristics of the plateau region in the vortex system which trails from a lifting wing are discussed. The decay of the vortex due to viscous or turbulent shear is very slow in the plateau so that the maximum tangential speed in the vortices remains nearly constant for some distance downstream of roll-up and then begins to decrease, becoming inversely proportional to the square root of the distance downstream. Mathematical models are developed to analyze the structure of the plateau area. Solutions are obtained for both constant and variable eddy viscosity models.
Author

**N75-19173*#** MacNeal-Schwendler Corp., Los Angeles, Calif.
**IMPROVEMENTS TO THE SADSAM COMPUTER PROGRAM FOR AEROELASTICITY ANALYSIS**
Robert G. Schwendler Mar. 1975 29 p refs
(Contract NAS1-12017)
(NASA-CR-132617) Avail: NTIS HC $3.75 CSCL 01A

A computer program for calculating the elastic element forces and strain energy distribution for normal mode shapes is presented. The subjects discussed are: (1) revised aerodynamic force representation, (2) flap aerodynamics, (3) chordwise motions and aerodynamic forces, (4) wing-tail interaction, and (5) gust analysis. An aircraft configuration used in sample gust analysis is included.
Author

**N75-19174#** National Aerospace Lab., Tokyo (Japan).
**A METHOD FOR PREDICTING UNSTEADY AERODYNAMIC FORCES ON OSCILLATING WINGS WITH THICKNESS IN TRANSONIC FLOW NEAR MACH NUMBER 1. PART 1: TWO-DIMENSIONAL THEORY. PART 2: RECTANGULAR WINGS**
Koji Isogai Jun. 1974 35 p refs
(NAL-TR-368T-Pt-1; NAL-TR-368T-Pt-2) Avail: NTIS HC $3.75

An approximate method for predicting aerodynamic loadings on circular-arc airfoils oscillating in two-dimensional transonic flow at Mach number 1 or very near 1 is presented. Employing an idea analogous to the local linearization concept, a linear partial differential equation with variable coefficients for an unsteady small disturbance velocity potential is transformed into an approximate integral equation, which relates an unknown load distribution to a normalwash condition. A method for solving

the integral equation is discussed and its working form is given together with appropriate forms of the kernel functions for numerical evaluation. Aerodynamic forces on circular-arc airfoils oscillating at Mach number 1 are calculated for several values of thickness to chord ratio and compared with those predicted by the sonic theory. A considerable effect of the airfoil thickness on both the magnitudes and phase angles of the aerodynamic forces is found, especially in the reduced frequency range from 0 to 0.2, where flutter usually occurs. Aerodynamic forces predicted by the present method are applied to a flutter calculation of a rectangular wing, and the effects of airfoil thickness on the flutter speed, which were observed in the experiment, are well predicted by the present method. Author

**N75-19175#** Cranfield Inst. of Technology (England). Coll. of Aeronautics.

**LONGITUDINAL AERODYNAMIC DERIVATIVES OF A SLENDER DELTA WING RESEARCH AIRCRAFT EXTRACTED FROM FLIGHT DATA**

V. Klein Jul. 1974 85 p refs

(Cranfield-Aero-27) Avail: NTIS HC $4.75

The Maximum Likelihood parameter-estimation algorithm was used to extract the longitudinal aerodynamics derivative from flight data for the Handley Page HP 115 slender delta-wing research aircraft. The responses in the rate of pitch and vertical acceleration were excited from the horizontal steady-state flights at different air speeds by the elevon deflection. In some cases the measured time histories were converted into frequency response curves, from which the unknown parameters were estimated. For the low angle of attack measurements the linear model of the aircraft was adequate, whereas for the runs measured at high angle of attacks the non-linear model had to be used. Some indentifiability problems were met because of the limited number of measured outputs and incorrect design of the experiment. The non-dimensional aerodynamic derivatives extracted were compared with those from wind-tunnel tests and steady-state measurements. A reasonable degree of consistency between the various sets of results was obtained. Author

**N75-19176#** National Aerospace Lab., Tokyo (Japan).

**AN EXACT SOLUTION FOR TRANSONIC POTENTIAL FLOW PAST AEROFOIL SECTIONS**

Susumu Takanashi Aug. 1974 31 p refs In JAPANESE; ENGLISH summary

(NAL-TR-383) Avail: NTIS HC $3.75

A hodograph method is developed for obtaining exact solutions of transonic potential flow around lifting airfoils. The procedure of constructing compressible flows from incompressible flows is based on those of Lighthill and Nieuwland. In the present theory, however, the complex hodograph potential representing the starting incompressible flow is divided into two parts; one is a simple function which has the desired singularity of dipole and vortex at the point corresponding to infinity in the physical plane, and the other is chosen to be a regular function so that the total function represents a flow around a pseudo-elliptical body. This splitting of the solution has many advantages from the mathematical and computational points of view. The geometrical and aerodynamical characteristics of the resulting airfoils in the compressible flow are controlled by a number of parameters. A family of practically interesting transonic shock-free airfoils has been computed by changing the values of these parameters. An airfoil of this family was tested in the wind tunnel to compare with the theoretical prediction. Author

**N75-19177#** Cranfield Inst. of Technology (England). Coll. of Aeronautics.

**PARAMETER IDENTIFICATION APPLIED TO AIRCRAFT**

V. Klein [1974] 153 p refs

(Cranfield-Aero-26) Avail: NTIS HC $6.25

All three steps in the identification, namely characterization, parameter estimation and verification are considered and applied to the determination of aircraft parameters from flight data. The estimation procedure includes the equation error method and the output error method with the weighted least squares, maximum likelihood and Bayesian estimation technique. The problems concerning accuracy and identifiability are also discussed. A general computing algorithm is developed covering all estimation techniques described. It is applicable to linear as well as nonlinear systems and is flexible enough for the solution of various identifiability problems. Using this algorithm the computing program has been compiled in general terms to enable the user to achieve the objectives mentioned. As examples, the results of the identification of aircraft parameters and aerodynamic derivatives for four different aircraft are presented. They include the analysis of flight data from the Basset variable stability aircraft and the simulated data for a nonlinear model of the F-100 aircraft, and the flight data from the longitudinal motion of the HP-115 slender delta-wing research aircraft. Author

**N75-19178*#** TRW Systems, Redondo Beach, Calif. Applied Mechanics Dept.

**TRW VORTEX-LATTICE METHOD SUBSONIC AERODYNAMIC ANALYSIS FOR MULTIPLE-LIFTING-SURFACES (N. SURFACE) TRW PROGRAM NUMBER HA010B**

Antulio V. Gomez 1 Sep. 1972 266 p refs

(Contract NAS9-12330)

(NASA-CR-128588; TRW-20029-H110-R0-00) Avail: NTIS HC $8.50 CSCL 01A

The program was designed to provide solutions of engineering accuracy for determining the aerodynamic loads on single- or multiple-lifting-surface configurations that represent vehicles in subsonic flight, e.g., wings, wing-tail, wing-canard, lifting bodies, etc. The preparation is described of the input data, associated input arrangement, and the output format for the program data, including specification of the various operational details of the program such as array sizes, tape numbers utilized, and program dumps. A full description of the underlying theory used in the program development and a review of the program qualification tests are included. Author

**N75-19179*#** Kanner (Leo) Associates, Redwood City, Calif.

**DYNAMICS OF THE MOTION OF A BODY WITH ALLOWANCE FOR THE UNSTEADY STATE OF THE FLOW ABOUT IT**

S. M. Belotserkovskiy, Yu. A. Kochetkov, and V. K. Tomshin Washington NASA Feb. 1975 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Tverd. Tela (USSR), May-Jun. 1974 p 35-43

(Contract NASw-2481)

(NASA-TT-F-16133) Avail: NTIS HC $3.25 CSCL 01A

A numerical method and an approximate method based on the approximation of transient aerodynamic functions by exponential curves are proposed for the solution of the integrodifferential equations to which some dynamics problems reduce. The approximate method leads to systems of ordinary differential equations with constant coefficients. The methods are applied to solving three problems in flight dynamics. Solutions of exact equations are analyzed. Author

**N75-19180*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**INTEGRATION OF AFT-FUSELAGE-MOUNTED FLOW THROUGH ENGINE NACELLES ON AN ADVANCED TRANSPORT CONFIGURATION AT MACH NUMBERS FROM 0.6 TO 1.0**

Bernard J. Blaha Washington Mar. 1975 72 p refs

(NASA-TM-X-3178) Avail: NTIS HC $4.25 CSCL 01C

An approximately 1/30th-scale model of a CTOL aircraft designed for efficient cruise between Mach 0.9 and 0.98 was tested in the Lewis Research Center's 8- by 6-Foot Supersonic Wind Tunnel. Aft-fuselage axial force and pressure were measured for a series of locally area-ruled engine installations. Two flow-through nacelles with different exit diameters which simulated inlet mass flow ratios of 0.46 and 0.6 (based on maximum nacelle cross-sectional) area were investigated. Both an NACA-1 cowl and a blunter supercritical cowl were tested with these nacelles. Variations in the amount of local area ruling were investigated and an aft fuselage without nacelles was tested for reference. Results observed with flow-through nacelles indicate that efficient cruise may be obtained on this type of aircraft with aft-fuselage-mounted engine nacelles. Author

**N75-19181*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**EXPERIMENTAL AERODYNAMIC CHARACTERISTICS FOR A CYLINDRICAL BODY OF REVOLUTION WITH SIDE STRAKES AND VARIOUS NOSES AT ANGLES OF ATTACK FROM 0 DEGREES TO 58 DEGREES AND MACH NUMBERS FROM 0.6 TO 2.0**

Leland H. Jorgensen and Edgar R. Nelson Washington Mar. 1975 88 p refs

(NASA-TM-X-3130; A-5759) Avail: NTIS HC $4.75 CSCL 01A

For a body of revolution with afterbody side strakes, an experimental investigation was conducted in the Ames 6- by 6-Foot Wind Tunnel to determine the effects on the aerodynamic characteristics of forebody geometry, nose strakes, body side strakes, Reynolds number, Mach number, and angle of attack. Aerodynamic force and moment characteristics were measured for the straked cylindrical afterbody (cylinder fineness ratio of 7) with tangent ogive noses of fineness ratio 2.5 to 5.0. In addition, the straked cylinder afterbody was tested with an ogive nose having a rounded tip and an ogive nose with two different nose strake arrangements. The data demonstrate that the aerodynamic characteristics for a body of revolution with side strakes can be significantly affected by changes in nose fineness ratio, nose bluntness, Reynolds number, Mach number, and, of course, angle of attack. Removing the strakes from the cylindrical aftersection greatly decreased the lift, but this removal hardly changed the maximum magnitudes of the undesirable side forces that developed at angles of attack greater than about 25 deg for subsonic Mach numbers. Author

**N75-19182*#** Linguistic Systems, Inc., Cambridge, Mass.

**MECHANICS OF OPTIMUM THREE-DIMENSIONAL MOTION OF AIRCRAFT IN THE ATMOSPHERE**

L. M. Shkadov, R. S. Bukhanova, V. F. Illarionov, and V. P. Plokhikh Washington NASA Mar. 1975 288 p refs Transl. into ENGLISH of the book "Mekhanika optimalnogo prostranstvennogo dvizheniya letatelnykh apparatov v atmosfere" Moscow, Mashinostroyeniye Press, 1972 240 p

(Contract NASw-2482)

(NASA-TT-F-777) Avail: NTIS HC $8.75 CSCL 01C

The theoretical bases are presented for the method of investigating an optimum three-dimensional maneuver of a hypersonic aircraft with the use of aerodynamic forces in motion in the atmosphere of a planet. The application of the method is illustrated by the solution of a number of specific problems associated with the maneuver: maximization of lateral range (slant range) in the launching of an orbiting craft (missiles) (in the absence and in the presence of limitations with respect to the heating temperature of the structure); rotation of the plane of the orbit by means of aerodynamic forces, and landing at a given point on the earth's surface. Author

**N75-19183*#** Franklin Inst. Research Labs., Philadelphia, Pa.

**WIND TUNNEL TESTS OF A SYMMETRICAL AIRFOIL WITH SCOOP FED SLOTS**

Charles A. Belsterling Nov. 1974 55 p ref

(Contract NAS1-12451)

(NASA-CR-132568; FIRL-C-3741-2) Avail: NTIS HC $4.25 CSCL 01A

The design and wind tunnel test of a model vertical tail fin is described in this report. The model is designed to provide the aerodynamic forces necessary for lateral stabilization without moving parts or a separate source of power. It employs scoop-fed slots on both surfaces of the symmetrical airfoil. They are to be controlled differentially by means of a fluidic amplifier to implement an automatic fulltime lateral stabilization system. The results of tests show that the control of forces is stable and quite linear in various modes of operation. Significant forces were produced that can be increased as necessary by increasing slot size and scoop size. Slots can be located ahead of the conventional rudder and the scoop can be at the base of the vertical tail fin to avoid the need for major changes in conventional aircraft design. The first phase of the work demonstrated the feasibility of no-moving-parts aircraft control. The second phase established that a practical fluidic amplifier can be built to control slot flows from fluidic signals. Recommendations are made to optimize the design of the fluidic amplifier and to characterize its dynamic response in support of further analytical studies. Author

**N75-19184*#** Boeing Commercial Airplane Co., Seattle, Wash.

**LOW SPEED AND ANGLE OF ATTACK EFFECTS ON SONIC AND NEAR-SONIC INLETS**

T. E. Hickcox, R. L. Lawrence, J. Syberg, and D. R. Wiley Mar. 1975 207 p refs

(Contract NAS3-18035)

(NASA-CR-134778; D6-42392) Avail: NTIS HC $7.25 CSCL 01A

Tests of the Quiet, Clean Short-Haul Experimental Engine (QCSEE) were conducted to determine the effects of forward velocity and angle of attack on sonic and near-sonic inlet aerodynamic performance penalties and acoustic suppression characteristics. The tests demonstrate that translating centerbody and radial vane sonic inlets, and QCSEE high throat Mach number inlets, can be designed to operate effectively at forward speed and moderate angle of attack with good performance and noise suppression capability. The test equipment and procedures used in conducting the evaluation are described. Results of the tests are presented in tabular form. Author

**N75-19185#** Cambridge Univ. (England). Dept. of Engineering.

**LIFTING SURFACE THEORY FOR A ROTATING SUBSONIC OR TRANSONIC BLADE ROW**

M. Namba London ARC 1974 77 p refs Supersedes ARC-34126; ARC-34127 Sponsored in part by the Roy. Soc. of London

(ARC-R/M-3740; ARC-34126; ARC-34127) Avail: NTIS HC $4.75; HMSO £2.95; PHI $11.55

A lifting-surface method is presented for calculating the disturbance velocity and pressure fields as well as the aerodynamic lift distributions for a rotating thin blade row in a cylindrical duct at subsonic or transonic relative Mach numbers on the basis of an inviscid, isentropic, small disturbance three-dimensional flow theory. The most significant features of the method stem from a new mathematical treatment of the Fourier-Bessel double series, which consists of re-expanding radial eigenfunctions, i.e., Bessel functions, of an arbitrary circumferential order in terms of a set of radial eigenfunctions of the zero-th order in the same family. This permits the separation of the singular parts and the treatment of essentially a finite number of unknown parameters in solving the off-design problem. Some numerical examples of solutions of the off-design problem of a subsonic lifting blade row are presented, and the validity of the two-dimensional blade element concept, as well as the importance of various three-dimensional factors, are discussed. The analysis is also given for a transonic lifting blade row in which the relative Mach numbers at the blade tip exceed unity. The new mathematical treatment has turned out to be powerful in discriminating the supersonic singular parts from the subsonic ones. Numerical results are presented, which illustrate the comparison between the present lifting-surface theory and the strip theory and demonstrate the special features of the flows in transonic and supersonic axial compressors. It is found that the three-dimensional effects, i.e., the departure from the strip theory is greatest near the sonic radius. Author (ESRO)

**N75-19186#** East Anglia Univ., Norwich (England). School of Mathematics and Physics.

**FLOW PAST CONICALLY-CAMBERED SLENDER DELTA WINGS WITH LEADING-EDGE SEPARATION**

J. E. Barsby London ARC 1974 50 p refs Supersedes RAE-TR-72179; ARC-34435 Monitored by RAE, Farnborough, Engl.

(ARC-R/M-3748; RAE-TR-72179; ARC-34435) Avail: NTIS HC $3.75; HMSO £1.95; PHI $7.65

The vortex sheet model of leading edge separation previously applied to uncambered delta wings was applied to thin, conically cambered delta wings whose cross sections are circular arcs. The simplifications introduced by the use of slender body theory and an asymptotic treatment for the core of the vortex were

retained. Solutions were found showing a gradual growth of the leading edge vortex above the upper surface at incidences above that for attached flow for wings between the flat plate and the semi-circular cone. Variations of the shape and strength of the vortex sheet, the pressure distribution on the wing, and the lift and drag of the wing with camber and incidence are displayed. An attempt is made to relate the lifting efficiency of the wing to both the distribution of pressure over its surface and to the vorticity shed from its edges. The results support the choice of an attachment lift coefficient approximately half that at which the best performance is desired. Author (ESRO)

**N75-19187#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

**CALCULATIONS OF GENERALISED AIRFORCES ON TWO PARALLEL LIFTING SURFACES OSCILLATING HARMONICALLY IN SUBSONIC FLOW**

D. E. Davies London Aeron. Res. Council 1974 86 p refs Supersedes RAE-TR-72180; ARC-34466

(ARC-R/M-3749; RAE-TR-72180; ARC-34466) Avail: NTIS HC $4.75; HSMO £3.35; PHI $12.95

Two flat parallel surfaces, oscillating harmonically about a mean configuration were immersed in a uniform subsonic main stream in a direction parallel to the surfaces. The linearized equations of potential flow were assumed to be valid, so that the upwash on the surfaces could be related to the loading on the surfaces by means of a pair of integral equations. This pair of integral equations was solved, by collocation, for approximations to the loadings in terms of given upwashes and these approximations were used to ovaluate generalized airforces. The results were compared with some results obtained by other numerical procedures and with some experimental results. Author (ESRO)

**N75-19188#** Royal Aircraft Establishment, Farnborough (England). Aerodynamic Dept.

**NOTES ON THE APPROXIMATE SOLUTION OF LIFTING-SURFACE THEORY USED IN THE RAE STANDARD METHOD**

J. Weber London ARC 1974 71 p refs Supersedes RAE-TR-73044; ARC-34766

(ARC-R/M-3752; RAE-TR-73044; ARC-34766) Avail: NTIS HC $4.25; HMSO £2.80; PHI $11.00

The downwash induced by planar vorticity distributions was computed by exact linear theory and by the RAE Standard Method to examine the accuracy of the approximate method. The results on wings of infinite span with load distributions which are uniform across the span were used to derive a modification of the downwash equation of the approximate method. It is shown that this modification can explain some of the difference between the exact and the approximate results for the spanwise lift coefficient distribution of a plane wing of infinite span at an angle of incidence. The downwash distributions on finite wings of constant chord, unswept and sweptback by 45 degrees, with given load distributions, computed by the exact and the approximate method are compared. The lift distribution for wings of given shape derived by the approximate method is also compared with more accurate results. Author (ESRO)

**N75-19189#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

**BOUNDARY-LAYER PRESSURE FLUCTUATIONS AT HIGH REYNOLDS NUMBERS ON A SECOND FREE-FLIGHT TEST VEHICLE**

D. R. Roberts London Aeron. Res. Council Feb. 1974 103 p refs Supersedes RAE-TR-74029; ARC-35404

(ARC-CP-1302; RAE-TR-74029; ARC-35404) Avail: NTIS HC $5.25; HMSO £1.70; PHI $6.75

Measurements were made of the boundary layer pressure fluctuations at two positions on the body of a free flight aerodynamic test vehicle powered by a solid fuel rocket motor. The vehicle reached a maximum Mach number of 2.2 with a maximum Reynolds number of about 118 millions at the front measuring station and 207 millions at the rear. Pressure spectra were deduced, and were found to compare reasonably with a theoretical spectrum. The scale of the boundary layer turbulence fluctuates appreciably but is for the most part between 30% and 80% of the turbulence boundary layer thickness for all Mach numbers up to 2.2. The root mean square boundary layer pressure reduced with Mach number from about 0.01 times the free stream dynamic pressure at M = 1 to about 0.003 at M = 2.2, the front station tending to be slightly the higher at each Mach number. Author (ESRO)

**N75-19191#** Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

**CALCULATION OF TWO-DIMENSIONAL AND AXISYMMETRIC BLUFF BODY POTENTIAL FLOW**

P. W. Bearman and J. E. Fackrell Oct. 1974 44 p refs Sponsored partly by a Donald Campbell Res. Fellowship

(IC-Aero-74-07) Avail: NTIS HC $3.75

A numerical method for calculating the incompressible potential flow external to a bluff body and its wake is presented. The effect of the wake is modeled by placing sources on the rear of the wetted surface of the body. The body shapes that can be treated are not limited by the restrictions imposed by the use of conformal transformation. The wetted surface of the body is represented by a distribution of discrete vortices. Good agreement was found between the pressure distributions predicted by the numerical method and the analytic expressions of Parkinson and Jandali for a two-dimensional circular cylinder, flat plate and ellipse. The method was extended to axisymmetric bluff bodies and the results show good agreement with measured pressure distributions on a circular disc and a sphere.

Author (ESRO)

**N75-19192#** Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

**A WAKE SOURCE MODEL FOR AN INCLINED FLAT PLATE IN A UNIFORM STREAM**

M. E. Davies Sep. 1974 14 p refs Sponsored by Sci. Res. Council

(IC-Aero-74-08) Avail: NTIS HC $3.25

The wake-source potential flow model for bluff bodies, suggested by Parkinson and Jandali, was extended to the nonsymmetric case of an inclined flat plate in a uniform stream. For angles of inclination up to 60 or 70 degrees, the theory predicts the surface pressure distribution to a reasonable degree of accuracy (normal flat plate alpha 0). Author (ESRO)

**N75-19193#** Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

**ON THE CALCULATION OF NON-LINEAR AERODYNAMIC CHARACTERISTICS AND THE NEAR VORTEX WAKE**

Josef Rom, Carlos Zorea, and Rachel Gordon Aug. 1974 18 p refs Presented at the 9th Proc. of Congr. Intern. Council of Aeron. Sci., Haifa, Israel, 25-30 Aug. 1974

(Grant AF-AFOSR-2145-71; AF Proj. 9781)

(AD-A002161; AFOSR-74-1766TR; ICAS-Paper-74-27) Avail: NTIS CSCL 01/1

This investigation presents methods for the calculation of the distribution of vortices on the wing planform and on the trailing vortex wake by iterative procedures based on the application of the vortex lattice method concepts. In the case when the trailing vortices are taken to leave the wing at the trailing edge only the calculation results in determining the linear aerodynamic characteristics and the shape of a rolled up wake. The present investigation considers the cases when the vortices from each cell are allowed to leave the wing planform at a fixed angle, and the case when the vortex shedding can be limited to the planform edges only. In these cases non-linear aerodynamic characteristics are evaluated. The corresponding trailing vortex wakes were first calculated by using discrete ideal vortices. It is now proposed to use a finite core vortex model thereby eliminating some of the numerical problems associated with the use of the ideal vortices. GRA

**N75-19194#** Army Aviation Systems Test Activity, Edwards AFB, Calif.

**NATURAL ICING TESTS. UH-1H HELICOPTER Final Report**

Warren E. Griffith, II, Marvin L. Hanks, Carl F. Mittag, and James S. Reid Jun. 1974 36 p refs
(AD-A002077; USAASTA-74-31) Avail: NTIS CSCL 01/2

A limited evaluation of the capability of a modified UH-1H helicopter to fly in a natural icing environment was conducted at Fort Lewis, Washington, from 5 February through 23 February 1974. Testing was performed by the United States Army Aviation Systems Test Activity and consisted of 1.7 hours in icing conditions. During this test, four enhancing features, one deficiency, and one shortcoming were noted. There were four enhancing features associated with special equipment. The deficiency is the inability to maintain autorotational rotor speed within operational limits with main rotor ice accumulation. The striking of the tail rotor by the oscillating iced FM antenna is a shortcoming. Based on these tests, artificial icing characteristics observed in previous UH-1H icing tests are representative of natural icing characteristics. The UH-1H helicopter does not possess the capability to operate safely in an icing environment. GRA

**N75-19195#** Summa Corp., Culver City, Calif. Hughes Helicopter Div.
**DYNAMIC LOADS AND STRUCTURAL CRITERIA STUDY Final Report, Dec. 1973 - May 1974**
K. R. Spreuer, S. J. Snackenburg, and G. D. Roeck Sep. 1974 131 p refs
(Contract DAAJ02-74-C-0018; DA Proj. 1F1-62208-AH-90)
(AD-A001739; HH-74-124; USAAMRDL-TR-74-74) Avail: NTIS CSCL 01/3

This report presents the results of a 6-month technical effort to develop a realistic mission profile for each of six helicopter types in current and future Army inventories: observation, utility, utility/tactical assault, attack, crane, and transport. The profiles included in this report are the product of operational data gathered over two decades, starting with early NACA efforts and including extensive studies conducted by the Army Air Mobility R and D Laboratory and private enterprise. GRA

**N75-19197** Stanford Univ., Calif.
**ANALYSIS OF IN-FLIGHT DISINTEGRATION ACCIDENTS Ph.D. Thesis**
Frederick Harold Matteson 1974 316 p
Avail: Univ. Microfilms Order No. 74-27058

Patterns of wreckage resulting from the disintegration of aircraft in flight have been studied to aid in accident investigations. Emphasis has been given to general aviation accidents where economic losses are highest and showing little improvement, and where flight recorders are seldom used. Idealized wreckage patterns were generated by solution of ballistic trajectory equations for bodies with differing terminal velocities. Effects of changes in initial flight and wind variables on simultaneous distintegrations in atmospheres with uniform winds were shown by means of easily comprehended diagrams. The technique was then extended to progressive breakups and to the effects of altitudinal variations in the wind speed and direction, using wind profiles based on meteorological records. Dissert. Abstr.

**N75-19198#** Stanford Research Inst., Menlo Park, Calif.
**FEASIBILITY OF LASER SYSTEMS FOR AIRCRAFT LANDING OPERATIONS UNDER LOW VISIBILITY CONDITIONS Final Report**
William Viezee, John Oblanas, and Myron Glaser 11 Oct. 1974 116 p refs
(Contract DOT-FA73WA-3214; SRI Proj. 2831)
(AD-A005637; FAA-RD-74-190) Avail: NTIS HC $5.25

The effects of currently recommended eye-safety standards and of atmospheric scattering on the potential application of lasers to the low-visibility aircraft approach and landing operational environment are assessed. It is concluded that these two criteria are serious handicaps in any proposed development of a laser landing guidance system. The two criteria are interrelated: the application of high power, narrow beam lasers to overcome the large attenuation in dense fog increases the eye-safety hazard, whereas a lowering of laser power to guarantee eye-safety drastically reduces the distance over which the laser beam can be used effectively. Since the scattering coefficient during conditions of fog is essentially independent of wavelength, no laser wavelength that also falls within an absorption-free 'window', appears to be significantly better than any other wavelength as far as penetration in fog is concerned. The results of our evaluation of lasers as visual cues or optical guidance systems are based primarily on the performance characteristics of optical lasers under operationally important low-visibility conditions. Author

**N75-19199#** Princeton Univ., N.J. Dept. of Aerospace and Mechanical Science.
**GENERAL AVIATION AIRCRAFT SAFETY**
Oct. 1974 150 p Presented at Princeton Univ. Conf. Meeting no. 119, Princeton, N. J., 24-25 Oct. 1973 Sponsored by FAA
(AD-A003124; FAA-RD-74-154) Avail: NTIS HC $6.25

The proceedings of a conference on General Aviation Aircraft Safety are presented. Emphasis was placed on current research and development efforts in the areas of airworthiness and crashworthiness. The cost and regulatory implications of increased safety were examined. The general aviation accident record was reviewed to show accident patterns and pilot error influences. The prospects for improved safety records were discussed to show the contributions which can be made by the manufacturers. For individual titles, see N75-19200 through N75-19207.

**N75-19200** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**ANALYSIS OF GENERAL AVIATION ACCIDENT RECORDS**
Charles O. Miller *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 5-11

The system for investigating aircraft accidents involving general aviation aircraft is discussed. The functions of the National Transportation Safety Board are defined. The procedures for processing data pertaining to general aviation aircraft are examined to show the manner in which the information is used to improve flight safety. Data are tabulated to show the rank and percentage of general aviation aircraft during 1970, 1971, and 1973 based on accidents caused by: (1) personnel, (2) weather, (3) power plant, (4) terrain, and (5) airframe. Author

**N75-19201** Federal Aviation Administration, Washington, D.C.
**GENERAL AVIATION ACCIDENT PATTERNS**
Donald E. Kemp *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 12-16

The importance of aircraft design and standardization to the education and prevention of aircraft accidents is discussed. Several examples of aircraft accidents resulting from lack of standardization of aircraft controls are presented. The importance of education and training for flying personnel as an accident prevention measure are stressed. Author

**N75-19202** Ohio State Univ., Columbus. Dept. of Aviation.
**THE ACCIDENT RECORD IN TERMS OF THE PILOT**
Jack J. Eggspuehler *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 17-36

General aviation aircraft accidents are reviewed from the standpoint of pilot performance and pilot error. The importance of adequate pilot education and training to prevent aircraft accidents is stressed. Several examples of aircraft accidents which resulted from incorrect pilot decisions and actions are presented. Author

**N75-19203** Federal Aviation Administration, Washington, D.C.
**CRASH SURVIVABILITY**
P. Frank Castellon *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 37-45

A research project to improve the crash survivability of general aviation aircraft is discussed. Structural design criteria for aircraft components which will aid in crash survival are described. Various restraint mechanisms such as seat belts, shoulder harnesses, air

bags, and combinations of these devices are examined. Test equipment for conducting full scale drop and impact tests of aircraft to evaluate restraint equipment is proposed. Author

**N75-19204** Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
**GENERAL AVIATION HANDLING QUALITIES RESEARCH**
David R. Ellis *In its* Gen. Aviation Aircraft Safety Oct. 1974 p 46-58

Research projects to reduce the accident rate for general aviation aircraft by improving aircraft control and handling qualities are discussed. Various items of aircraft equipment which are designed to provide solutions to control problems are described. Flight tests of specific aerodynamic configurations to determine the effectiveness of modifications to control surfaces are reported. Efforts to improve the landing safety of aircraft under adverse conditions are reported. Author

**N75-19205*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**DESIGN CONSIDERATIONS FOR STALL/SPIN AVOIDANCE**
Seth B. Anderson *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 59-76

The paper discusses three aspects of the stall/spin problem: (1) aerodynamic effects, (2) stall warning, and (3) stall limiting. The results show that the stall/spin problem could be alleviated by good handling qualities up to and beyond the stall, careful selection of aerodynamic parameters which promote spin-resistance, adequate stall warning methods and stall margins, and an acceptable form of limiting elevator effectiveness near the maximum coefficient of lift. Author

**N75-19206** Federal Aviation Administration, Washington, D.C.
**ECONOMICS: GENERAL AVIATION COST FACTORS**
Gene S. Mercer *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 94-100

A study to determine the economic factors which influence the growth of general aviation was conducted. Emphasis was placed on the costs arising from changes in the Federal regulatory environment and higher Federal aviation user charges. The study developed a data base of ownership and operating costs in each segment of general aviation. Regression equations were developed which related the demand for aircraft and flight hours to the appropriate cost categories. Charts are included to show the various factors in aircraft operation which have an economic impact. Author

**N75-19207** General Aviation Manufacturers Association, Washington, D.C.
**MANUFACTURER'S OVERVIEW**
Edward W. Stimpson *In* Princeton Univ. Gen. Aviation Aircraft Safety Oct. 1974 p 117-120

The contribution of aircraft manufacturers to improved safety of general aviation aircraft is discussed. An analysis of the overall accident rate for general aviation aircraft is presented. Federal and state programs to provide better navigation aids and terminal facilities are reported. Research projects conducted by aircraft manufacturers to provide increased aircraft reliability are reported. Author

**N75-19208*#** Manned Systems Sciences, Inc., Northridge, Calif.
**A STUDY OF CARBURETOR/INDUCTION SYSTEM ICING IN GENERAL AVIATION ACCIDENTS Final Report**
Richard W. Obermayer and William T. Roe Mar. 1975 47 p refs
(Contract NAS4-2191)
(NASA-CR-143835) Avail: NTIS HC $3.75 CSCL 01B

An assessment of the frequency and severity of carburetor/induction icing in general-aviation accidents was performed. The available literature and accident data from the National Transportation Safety Board were collected. A computer analysis of the accident data was performed. Between 65 and 90 accidents each year involve carburetor/induction system icing as a probable cause/factor. Under conditions conducive to carburetor/induction icing, between 50 and 70 percent of engine malfunction/failure accidents (exclusive of those due to fuel exhaustion) are due to carburetor/induction system icing. Since the evidence of such icing may not remain long after an accident, it is probable that the frequency of occurrence of such accidents is underestimated; therefore, some extrapolation of the data was conducted. The problem of carburetor/induction system icing is particularly acute for pilots with less than 1000 hours of total flying time. The severity of such accidents is about the same as any accident resulting from a forced landing or precautionary landing. About 144 persons, on the average, are exposed to death and injury each year in accidents involving carburetor/induction icing as a probable cause/factor. Author

**N75-19209#** Royal Aircraft Establishment, Farnborough (England).
**THE STRADA FLIGHT PATH TRACKING SYSTEM**
J. P. Marvillet and J. L. Jouzeau Jan. 1975 29 p refs Transl. into ENGLISH from Aeronaut. Astronaut (Paris), v. 35, no. 3, 1972 p 19-29
(RAE-Lib-Trans-1813; BR46822) Avail: NTIS HC $3.75

A summary of the required performance and a general description of the STRADA system is given along with a detailed study of the LIDAR components. The problems related to system reliability and to propagation in the atmospheric medium are solved. The performance and the fields of application of the optimized test facility as regards cost, efficiency, and ease of operation are considered. Author

**N75-19210#** Air Force Special Weapons Center, Kirtland AFB, N.Mex.
**TIEDOWN TESTS FOR AIR TRANSPORT OF THE XM542 SPRINT CONTAINER Final Report, Apr. - May 1974**
Grant W. Gray Oct. 1974 25 p ref
(AF Proj. 921C)
(AD-A001844; AFSWC-TR-74-27) Avail: NTIS CSCL 15/5

Aircraft tiedown configurations for transport of the XM542 Sprint container in the C-5A, C-130, and C-141 aircraft were designed and tested by the Air Force Special Weapons Center (AFSWC). The developed tiedown configurations, test procedures, test data, and test observations are presented. GRA

**N75-19211#** Cincinnati Univ., Ohio.
**USERS MANUAL FOR UCIN VEHICLE OCCUPANT CRASH STUDY MODEL, VERSION 2 Technical Report, 1 Jun. - 1 Dec. 1974**
Chris E. Passerello, Ronald L. Huston, and Mark W. Harlow 2 Dec. 1974 34 p refs
(Contract N00014-72-A-0027-0002; NR Proj. 122-303)
(AD-A001801; UC-EA-120174-3) Avail: NTIS CSCL 01/2

The manual briefly describes the model and the range of applicability of the program. It provides detailed instructions regarding the card coding of input data. It discusses the interpretation of the out-put results. A sample listing of input data is also provided. GRA

**N75-19212#** EDMAC Associates, Inc., East Rochester, N.Y.
**TACAN/DME DIGITAL DATA BROADCAST DESIGN PLAN. VOLUME 5: FLIGHT TEST PROGRAM Final Report**
Sep. 1974 33 p
(Contract DOT-FA72WA-3080)
(AD-A001405/0; FAA-RD-74-161-5) Avail: NTIS HC $3.75

The digital data broadcasting design plan implements the system engineering process for the purpose of defining ground/airborne equipment configuration and flight test program. This plan documents an approach to verify the operational significance and technical feasibility of utilizing existing DME and TACAN to provide the function of broadcasting data to aircraft for use in support of area navigation in addition to its normal function. Author

**N75-19213#** EDMAC Associates, Inc., East Rochester, N.Y.
**TACAN/DME DIGITAL DATA BROADCAST DESIGN PLAN. VOLUME 1: OPERATIONAL ANALYSIS Final Report**
Sep. 1974 79 p
(Contract DOT-FA72WA-3080)
(AD-A001403/5; FAA-RD-74-161-1) Avail: NTIS HC $4.75

**N75-19214#** Mitre Corp., McLean, Va.
**MULTI-SITE INTERMITTENT POSITIVE CONTROL ALGORITHMS FOR THE DISCRETE ADDRESS BEACON SYSTEM**
A. L. McFarland 30 Sep. 1974 267 p refs
(Contract DOT-FA70WA-2448)
(AD-A001112/2; MTR-6742; FAA-EM-74-4) Avail: NTIS HC $8.50 CSCL 17/7

Complete detailed computer algorithms for implementing Intermittent Positive Control within a multi-site Discrete Address Beacon System network are presented. Author

**N75-19216#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**PROVISIONAL MESSAGE FORMATS FOR THE DABS/NAS INTERFACE (REVISION 1)**
D. Reiner and H. F. Vandevenne 10 Oct. 1974 46 p refs Supersedes FAA-RD-74-63 Revised
(Contracts DOT-FA72WAI-261; F19628-73-C-0002; FAA Proj. 034-241-012)
(FAA-RD-74-63-A; ATC-33-Rev-1; FAA-RD-74-63) Avail: NTIS HC $3.75

Formats for message are defined which are to be transmitted between DABS and NAS facilities (en route or terminal). These messages include one way surveillance reports to NAS and two way communications messages. The latter support data link functions between NAS and DABS equipped aircraft, as well as aiding in the monitoring and control of DABS sensors. Author

**N75-19217#** Royal Aircraft Establishment, Farnborough (England).
**HELICOPTER ROTOR-PRODUCED MODULATION AND AERIAL FIELD DISTRIBUTION IN THE BAND 30 TO 76 MHz**
W. W. Langrish and D. P. L. May Jul. 1974 200 p
(RAE-TR-74032; BR42417) Avail: NTIS HC $7.00

A comprehensive investigation into the cause and effect of rotor produced modulation was made in order to assess its consequences in the performance of frequency modulated systems of communication. The investigation included detailed measurements of the polar field patterns of two airborne antennas of a similar type, one mounted above and the other below the helicopter fuselage. The investigation was carried out in connection with a particular communications project, but the results described are applicable to a wide range of airborne systems of future design since the general case can be predicted from the information. Author (ESRO)

**N75-19219#** Michigan Univ., Ann Arbor. Radiation Lab.
**DUAL BAND AIRBORNE ANTENNA STUDY Final Report, 30 Jun. 1973 - 28 Feb. 1974**
Joseph E. Ferris Oct. 1974 110 p
(Contract DAAB07-73-C-0337)
(AD-A002043; UMICH-012126-1-F; ECOM-73-0337-F) Avail: NTIS CSCL 09/5

The design and fabrication of two antenna systems is described and experimental results are presented. Each includes two antennas, one of which operates in the C band and the other operates at Ku band. Both antennas in the first system are vertically polarized while those in the second system are horizontally polarized. The antenna systems are designed for airborne use and they are interchangeable with respect to the physical mounting arrangements. Extensive data is given on pattern characteristics, on interband isolation, on gain and on the input VSWR. GRA

**N75-19220#** Naval Air Development Center, Warminster, Pa.
**FLIGHT TEST EVALUATION OF SECANT VECAS COLLISION AVOIDANCE SYSTEM Final Report**
Michael Raditz, Oscar Shames, James Hinds, and Patrick Finnegan
Nov. 1974 262 p refs
(AD-A002281; NADC-74207-60) Avail: NTIS CSCL 17/7

SECANT (Separation and Control of Aircraft using nonsynchronous techniques) is a candidate for a national standard collision avoidance system. The VECAS (Vertical Escape Collision Avoidance System) version was evaluated for ability to communicate accurately and with sufficient distance to provide timely and correct advisories and maneuver commands in simulated high traffic density. GRA

**N75-19221** Stanford Univ., Calif.
**AERODYNAMIC DESIGN OF A ROTOR BLADE FOR MINIMUM NOISE RADIATION Ph.D. Thesis**
Yung Hoon Yu 1974 87 p
Avail: Univ. Microfilms Order No. 74-27141

An analysis of the aerodynamic design of a hovering rotor blade for obtaining minimum aerodynamic rotor noise has been carried out. Attention is given only to rotational noise due to pressure fluctuations on blade surfaces. A functional relation between the pressure distribution along the blade span and the radiated noise is developed. From this relation, along with constraint equations concerning given levels of aerodynamic performance such as given total lift and drag, one may deduce, by utilizing the variational method, an optimum shape of the lift distribution. Results are presented to show that the noise field is considerably affected by the shape of the lift distribution along the blade and that noise reduction of about 5 db may be obtained by designing the rotor blade to yield minimum noise. Dissert. Abstr.

**N75-19222*#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**ACOUSTIC TRANSMISSION THROUGH A FUSELAGE SIDEWALL**
J. F. Wilby and T. D. Scharton [1974] 79 p refs
(Contract NAS1-11839)
(NASA-CR-132602; BBN-2742) Avail: NTIS HC $4.75 CSCL 20A

A study was conducted to define an idealized fuselage sidewall structure and to construct a simplified analytical model for determining acoustikal transmission from exterior to interior of the fuselage. The structural model chosen for the study consists of a double wall system connected by line supports. The double wall has curvature in one direction but is assumed to be infinite in extent in the other direction. Diffuse acoustic plane waves are used as a representation of the excitation field. The transmission of acoustical energy through the sidewall is considered in terms of resonant and non-resonant response. The analytical model is used to estimate the noise levels expected in an aircraft with a high lift propulsion system. Author

**N75-19223*#** Kanner (Leo) Associates, Redwood City, Calif.
**PROBLEMS OF DESIGNING PASSENGER AIRCRAFT**
V. M. Sheynin and V. I. Kozlovskiy Washington NASA Mar. 1975 306 p refs Transl. into ENGLISH of the book "Problemy proyektirovaniya passazhirskikh samoletov" Moscow, Mashinostroyeniye Press, 1972 308 p
(Contract NASw-2481)
(NASA-TT-F-808) Avail: NTIS HC $9.25 CSCL 01C

Problems of passenger aircraft design, tracing tendencies from the past through the present, and presenting forecasts for the future are examined. Problems are approached primarily from the standpoint of increasing economic effectiveness, with a goal of improving passenger-cargo mixes, operating expenses and thresholds of profitability. The work goes into problems of different configurations with respect to engine placement, advantages of different types of engines, empennage configuration, layout of passenger and cargo space and thrust- and lift-to-weight-ratios. The most attention is paid to standard jet passenger airplanes and air-buses, but Short Takeoff and Landing (STOL) and Vertical Takeoff and Landing (VTOL) airplanes are also discussed with respect to their use in relatively undeveloped areas. Author

**N75-19224*#** Boeing Commercial Airplane Co., Seattle, Wash.
**FUEL CONSERVATION POSSIBILITIES FOR TERMINAL AREA COMPATIBLE AIRCRAFT Final Report**
Mar. 1975 234 p refs
(Contract NAS1-12018)
(NASA-CR-132608; D6-22421) Avail: NTIS HC $7.50 CSCL 01C

Design features and operational procedures are identified, which would reduce fuel consumption of future transport aircraft. The fuel-saving potential can be realized during the last decade of this century only if the necessary research and technology programs are implemented in the areas of composite primary structure, airfoil/wing design, and stability augmentation systems. The necessary individual R and T programs are defined. The sensitivity to fuel usage of several design parameters (wing geometry, cruise speed, propulsion) is investigated, and the results applied to a candidate 18, 140-kg (40,000-lb) payload, 5556-km (3000-nmi) transport design. Technical and economic comparisons are made with current commercial aircraft and other advanced designs. Author

**N75-19225#** Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
**SHEAR LAG ANALYSIS OF THICK SKIN AIRCRAFT STRUCTURES**
Grant P. Steven Sep. 1974 36 p refs
(ATN-7404) Avail: NTIS HC $3.75

With the increasing thickness of the stiffened skin panels in aircraft structures it is found that the traditional method of diffusion analysis for concentrated loads is inadequate. A closed form theory is developed which allows the skin to take up its direct stress stiffness in a more natural manner rather than lumping it in with the longitudinal stiffeners. The results of this solution are compared with experimental and finite element results and it is found to offer significant improvements both in predicting the diffusion and the maximum shear stress in the skin panel. This latter aspect is of importance when the buckling strength of the skin panel in shear is under consideration. Author

**N75-19226*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LOW-SPEED WIND-TUNNEL TESTS OF A 1/10-SCALE MODEL OF A BLENDED ARROW ADVANCED SUPERSONIC TRANSPORT An Early Domestic Dissemination Report**
H. Clyde McLemore and Lysle P. Parlett Mar. 1975 70 p refs
(Proj. FEDD)
(NASA-TM-X-72671) Avail: NASA Industrial Applications Centers only to U.S. Requesters: HC $4.25/MF $2.25 CSCL 01C

Tests were conducted in the Langley full-scale tunnel to determine the low-speed aerodynamic characteristics of a 1/10-scale model of a blended-arrow advanced supersonic transport. Tests were made for the clean configuration and a high-lift configuration with several combinations of leading and trailing-edge flaps deflected for providing improved lift and longitudinal stability in the landing and takeoff modes. The tests were conducted for a range of angles of attack from -6 deg to 30 deg, sideslip angles from -5 deg to 10 deg, and for Reynolds numbers from 6,780,000 to 13,850,000 corresponding to test velocities of 41 knots to 85 knots. Author

**N75-19227#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**A COMPARISON OF FLIGHT LOADS COUNTING METHODS AND THEIR EFFECTS ON FATIGUE LIFE ESTIMATES USING DATA FROM CONCORDE**
Ann G. Goodwillie London Aeron. Res. Council 1974 66 p refs Supersedes RAE-TR-73200; ARC-35297
(ARC-CP-1304; RAE-TR-73200; ARC-35297) Avail: NTIS HC $4.25; HMSO £1.15; PHI $4.90

Four load-time histories of turbulence encountered by Concorde are analyzed by six different peak-counting and level-crossing counting procedures. The frequency distributions obtained are then used to find fatigue life ratios using the Miner-Palmgren hypothesis of cumulative damage. Results show that those methods which consider every level crossed or every peak encountered give shorter life estimates than those which disregard all minor intermediate load fluctuations. Those which depend upon threshold conditions occupy an intermediate position. Correlation and spectral analyses are also conducted for each flight. Author (ESRO)

**N75-19228#** General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
**ENVIRONMENTAL AND OPERATING REQUIREMENTS FOR FIRE EXTINGUISHING SYSTEMS ON ADVANCED AIRCRAFT Final Report, 25 Jun. 1973 - 25 Jan. 1974**
J. D. McClure and R. J. Springer Sep. 1974 161 p refs
(Contract F33615-73-C-2071)
(AD-A001640; JTCG/AS-74-T-002; AFAPL-TR-73-122) Avail: NTIS CSCL 01/3

Fire extinguishing systems for the advanced aircraft to 1980 will be required to operate efficiently over a wider range of environmental conditions than ever before. To determine what these environmental conditions will be for engine nacelles and adjacent compartments, a study was performed using an existing high performance aircraft. Using this aircraft, its operational parameters were extrapolated out to the advanced aircraft environment. This study defines the environment in which the fire extinguishing system will be required to operate, primary and secondary fire zones, ignition sources, combustibles, and fire extinguishing agent requirements. GRA

**N75-19230#** Army Aviation Systems Command, St. Louis, Mo.
**MAJOR ITEM SPECIAL STUDY (MISS), UH-1C TAIL ROTOR BLADE Final Report, Jan. 1964 - Dec. 1973**
Nov. 1974 22 p
(AD-A001714; USAAVSCOM-TR-74-47) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components. These are time change items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From this data, removal distribution can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas. GRA

**N75-19231#** Army Aviation Systems Test Activity, Edwards AFB, Calif.
**VIBRATION AND TEMPERATURE SURVEY PRODUCTION AH-1G HELICOPTER Final Report, 12 Sep. - 29 Nov. 1973**
Emmett J. Laing and Arnold E. Weand, Jr. Mar. 1974 370 p refs
(AD-A002063; USAASTA-70-15-5) Avail: NTIS CSCL 01/3

The objective of the entire environmental test project is to determine quantitative vibration and temperature environment data for all present-day Army helicopters. The objective of the AH-1G environmental survey was to determine the vibration and temperature environment of the AH-1G instruments, avionics, selected components, and the crew stations under all normal operating conditions. GRA

**N75-19232#** Army Aviation Systems Command, St. Louis, Mo.
**CH-47A ASSESSMENT AND COMPARATIVE FLEET EVALUATION: EXECUTIVE SUMMARY REPORT Final Report**
Nov. 1974 168 p
(AD-A002057; USAAVSCOM-TR-74-46) Avail: NTIS CSCL 01/3

The purpose of the executive summary is to provide an overview and summarization of the CH-47A assessment. The parameters presented provide management perspective of the CH-47A fleet, in addition to comparative fleet evaluations. Various presentations of reliability and maintainability related parameters give the present system posture of the CH-47A fleet. Model designation series assessment and comparative fleet evaluations are covered in this report. Quality and command program assessments and the command statistics and problem summary are the other reports which make up the total executive summary for the CH-47A. GRA

**N75-19234#** California Univ., Los Angeles. Dept. of System Sciences.
**AN AIRCRAFT APPLICATION OF SYSTEM IDENTIFICATION IN THE PRESENCE OF STATE NOISE**
Kenneth W. Iliff 1974 16 p refs Presented at NATO Advan. Study Inst., New Direc. in Signal Process. in Commun. and Control, Darlington, England, 5-17 Aug. 1974
(Grant AF-AFOSR-2492-73; AF Proj. 9769)
(AD-A001936; AFOSR-74-1756TR) Avail: NTIS CSCL 01/2

A maximum likelihood estimator for a linear system with state and observation noise is developed to determine unknown aircraft coefficients from flight data in the presence of turbulence (state noise). The formulation of the algorithm is presented briefly. The linear equations for an aircraft in atmospheric turbulence are defined. The effectiveness and accuracy of the technique are assessed by first applying it to simulated flight data, in which the true parameter values are known, then to actual flight data obtained in turbulence. A complete set of aircraft coefficients is obtained as well as an estimate of the turbulence time history. The validity of the estimated state noise and of the estimated coefficients is tested. The feasibility of using the algorithm for defining an adaptive control law to alleviate the effects of turbulence on the aircraft is discussed. GRA

**N75-19235#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
**DESIGN AND FATIGUE TESTING OF INTEGRAL ARMORED SERVO ACTUATOR MODIFIED TRUNNION Final Report**
K. Wood and L. Moriarty Oct. 1974 38 p
(Contract DAAJ02-74-C-0013; DA Proj. 1F2-62205-AH-88)
(AD-A002069; SER-64383; USAAMRDL-TR-74-80) Avail: NTIS CSCL 01/3

The program summarized by this report was conducted to design and establish the structural strength of a modified trunnion design for the integral armored servo actuator. The originally designed trunnion was found to have a fatigue strength below the mean strength level of comparable CH-54B parts as reported in USAAMRDL Technical Report 73-25. The design analysis and fatigue test data show that the modified trunnion is comparable in strength to the mean strength levels of the equivalent components on the production CH-54B helicopter. GRA

**N75-19236#** Technology, Inc., Dayton, Ohio.
**OPERATIONAL USE OF THE UH-1 H HELICOPTERS IN ARCTIC ENVIRONMENT Final Report, 16 Oct. 1972 - 15 Feb. 1974**
Raymond B. Johnson, Jr. and Ruth E. Meyers Aug. 1974 465 p refs
(Contract DAAJ02-73-C-0014; DA Proj. 1F1-62208-AH-90)
(AD-A002603; USAAMRDL-TR-74-65) Avail: NTIS CSCL 01/3

For the continued study of Army helicopter operations, a multichannel operational usage data program was conducted on two UH-1H helicopters flying assorted missions in the arctic environment from December 1972 to April 1973. During this period, 88 hours of valid in-flight data were recorded and processed for each of 15 time-related parameters. These parameters were selected to reflect the operational usage of the helicopters. Two zechniques, the Four Mission Segment and the Flight Condition Recognition (FCR) methods, were used in processing and analyzing the data. The ultimate objective was to improve the fatigue analyst's understanding of the operational flight spectrum of U.S. Army helicopters and its effect in defining reliable design criteria for helicopters. GRA

**N75-19237#** Grumman Aerospace Corp., Bethpage, N.Y.
**AN IMPROVED AUTOMATED STRUCTURAL OPTIMIZATION PROGRAM Final Report, 27 Mar. 1973 - 30 Aug. 1974**
Walter J. Dyer, Sep. 1974 158 p refs
(Contract F33615-73-C-3086; AF Proj. 1467)
(AD-A002688; AFFDL-TR-74-96) Avail: NTIS CSCL 01/3

This volume presents the results of an effort to modify, expand and improve the usefulness of ASOP (Automated Structural Optimization Program), originally documented in AFFDL TR-70-118. The new version of the program is named ASOP-2. GRA

**N75-19238#** Army Materiel Command, Alexandria, Va.
**ENGINEERING DESIGN HANDBOOK. HELICOPTER ENGINEERING, PART 1: PRELIMINARY DESIGN**
30 Aug. 1974 876 p refs
(AD-A002007; AMCP-706-201-Pt-1) Avail: NTIS CSCL 01/3

This handbook discusses the design requirements applicable to Army helicopters for all missions under visual flight rule (VFR) operation, day or night. As such, the scope of this document has been limited to cover the basic aerial vehicles. Design requirements for mission-essential equipment--e.g., weapons, sensors, cargo-handling equipment--are beyond this scope and are not discussed, although the helicopter-integral interface requirements for such equipment are included. The design of power plants, batteries, generators or alternators, and similar components, are also beyond the scope of the handbook. GRA

**N75-19239#** Advanced Technology Labs., Inc., Westbury, N.Y.
**MULTI-SLOT FILM COOLING OF SUPERSONIC AIRCRAFT USING AIR AS A COOLANT Final Technical Report, 4 Jun. 1973 - 3 May 1974**
John I. Erdos and John D. Ranlet Jul. 1974 96 p refs
(Contract F33615-73-C-3132; AF Proj. 1366)
(AD-A002673; ALT-TR-202; AFFDL-TR-74-85) Avail: NTIS CSCL 01/3

The study evaluates multi-slot film cooling using air as an active coolant for thermal protection of aircraft surfaces under conditions of steady-state (cruise) operation at supersonic speeds and low to moderate altitudes. In-flight refrigeration of captured atmospheric air using a turbocooler, as described, is assumed to be the only practical means of providing the required continuous supply of cold air. Therefore the properties of the coolant have been described in terms of the vehicle flight conditions and the efficiency of a turbocooler. A computer program has been developed based on the described analysis which determines the slot locations necessary to protect a surface to a specified maximum adiabatic wall temperature at a given set of primary flow conditions. GRA

**N75-19241#** Instrument Flight Center, Randolph AFB, Tex.
**HAROWE ALTITUDE WARNING SYSTEM EVALUATION Final Report**
Edwin G. Webb, Jr. and Gabriel P. Intano Nov. 1974 15 p refs
(AD-A002583; IFC-TR-74-7) Avail: NTIS CSCL 01/2

A pilot factors evaluation of the Harowe altitude warning system was conducted to determine its acceptability for use in Air Force aircraft. The system has the primary function of assisting pilots in attaining and maintaining assigned or desired command altitudes. A secondary function, decision height mode, was incorporated in the AWS to examine the concept of altitude warning during landing approaches. Ten sorties were flown in a North American T-39 Sabreliner. Pilots were selected from the IFC and instrument pilot instructor school student population. The normal mode of operation was found acceptable for aiding pilots in leveling at and maintaining desired altitudes. The accuracy of the normal mode was acceptable and with further development of the decision height mode, the Harowe system would be acceptable for installation in Air Force aircraft. GRA

**N75-19243*#** Avco Lycoming Div., Stratford, Conn.
**DEVELOPMENT OF SELF-ACTING SEALS FOR HELICOPTER ENGINES**
Peter Lynwander Oct. 1974 72 p refs
(Contract NAS3-16823)
(NASA-CR-134739; LYC-74-55) Avail: NTIS HC $4.25 CSCL 11A

An experimental evaluation of a NASA-designed self-acting face seal for use in advanced gas turbine main shaft positions was conducted. The seal incorporated Rayleigh step pads (self-acting geometry) for lift augmentation. Satisfactory performance of the gas film seal was demonstrated in a 500-hour endurance test at speeds to 183 m/s (600 ft/sec, 54,000 rpm) and air pressure differential of 137 newtons per square centimeter (198.7 psi). Carbon wear was minor. Tests were also conducted with seal seat runout greater than that expected in engine operation and in a severe sand and dust environment. Seal operation was satisfactory in both these detrimental modes of operation. Author

**N75-19244*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PRELIMINARY EVALUATION OF TURBOFAN CYCLE PARAMETERS AND ACOUSTICAL SUPPRESSION ON THE NOISE AND DIRECT OPERATING COST OF A COMMERCIAL MACH 0.85 TRANSPORT**
J. D. Eisenberg Feb. 1975 48 p refs
(NASA-TM-X-71664; E-8239) Avail: NTIS HC $3.75 CSCL 20A

A study was made of the effects of turbofan cycle parameters and the use of acoustic noise suppression material to quiet 200 passenger, Mach 0.85 trijets having design ranges of 2778, 4630, and 9260 kilometers (1500, 2500, and 5000 n. mi). Aircraft gross weight and direct operating cost, which varied with amount of suppression and cycle selection, are presented as functions of both EPNdB traded and 90 EPNdB contour footprint area. Noise levels 10.9 EPNdB below FAR 36 requirements result in a 5 percent increase in DOC for an aircraft designed for a range of 9260 kilometers (5000 n. mi.). An aircraft designed for a 2778 kilometer (1500 n. mi.) range would have an EPNdB level 14 below FAR 36 for this same economic penalty. In this range of noise level, fan-machinery noise is the principal source. Author

**N75-19245*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METAL MATRIX COMPOSITES FOR AIRCRAFT PROPULSION SYSTEMS**
Robert A. Signorelli 1975 24 p refs Presented at Intern. Conf. on Composite Mater., Geneva, 7-11 Apr. 1975 and Boston, 14-18 Apr. 1975
(NASA-TM-X-71685; E-8280) Avail: NTIS HC $3.25 CSCL 21E

Studies of advanced aircraft propulsion systems have indicated that performance gains and operating costs are possible through the application of metal matrix composites. Compressor fan blades and turbine blades have been identified as components with high payoff potential as a result of these studies. This paper will present the current status of development of five candidate materials for such applications. Boron fiber/aluminum, boron fiber/titanium, and silicon carbide fiber/titanium composites are considered for lightweight compressor fan blades. Directionally solidified eutectic superalloy and tungsten wire/superalloy composites are considered for application to turbine blades for use temperatures to 1100 C (2000 F). Author

**N75-19246*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**INFLUENCE OF MULTITUBE MIXER NOZZLE GEOMETRY ON CTOL-OTW JET NOISE SHIELDING**
U. VonGlahn and D. Groesbeck 1975 21 p refs Presented at 89th Meeting of the Acoust. Soc. of Am., Austin, Tex., 8-11 Apr. 1975
(NASA-TM-X-71681; E-8275) Avail: NTIS HC $3.25 CSCL 20A

Acoustic shielding benefits for CTOL over-the-wing (OTW) applications were obtained experimentally with various multitube nozzles using a simple board to represent a wing. Eight nozzles consisting of three to thirteen 2.36-cm diameter tubes were tested. The nozzles included single and double rings of tubes. Shielding surface lengths of 15.0 to 54.4 cm were used with each nozzle. Far-field noise data were obtained at 90 deg from the jet axis and with a nominal jet exhaust velocity of 200 m/sec. The jet noise shielding benefits for the nozzles with double rows of tubes, in terms of sound pressure level spectra, are correlated successfully as a function of an earlier developed parameter for nozzles with a single ring of tubes that includes consideration of the number of tubes and the local peak velocity in the flow field at the trailing edge of the shielding surface. Author

**N75-19247*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**COMPARISON OF PARAMETRIC DUCT-BURNING TURBOFAN AND NON-AFTERBURNING TURBOJET ENGINES IN A MACH 2.7 TRANSPORT**
John B. Whitlow, Jr. Mar. 1975 73 p refs
(NASA-TM-X-71679; E-8269) Avail: NTIS HC $4.25 CSCL 21E

A parametric study was made of duct-burning turbofan and suppressed dry turbojet engines installed in a supersonic transport. A range of fan pressure ratios was considered for the separate-flow-fan engines. The turbofan engines were studied both with and without jet noise suppressors. Single- as well as dual-stream suppression was considered. Attention was concentrated on designs yielding sideline noises of FAR 36 (108 EPNdB) and below. Trades were made between thrust and wing area for a constant takeoff field length. The turbofans produced lower airplane gross weights than the turbojets at FAR 36 and below. The advantage for the turbofans increased as the sideline noise limit was reduced. Jet noise suppression, especially for the duct stream, was very beneficial for the turbofan engines as long as duct burning was permitted during takeoff. The maximum dry unsuppressed takeoff mode, however, yielded better results at extremely low noise levels. Noise levels as low as FAR 36-11 EPNdB were obtained with a turbofan in this takeoff mode, but at a considerable gross weight penalty relative to the best FAR 36 results. Author

**N75-19248*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**INTERIOR NOISE CONSIDERATIONS FOR POWERED-LIFT STOL AIRCRAFT**
C. Kearney Barton Apr. 1975 19 p refs
(NASA-TM-X-72675) Avail: NTIS HC $3.25 CSCL 01C

Powered-jet configuration which are under development for use on STOL aircraft involve impingement of the jet engine exhaust onto wing and flap surfaces. The impinging jet produces higher noise levels at lower frequencies than does the jet alone. These higher levels, together with the close proximity of the engine and flap noise sources to the fuselage sidewall, suggest that the noise levels in these aircraft may be high enough to interfere with passenger comfort. To investigate this possibility, interior noise levels were estimated for both an upper surface blown and an externally blown flap configuration. This paper describes the procedure used to estimate the interior noise levels is described these levels are compared with levels on existing jet aircraft and on ground transportation vehicles. These estimates indicate high levels in the STOL aircraft; therefore, areas of possible improvements in technology for control of STOL interior noise are also discussed. Author

**N75-19249#** Goodyear Tire and Rubber Co., Akron, Ohio.
**INVESTIGATION OF 14.5mm API SELF-SEALING/CRASHWORTHY FUEL TANK MATERIAL Final Report, Jun. 1973 - Jun. 1974**
E. J. Koski and H. F. Villemain Sep. 1974 30 p refs
(Contract DAAJ02-73-C-0099)
(AD-A001752; GTR-19-927; USAAMRDL-TR-74-78) Avail: NTIS CSCL 13/4

This final report describes the results of a program for a crashworthy, 14.5mm API tolerant fuel cell construction developed and subjected to qualification testing. GRA

**N75-19250#** General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.
**INVESTIGATION OF AIRCRAFT COMBUSTOR NOISE Final Report, Jun. 1973 - Apr. 1974**
W. R. Semrau and D. E. Frye, Jr. Sep. 1974 413 p refs
(Contract DAAJ02-73-C-0088; DA Proj. 1G1-72207-AA-110) (AD-A001737; DDA-EDR-8225; USAAMRDL-TR-74-73) Avail: NTIS CSCL 21/5

Current combustor design technology depends primarily upon empirical correlation and past experimental experience of the designers. There is a continuing need for knowledge of the combustion process and how the different design and performance parameters are related. The objective of this program was to investigate the feasibility of measuring combustor noise and then relating the noise levels by correlation curves to other pertinent performance parameters, such as combustor efficiency, and mass emissions. GRA

**N75-19251#** Avco Lycoming Div., Stratford, Conn.
**PLT 27 GAS TURBINE ENGINE EXHAUST EMISSION AND NOISE MEASUREMENTS Final Report, 21 May - 31 Dec. 1973**
Phillip M. Rubins, Edward Auerbach, and Jochen A. Deman Sep. 1974 111 p refs
(Contract DAAJ02-73-C-0068; DA Proj. 1G1-62204-AA-71) (AD-A001728; LYC-74-7; USAAMRDL-TR-62204-AA-71) Avail: NTIS CSCL 21/5

The results of the exhaust gas emission analysis show that the exhaust gases have a low content of unburned combustion products, i.e., hydrocarbons and carbon monoxide, down to idle power due to the high combustion efficiency of this engine. The combustion efficiency is 99.5 percent at idle and 99.9 percent above 10 percent of maximum-rated power. The smoke numbers of the PLT 27 engine are extremely low. No visible smoke was produced at any power setting with any of the injector systems tested. The PLT 27 engine meets the exhaust gas emission standards set by the EPA for 1979 for fixed-wing aircraft. GRA

**N75-19252#** European Space Research Organization, Paris (France).
**DETERMINATION OF AIRCRAFT CHARACTERISTICS FROM FLIGHT TESTS**
Nov. 1974 260 p refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 295 p Proc. of Joint Session of DGLR Specialist Comm. "Flight Characteristics and Flight Test Tech.", Brunswick, 10-12 Oct. 1972
(ESRO-TT-104; DLR-Mitt-73-25) Avail: NTIS HC $8.50; ZLDI, Munich 61.95 DM

Different procedures for the analysis of flight test data in order to obtain stability characteristics are presented. Methods discussed include: time vectors, forced oscillations, analog matching, and regression analysis. Notwithstanding the considerable difficulties in data measurement, the task of evaluating aircraft characteristics from flight data is indispensable for setting up reliable mathematical models to describe the dynamic behavior of the aircraft.

**N75-19254** European Space Research Organization, Paris (France).
**COMPARISON OF EVALUATION PROCEDURES FOR THE DETERMINATION OF FLIGHT-MECHANICAL COEFFICIENTS AND DERIVATIVES FROM FLIGHT TESTS**
H. Friedrich *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 7-16 refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 15-28

The analysis of data from flight tests of a Fiat G.91-T3 aircraft is discussed. A survey is presented of possible evaluation methods of which five methods were selected. A description is given of the procedures adopted. ESRO

**N75-19255** European Space Research Organization, Paris (France).
**MANUAL EVALUATION OF SPECIAL FLYING MANEUVERS FOR THE DETERMINATION OF FLIGHT-MECHANICAL COEFFICIENTS AND DERIVATIVES FROM FLIGHT TESTS**
U. VonMeier *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 17-32 refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 29-50

Manual data analysis procedures of G.91-T3 aerodynamic characteristics are described. The aircraft was fitted with equipment designed to measure the derivatives in non-steady flight, consisting of measurement units, a recording system and a data conversion unit. The measurement of the dynamic longitudinal stability is discussed. The method used for evaluation of the lateral motion is described. A simplified evaluation of special flying maneuvers is considered. ESRO

**N75-19257** European Space Research Organization, Paris (France).
**DETERMINATION OF AERODYNAMIC DERIVATIVES OF THE FIAT G-91 T3 AIRCRAFT FROM FLIGHT TESTS BY MEANS OF MANUAL ANALOG MODEL MATCHING**
A. Pietrass *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 58-87 refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 81-110

Aerodynamic derivatives of the FIAT G-91 T3 aircraft were determined by evaluating the results of flight tests in accordance with the method of the manual variation of the model parameters in the analog computer (analog model matching). The test flights were carried out at an altitude of 20,000 ft and at Mach numbers of 0.4 and 0.8. The results often deviate significantly from the values deduced from the manufacturer's data, this being particularly true as regards the lateral motion. Author (ESRO)

**N75-19258** European Space Research Organization, Paris (France).
**EVALUATION OF FLIGHT TEST OF THE FIAT G-91 T3 BY MEANS OF THE METHOD OF FORCED OSCILLATIONS**
H. J. Munser *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 88-106 ref Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 111-132

The G.91-T3 aircraft was actuated to perform harmonic oscillations, in order to determine its stability characteristics. Sets of equations were derived in order to calculate the stability derivatives for each degree of freedom. The method was tested with simulated, and flight test data. It is concluded that the method of forced oscillations is not particularly suitable for fully automatic evaluation. ESRO

**N75-19259** European Space Research Organization, Paris (France).
**EVALUATION OF FLIGHT TESTS OF THE FIAT G-91 T3 BY MEANS OF REGRESSION ANALYSIS**
H. Friedrich *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 107-137 ref Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 133-168

The experiences made in applying regression analysis are summarized. Regression analysis is a refined mathematical

program that undertakes the breakdown of the aerodynamic coefficients into the components due to the individual variables and at the same time eliminates any stochastic errors. All the derivations can be obtained on one run. Attempts at practical evaluation are described. ESRO

**N75-19260** European Space Research Organization, Paris (France).
**A SAAB-SCANIA DEVELOPED METHOD FOR OBTAINING STABILITY DERIVATIVES FROM FLIGHT TESTS**
G. Niss *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 138-153 ref Transl. into ENGLISH of "Bestimmunng von Flugzeugkenndaten aus Flugversuchen" DGLR, Cologne, DLR-Mitt-73-25, 1973 p 169-184

The method used is an assembly of procedures from other known methods. Parameters needed for the analyses are available from onboard analog tape recordings. The tapes are converted to digital computer tapes at the same time as all the scaling and other instructions are fed into the process. The time intervals to be processed are also defined. After corrections have been made the process continues with calculation of forces and moments. Digital simulation in 6 degrees of freedom is used as a validity check. ESRO

**N75-19261** European Space Research Organization, Paris (France).
**CHARACTERISTICS OF THE AJ 37 AIRCRAFT: COMPARISON OF THE RESULTS OF WIND TUNNEL AND FLIGHT TESTS**
G. Straeng *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 154-170 Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 185-202

Comparison of aerodynamic coefficients obtained from wind tunnel measurements with results of flight tests is possible only in individual cases, since wind tunnel models have a rigidity or elasticity not corresponding to that of the aircraft. Elasticity correction must, therefore, be carried out. The method used for the AJ 37 aircraft is briefly described. A satisfactory agreement was found between coefficients obtained from flight tests and the ones calculated from corrected wind tunnel tests. ESRO

**N75-19262** European Space Research Organization, Paris (France).
**SOME ASPECTS OF PERFORMANCE MEASUREMENTS IN NONSTEADY FLIGHT**
J. A. Mulder *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 171-190 refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 203-222

The principle of determining the angle of attack and the rate of climb from measurements in nonsteady flight is described. It is shown that small zero-shifts of the inertial transducers would result in unacceptable errors in the calculated angle of attack and in rate of climb. A flight path reconstruction technique yielding estimates of the zero-shifts turns out to be the keypoint of the flight test technique presented. ESRO

**N75-19263** European Space Research Organization, Paris (France).
**DETERMINATION OF THE PARAMETERS OF A SYSTEM OF EQUATIONS OF MOTION FROM FLIGHT TEST DATA**
H. U. Schaeufele *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 191-212 refs Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 223-248

The method of least squares can be used for the determination of the parameters of a system of differential equations. It is shown that good results can be obtained with this method. A subsequent iteration aims at improving the parameters calculated with the help of the method of least squares. A new procedure for the iterative determination of the parameters of a system of differential equations is described; the new method is simpler than other procedures of this type known at present. Author (ESRO)

**N75-19265** European Space Research Organization, Paris (France).
**DETERMINATION OF DERIVATIVES BY A MODEL WITH AUTOMATIC PARAMETER**
R. Koehler *In its* Determination of Aircraft Characteristics from Flight Test (ESRO-TT-104) Nov. 1974 p 224-239 Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 261-278

An analog circuit that continuously adapts the model parameters to the unknown system characteristic values is used to determine the derivatives of an aircraft from flight data. The results of an evaluation with a linear and a nonlinear model are discussed. Author (ESRO)

**N75-19266** European Space Research Organization, Paris (France).
**SELECTED EXAMPLES OF THE EVALUATION OF VAK 191 B FLIGHT TESTS**
R. Burdorf *In its* Determination of Aircraft Characteristics from Flight Tests (ESRO-TT-104) Nov. 1974 p 240-254 Transl. into ENGLISH of "Bestimmung von Flugzeugkenndaten aus Flugversuchen", DGLR, Cologne, DLR-Mitt-73-25, 1973 p 279

A method is described enabling determination of the roll control characteristic of the VAK 191 B aircraft from measured values obtained during hovering flight. The basic magnitude is the rotational velocity as measured by the rate gyro, its variations in time approximated by means of a polynomial that is then differentiated. The effect of the discretization of the measured values as a result of data transmission is investigated. The rotational acceleration obtained consists of the desired control acceleration and aerodynamic disturbances. The disturbances occurring during these flights were estimated with a simulation program for the VAK 191 B aircraft, thereby determining the control characteristic. ESRO

**N75-19267#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**DETERMINATION OF THE RUDDER POWER AND DIRECTIONAL STABILITY OF THE FAIREY DELTA 2 AIRCRAFT USING A WINGTIP PARACHUTE**
G. Ingle London Aeron. Res. Council 1974 34 p refs Supersedes RAE-TR-73025; ARC-34852
(ARC-CP-1298; RAE-TR-73025; ARC-34852) Avail: NTIS HC $3.75; HMSO 65p; PHI $2.75

The wingtip parachute technique was used to extract a rudder power derivative for the Fairey Delta 2 research aircraft. The flight tests revealed that the derivative has a considerably smaller value than tunnel tests suggested, and it is believed that this is due to the aeroelasticity of the fin and rudder, and possibly to unrepresentative flow over the rear of the wind-tunnel model. Once the derivative was obtained, a directional stability derivative was derived on the assumption that the rudder power derivative was small. The values of the directional stability derivative obtained by this technique agree well with those from other flight tests and reasonably well with tunnel test results. Author (ESRO)

**N75-19268#** Army Foreign Science and Technology Center, Charlottesville, Va.
**HELICOPTER FLIGHT REGIMES**
G. Samoilov 17 Aug. 1974 18 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika (USSR), no. 11, 1972 p 20-21, 26-27
(AD-A001220; FSTC-HT-23-299-74) Avail: NTIS CSCL 01/2

The article deals with steady regimes of helicopter flight. The first and the second regimes of a steady he. opter flight are described. Horizontal flights as well as other rectilinear states such as climbs and engine descent are studied. A significant part of the article is devoted to steady turns and some unsteady flight regimes such as acceleration and slowing down. GRA

**N75-19269#** Princeton Univ., N.J. Instrumentation and Control Lab.

**FLIGHT PATH CONTROL AND PERFORMANCE ANALYSIS, PHASES 1 AND 2. INTEGRATED DISPLAY, PHASE 3 Final Report**

G. J. Born, T. A. Dukes, E. J. Durbin, and P. B. Sun Jul. 1974 114 p refs

(Contract DAAB07-72-C-0161)

(AD-A002014; ECOM-0161-72-F) Avail: NTIS CSCL 01/3

The question of symbology superimposed on an image display for low level flying is explored. Three formats of symbology superimposed on a TV image display have been developed, based on the ITED (Integrated Trajectory Error Display). A helicopter performance and control model developed earlier is reviewed. A gas turbine engine model is developed, first for the ideal turbine, and then modified for a practical engine mounted in a helicopter. Three modifications of the S-ITED (Superimposed Integrated Trajectory Error Display) are described. These changes have been made to improve the integration of the symbology with the image display. The modified display is described in the form of a briefing for simulator test subjects. GRA

**N75-19271*#** Calspan Corp., Buffalo, N.Y.

**A STUDY FOR ACTIVE CONTROL RESEARCH AND VALIDATION USING THE TOTAL IN-FLIGHT SIMULATOR (TIFS) AIRCRAFT**

Robert T. N. Chen, Hamilton Daughaday, Dominick Andrisani, II, Robert D. Till, and Norman C. Weingarten Apr. 1975 164 p refs

(Contract NAS1-13329)

(NASA-CR-132614; AK-5560-F-1) Avail: NTIS HC $6.25 CSCL 14B

The results of a feasibility study and preliminary design for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft are documented. Active control functions which can be demonstrated on the TIFS aircraft and the cost of preparing, equipping, and operating the TIFS aircraft for active control technology development are determined. It is shown that the TIFS aircraft is as a suitable test bed for inflight research and validation of many ACT concepts. Author

**N75-19274#** Royal Aircraft Establishment, Farnborough (England).

**REAL-TIME SIMULATION OF JET ENGINES WITH A DIGITAL COMPUTER(1), FABRICATION AND CHARACTERISTICS OF THE SIMULATOR**

K. Nishio, N. Sugiyama, T. Koshinuma, T. Hashimoto, T. Ohata, and H. Ichikawa 18 Sep. 1974 53 p refs Transl. into ENGLISH from Japanese report

(RAE-Lib-Trans-1768; BR46783; NAL-TR-283(1972)) Avail: NTIS HC $4.25

The fabrication and performances of a real-time jet engine simulator using a digital computer are reported along with simulation test results. Actual engine test data for the lift jet engine JR-100H are included. Author

**N75-19278#** University of Southern Calif., Los Angeles. Behavioral Technology Labs.

**FIELD EVALUATION OF MODEL 2 OF THE COMPUTER-BASED, INDIVIDUAL TRAINER FOR THE RADAR INTERCEPT OFFICER Final Report, 1 Jan. - 31 Dec. 1974**

Joseph W. Rigney, D. Kirk Morrison, Louis A. Williams, and Douglas M. Towne Jul. 1974 58 p refs

(Contract N61339-73-C-0065; ARPA Order 2310)

(AD-A002705; NAVTRAEQUIPCEN-73-C-0065-2) Avail: NTIS CSCL 05/9

Model II of the basic skills intercept trainer for Radar Intercept Officers was evaluated in a school environment. Model II incorporated different instructional sequencing logic, additional weaponry capability, and additional graphic features from Model I (developed under a previous project). These added features were designed to assist the student in understanding the intercept geometry and in learning to use the B-scan display. One (N-31) of two random groups practiced on a trainer with these additional graphics, the other group (N-29) used a version of the trainer without these features. The group using the enhanced trainer took longer and required more problems to satisfy the trials-to-criterion logic used in the practice session. All students expressed predominantly favorable attitudes toward the trainer. Results are discussed, and recommendations are offered. GRA

**N75-19367*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**PROCESSABLE HIGH TEMPERATURE RESISTANT POLYMER MATRIX MATERIALS**

Tito T. Serafini 1975 20 p refs Presented at Intern. Conf. on Composite Mater., Geneva, 7-11 Apr. 1975

(NASA-TM-X-71682; E-7324) Avail: NTIS HC $3.25 CSCL 11D

Studies conducted with addition-type polyimides are reviewed with emphasis on the development of the Polymerization of Monomer Reactants (PMR) approach, in which PMR occurs on the surface of the reinforcing fibers. Author

**N75-19413#** National Aerospace Lab., Tokyo (Japan).

**ON FATIGUE CRACK ARRESTING BY A STOP-HOLE IN 2024-T3 ALUMINUM ALLOY SHEET SPECIMENS**

Hiroyuki Terada and Yoshiaki Kakuta 1974 18 p refs In JAPANESE; ENGLISH summary

(NAL-TR-359) Avail: NTIS HC $3.25

Attempts made to find out the most effective way to arrest the fatigue crack by the stop-hole are reported. The influence of the following three parameters on the crack propagation life was studied; the size of the stop-hole, the distance between the front edge of the stop-hole and the tip of the crack occured, and the crack length at the moment of repair. Single edge notched sheet specimens of 2024-T3 aluminum alloy were tested under partially tensile fatigue loads with constant stress amplitudes. Conclusions drawn from the study show: (1) repairing fatigue cracks of shorter length is more effective; and (2) the radius of the stop-hole must be large enough to release the stress near the crack tip sufficiently. The distance between the front edge of the stop-hole and the tip of the fatigue crack occurring must be short enough to leave sufficient residual width and to leave an effective residual compressive stress region around the crack tip. Author

**N75-19414#** National Aerospace Lab., Tokyo (Japan).

**RELATION BETWEEN SCATTER OF FATIGUE LIFE AND S-N CURVE IN AIRCRAFT STRUCTURAL ALUMINIUM ALLOY 2024-T4**

Toshiyuki Shimokawa and Yasumasa Hamaguchi Apr. 1974 10 p refs In JAPANESE; ENGLISH summary

(NAL-TR-360) Avail: NTIS HC $3.25

The accumulated effect on fatigue life of the experimental conditions, the material properties in its virgin state, and the cumulative process of damage in cyclic loading was investigated as an error in the applied stress. This concept was applied to the results of a series of fatigue tests on unnotched sheet specimens of aircraft structural aluminum alloy 2024-T4. Firstly, the S-N curve, where N is the median fatigue life, was determined from a series of experimental results. The equivalent stress of each specimen, which is considered to be the sum of the applied stress and its estimated error, was calculated from the S-N curve and the fatigue life of each specimen. The distribution of tye equivalent stress is quantitatively evaluated. Secondly, using the order statistics and assuming the distribution of the equivalent stress to be normal, the fatigue life distribution having the same scatter as that obtained in the experiment was introduced from the S-N curve and the assumed equivalent stress distribution. The interrelation between the scatter of the equivalent stress, the S-N curve, and the scatter of fatigue life is discussed. Author

**N75-19546#** Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

**PROGRAM FOR THE DEVELOPMENT OF A SUPERCONDUCTING GENERATOR. PART 1: PHASE 1 Report for May 1971 - Jan. 1974**

R. D. Blaugher, J. L. McCabria, and James H. Parker, Jr. Oct.

1974 243 p refs
(Contract F33615-71-C-1591; AF Proj. 3145)
(AD-A001649; AFAPL-TR-74-84-Pt-1) Avail: NTIS CSCL 10/21

The work included the preliminary studies and design of a 12,000 RPM, 5 MVA, 400 Hz generator with a rotating field. It also includes the individual tests of the most critical components, i.e., the dynamic cryogenic seals, power leads, interconnections of the SC coils, SC field windings, and construction and test of a complete rotor. The cold rotor tests (at 4.2K) were conducted up to the overspeed value of 13,200 rpm. Full excitation of the field (equivalent to 5.32 MVA) was obtained at the operating speed of 12,000 rpm. GRA

**N75-19557#** Army Foreign Science and Technology Center, Charlottesville, Va.
**ANTENNAS, A COLLECTION, ISSUE 15**
L. Sopin, L. Bazelyan, G. Inyutin, V. Narbut, and Y. Zamyatin 15 Jun. 1974 128 p refs Transl. into ENGLISH from Antenny (Moscow), no. 15, 1972
(AD-A002646; FSTC-HT-23-718-74) Avail: NTIS CSCL 09/5

Contents: The theory of two-dimensional arrays with random arrangement of the radiators; Experience in the development of two-dimensional antenna arrays with random arrangement of the radiators; On the three-dimensional structure of cross-polarization radiation of axisymmetrical parabolic antennas; On the problem of reducing directive gain and dispersion of the direction of the principal maximum of the radiation pattern of a sectionalized antenna of a traveling wave; On the problem of the statistics of a field of focussed systems; Directive gain and input impedence of a flat radiator located close to a boundary surface; Analysis of the properties of coupled structures; An evaluation of aircraft capacitor medium wavelength folded-dipole antennas for their efficiency. GRA

**N75-19585#** Advisory Group for Aerospace Research and Development, Paris (France).
**TECHNICAL EVALUATION REPORT ON FLUID DYNAMICS PANEL SYMPOSIUM ON V/STOL AERODYNAMICS**
B. M. Spee (Natl. Aerospace Lab.) Feb. 1975 13 p refs Symp. held at Delft, Netherlands, 24-26 Apr. 1974
(AGARD-AR-78) Avail: NTIS HC $3.25

Papers presented at the Fluid Dynamics Panel Symposium are reviewed along with the current situation in V/STOL aerodynamics research. The following areas were discussed; powered high-lift systems; mechanical high-lift systems and jet lift. It is concluded that the direct operating cost of V/STOL must be decreased through optimization of aerodynamic characteristics in order to compete with conventional aircraft. Author

**N75-19586*#** McDonnell-Douglas Astronautics Co., St. Louis, Mo.
**ANALYTICAL COMPARISON OF HYPERSONIC FLIGHT AND WIND TUNNEL VISCOUS/INVISCID FLOW FIELDS Final Report**
H. J. Fivel, R. V. Masek, and L. J. Mockapetris Washington NASA Feb. 1975 124 p refs
(Contract NAS1-11728)
(NASA-CR-2489) Avail: NTIS HC $5.25 CSCL 20D

Flow fields were computed about blunted, 0.524 and 0.698 radians, cone configurations to assess the effects of nonequilibrium chemistry on the flow field geometry, boundary layer edge conditions, boundary layer profiles, and heat transfer and skin friction. Analyses were conducted at typical space shuttle entry conditions for both laminar and turbulent boundary layer flow. In these calculations, a wall temperature of 1365 K (2000 F) was assumed. The viscous computer program used in this investigation was a modification of the Blottner non-similar viscous code which incorporated a turbulent eddy viscosity model after Cebeci. The results were compared with equivalent calculations for similar (scaled) configurations at typical wind tunnel conditions. Wind tunnel test gases included air, nitrogen, CF4 and helium. The viscous computer program used for wind tunnel conditions was the Cebeci turbulent non-similar computer code. Author

**N75-19878#** Air Force Weapons Lab., Kirtland AFB, N.Mex.
**USAF AIRCRAFT TAKEOFF LENGTH DISTANCES AND CLIMBOUT PROFILES Final Report, 1 Jun. 1973 - 15 Sep. 1974**
David F. Menicucci Oct. 1974 35 p ref
(AD-A001826; AFWL-TR-74-279) Avail: NTIS CSCL 13/2

The Air Force Weapons Laboratory in cooperation with the Argonne National Laboratory has developed a computerized Air Quality Assessment Model (AQAM) which will be used to assess the impact of airbase activity on Ambient Air Quality within the airbase and in surrounding areas. The AQAM has the capability of precisely simulating the aerial and ground operating cycle of each active USAF aircraft. An important component of this operating cycle is the takeoff runway roll distance. The runway roll is associated with high engine power settings and correspondingly high pollution emissions. This report outlines the procedure for utilizing least-squares curve fitting techniques to develop equations to accurately define the runway roll distance for each USAF aircraft in given meteorological conditions. GRA

**N75-20209** European Space Research Organization, Paris (France).
**THE COEXISTENCE OF TWO SUPERSONIC PLANE FLOWS IN THE PRESENCE OF A LONGITUDINAL PRESSURE GRADIENT c02**
Jacques Paulon, Xavier Garonne et al *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1974-2 (ESRO-TT-113) Dec. 1974 p 15-34 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1974-2, Mar.-Apr. 1974 p 75-82

A study of two supersonic, plane, parallel flows at different Mach numbers, but at the same pressure, is used to contribute to the understanding of the complex stratified flows encountered in supersonic compressors with shocks. In particular, it sheds some light on the shape of de-energization shock waves and allows the verification of the correlation formulas used for calculating flow separations at the walls. Author (ESRO)

**N75-20212** European Space Research Organization, Paris (France).
**SOME NOTES ON THE THERMODYNAMICS OF THRUST REVERSAL IN FLIGHT c77**
Pierre Garriere *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1974-2 (ESRO-TT-113) Dec. 1974 p 86-88 Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1974-2, Mar.-Apr. 1974 p 107

It is shown that, in order to obtain a maximum braking effect in flight, the thrust reversal should take place in a manner leading to the greatest possible irreversibility through interaction of the jet with the external free flow. Thrust reversers should be tested, not on a test bench, but in a wind tunnel only. Author (ESRO)

**N75-20213** European Space Research Organization, Paris (France).
**DETERMINATION BY MEANS OF HYDRAULIC ANALOGY OF THE TRANSONIC FLOW IN A BLADE CASCADE c02**
Emilien Robert, Lucien Reding et al *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1974-2 (ESRO-TT-113) Dec. 1974 p 89-101 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1974-2, Mar.-Apr. 1974 p 108-112

A technique is described for studying the flow through the interblade channels of a transonic cascade and for determining the position of the flow isobars. The use of injected powder particles and motion picture photography reveals the flow velocity and direction along the isobars. Author (ESRO)

**N75-20221*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**A FLIGHT TEST INVESTIGATION OF THE ROLLING MOMENTS INDUCED ON A T-37B AIRPLANE IN THE WAKE OF A B-747 AIRPLANE**

Harriet J. Smith Apr. 1975 23 p refs
(NASA-TM-X-56031) Avail: NTIS HC $3.25 CSCL 01C

A flight test investigation of the B-747 vortex wake characteristics was conducted using a T-37B as a probe aircraft. The primary purpose of the program was the validation of the results of B-747 model tests which predicted significant alleviation of the vortex strength when only the inboard flaps were deflected. Measurements of the vortex-induced rolling moments of the probe aircraft showed that the predicted alleviation did occur. The effects of landing gear extension, increased lift coefficient, idle thrust, and sideslip were investigated, and all had an adverse effect on the alleviated condition as evidenced by increased induced rolling moments of the T-37B probe aircraft. Idle thrust also increased the strength of the B-747 wake vortexes with both inboard and outboard flaps extended. Author

**N75-20222*#** Kansas Univ., Lawrence.
**THE FUTURE OF AERONAUTICS**
1974 419 p refs Presented at NASA/Univ. Conf. on Aeron., Lawrence, Kans., 23-24 Oct. 1974 Sponsored in part by NASA
(NASA-CR-142559) Avail: NTIS HC $10.50 CSCL 01B

The proceedings of a conference on the future of aeronautics are presented. The subjects discussed include the following: (1) aeronautics and the education of the engineer, (2) technical trends in aeronautics, and (3) the role of the university in aeronautics. The technical trends in aeronautics are concerned with aircraft noise control, the effect of the aircraft on the environment, airborne electronics for automated flight, and trends in aircraft design.

**N75-20223*** National Aeronautics and Space Administration, Washington, D.C.
**AERONAUTICS IN THE AMERICAN SOCIETY**
James C. Fletcher *In* Kans. Univ. The Future of Aeron. 1974 p 1-10
CSCL 01B

The trends in aeronautics and aeronautical education are discussed with respect to the roles of industry, government, and the universities. The importance of the aviation industry to the economy of the country is examined. The impact of reduced enrollment of aeronautical engineering students in the universities on the future of the aeronautical industry is stressed. It is stated that the role of the government should be to sponsor and conduct basic research and advanced technology programs for civil and military aviation, and the specification, development, procurement, and operation of military aircraft. Recommendations are made for approaches which may be taken to influence more qualified students to enter the field of aeronautics. Author

**N75-20228*** Lockheed Aircraft Corp., Sunnyvale, Calif.
**THE NEXT FORTY YEARS IN AVIATION**
Willis M. Hawkins *In* Kans. Univ. The Future of Aeron. 1974 p 58-95
CSCL 01B

A prediction of the status of various types of aviation activities which may be expected in twenty years is presented. The basic assumptions are that the population of the nation will continue to grow at more than 7 percent and that the need for air transportation of passengers and cargo will increase accordingly. Various predictions are also made for the developments in vertical takeoff aircraft, short haul airline operations, general aviation, and military aircraft. Areas of improvement are indicated for air navigation, air traffic control, night vision, quiet aircraft, and the use of hydrogen as a fuel. Author

**N75-20229*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**TRENDS IN AIRCRAFT NOISE CONTROL**
Harvey H. Hubbard and Earl W. Conrad *In* Kans. Univ. The Future of Aeron. 1974 p 96-122 refs
CSCL 01C

Flight vehicles are characterized according to their manner of operation and type of propulsion system; and their associated sources of noise are identified. Available noise reduction technology as it relates to engine cycle design and to powerplant component design is summarized. Such components as exhaust jets, fans, propellers, rotors, blown flaps, and reciprocating-engine exhausts are discussed, along with their noise reduction potentials. Significant aircraft noise reductions are noted to have been accomplished by the application of available technology in support of noise certification rules. Further noise reductions to meet more stringent future noise regulations will require substantial additional technology developments. Improved analytical prediction methods, and well-controlled validation experiments supported by advanced-design aeroacoustic facilities, are required as a basis for an effective integrated systems approach to aircraft noise control. Author

**N75-20231*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**ON WAKE VORTEX ALLEVIATION**
Leonard Roberts *In* Kans. Univ. The Future of Aeron. 1974 p 139-167 refs
CSCL 01A

Research within NASA relating to the nature of lift-induced vortex wakes behind large aircraft and the means whereby the hazard they represent to smaller aircraft can be alleviated is reviewed. The research, carried out in ground based facilities and in flight shows that more rapid dispersion of the wake can be effected by several means and that the modification of span-loading by appropriate flap deflection holds promise of early practical application. Author

**N75-20232*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AIRBORNE ELECTRONICS FOR AUTOMATED FLIGHT SYSTEMS**
George B. Graves, Jr. *In* Kans. Univ. The Future of Aeron. 1974 p 168-181 refs
CSCL 01D

The increasing importance of airborne electronics for use in automated flight systems is briefly reviewed with attention to both basic aircraft control functions and flight management systems for operational use. The requirements for high levels of systems reliability are recognized. Design techniques are discussed and the areas of control systems, computing and communications are considered in terms of key technical problems and trends for their solution. Author

**N75-20235*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SOME TRENDS IN AIRCRAFT DESIGN: STRUCTURE**

George W. Brooks *In* Kans. Univ. The Future of Aeron. 1974 p 212-270 refs
CSCL 01C

Trends and programs currently underway on the national scene to improve the structural interface in the aircraft design process are discussed. The National Aeronautics and Space Administration shares a partnership with the educational and industrial community in the development of the tools, the criteria, and the data base essential to produce high-performance and cost-effective vehicles. Several thrusts to build the technology in materials, structural concepts, analytical programs, and integrated design procedures essential for performing the trade-offs required to fashion competitive vehicles are presented. The application of advanced fibrous composites, improved methods for structural analysis, and continued attention to important peripheral problems of aeroelastic and thermal stability are among the topics considered. Author

**N75-20236*** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**STATUS AND TRENDS IN ACTIVE CONTROL TECHNOLOGY**
Herman A. Rediess and Kenneth J. Szalai *In* Kans. Univ. The

Future of Aeron. 1974 p 271-320 refs

CSCL 01C

The emergence of highly reliable fly-by-wire flight control systems makes it possible to consider a strong reliance on automatic control systems in the design optimization of future aircraft. This design philosophy has been referred to as the control configured vehicle approach or the application of active control technology. Several studies and flight tests sponsored by the Air Force and NASA have demonstrated the potential benefits of control configured vehicles and active control technology. The present status and trends of active control technology are reviewed and the impact it will have on aircraft designs, design techniques, and the designer is predicted. Author

**N75-20237*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**OPPORTUNITIES FOR AERODYNAMIC-DRAG REDUCTION**

Robert E. Bower *In* Kans. Univ. The Future of Aeron. 1974 p 321-350 refs

Methods for reducing aerodynamic drag to improve aircraft performance and reduce fuel consumption are discussed. The techniques considered are: (1) pressure drag reduction, (2) supercritical airfoils, (3) subcritical airfoils, (4) induced drag reduction by over-the-wing blowing and increased aspect ratio, and (5) friction drag reduction by laminar flow control and slot injection. It is stated that a 50 percent reduction from current drag values is expected through the application of these techniques. Author

**N75-20241*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**UNIVERSITY RESEARCH IN AERONAUTICS**

John E. Duberg *In* Kans. Univ. The Future of Aeron. 1974 p 371-373

CSCL 01B

The contributions which universities can make to aeronautical research projects are discussed. The activities of several facilities are presented to show the effectiveness of the educational and research programs. Reference is made to the Intergovernmental Personnel Act of 1970 which permits an exchange of Federal agency personnel with state and local governments and with public and private higher education schools. Author

**N75-20242*** Cessna Aircraft Co., Wichita, Kans.

**GENERAL AVIATION'S FUTURE NEED FOR RESEARCH**

Malcolm Harned *In* Kans. Univ. The Future of Aeron. 1974 p 374-375

CSCL 01B

The research requirements for general aviation aircraft are presented. Emphasis is placed on improving the performance of airfoils, propellers, and engines. Additional requirements are expressed with respect to external noise reduction, internal noise reduction, and exhaust emission control. The requirement for anti-icing developments to create improved flight safety is discussed. Author

**N75-20243*** Stanford Univ., Calif.

**UNIVERSITY RESEARCH IN AERONAUTICS**

Holt Ashley *In* Kans. Univ. The Future of Aeron. 1974 p 376-381

CSCL 01B

The types of aeronautical research projects which universities should and should not accept for Government and industry are discussed. Specific examples of suitable and unsuitable research projects are presented. The author recommends two modes by which universities can be of assistance to other organizations in aeronautical research. Author

**N75-20247*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**PERFORMANCE OF AN ISOLATED TWO-DIMENSIONAL VARIABLE-GEOMETRY WEDGE NOZZLE WITH TRANSLATING SHROUD AND COLLAPSING WEDGE AT SPEEDS UP TO MACH 2.01**

Donald L. Maiden Washington Apr. 1975 77 p refs

(NASA-TN-D-7906; L-9976) Avail: NTIS HC $4.25 CSCL 01A

A wind-tunnel investigation was conducted to determine the aeropropulsion performance (thrust-minus-drag) of a single-engine, variable-geometry, two-dimensional (2-D) wedge nozzle with simulated translating-shroud and collapsing-wedge mechanisms. The investigation was conducted statically and at Mach numbers from 0.60 to 2.01 at an angle of attack of 0 deg and at varied jet total-pressure ratios up to 21, depending on the Mach number. The results indicate that the isolated aeropropulsion performance of a variable-geometry two-dimensional wedge nozzle is competitive with axisymmetric nozzles at transonic and supersonic speeds, but the isolated performance is slightly inferior for static take-off and low subsonic speeds. With the use of a simple tertiary-air ejector, the static take-off performance was increased. Author

**N75-20248*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**AN EXPERIMENTAL INVESTIGATION OF COMPRESSOR STALL USING AN ON-LINE DISTORTION INDICATOR AND SIGNAL CONDITIONER**

William G. Costakis and Leon M. Wenzel Washington Apr. 1975 33 p refs

(NASA-TM-X-3182; E-8120) Avail: NTIS HC $3.75 CSCL 01A

The relation of the steady-state and dynamic distortions and the stall margin of a J85-13 turbojet engine was investigated. A distortion indicator capable of computing two distortion indices was used. A special purpose signal conditioner was also used as an interface between transducer signals and distortion indicator. A good correlation of steady-state distortion and stall margin was established. The prediction of stall by using the indices as instantaneous distortion indicators was not successful. A sensitivity factor that related the loss of stall margin to the turbulence level was found. Author

**N75-20249#** National Research Council of Canada, Ottawa (Ontario).

**QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 OCTOBER - 31 DECEMBER 1974**

31 Dec. 1974 102 p refs

(DME/NAE-1974(4)) Avail: NTIS HC $5.25

Research data on estimates of stability derivatives of the Bell 205 helicopter and V/STOL aircraft, air cushion vehicle transportation in Canada, and thermodynamic efficiency of the Otto and Carnot cycles are summarized.

**N75-20250** National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.

**ESTIMATES OF THE STABILITY DERIVATIVES OF A HELICOPTER AND A V/STOL AIRCRAFT FROM FLIGHT DATA**

D. G. Gould and W. S. Hindson *In* NRC Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab. 31 Dec. 1974 p 1-20 refs Presented at the Specialists Meeting on Aircraft State and Parameter Identification Tech., Hampton, Va., 5-8 Nov. 1974

Stability derivatives for the Bell 205 helicopter have been derived from flight data using a least squares quasilinearization technique. The aircraft model, which included a first order representation of rotor response characteristics was based on fundamental parameters descriptive of the particular design. A conglomerate analysis procedure which produced estimates based on data from several similar manoeuvres was used to increase the confidence in the results obtained. Data from the CL-84 V/STOL aircraft were also analyzed, indicating the validity of certain a priori longitudinal stability derivatives for the aircraft, and yielding estimates of others. The results indicate the need to use a more elaborate modelling technique, such as was used for the Bell 205, which takes into account the particular complexities of the aircraft. Author

N75-20251 Division of Mechanical Engineering, Ottawa (Ontario). Engine Lab.
**SOME AIR CUSHION TECHNOLOGY RESEARCH IN CANADA**
H. S. Fowler *In* NRC Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab. 31 Dec. 1974 p 21-31 refs (For availability see N75-20249 12-01)

Details are given of hovercraft use for transport of heavy loads over poor roads on off-road terrain which varies with the season. Special attention was given to: (1) low temperature operation of ACVs, (2) the use of ACVs as icebreakers, (3) field trials of hoverbarges, and (4) the use of mobile laboratory vehicles, Project CASPAR, for studying performance and skirt-terrain interaction of various skirt problems. Author

N75-20253# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**COMPUTER SIMULATION OF MAINTENANCE FOR MULTI-MISSION RPV'S M.S. Thesis**
Paul R. Sheridan Dec. 1974 104 p refs
(AD-A003351; GSA/SM/74D-8) Avail: NTIS CSCL 01/3

The purpose of this research project was to develop a computer simulation model of maintenance for a multi-mission RPV. The model is developed with as much flexibility as possible consistent with the expressed desires of the RPV SPO at Wright-Patterson AFB, Ohio. A method of analyzing the output of the simulation to determine trade-offs between the use of manpower and vehicles is also developed and a numerical example is presented. The greatest value of this research is the potential for use in various areas of study concerning RPV maintenance. This report does not address questions of operational effectiveness of MMRPVs in the target area. GRA

N75-20256*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EVALUATION OF SOME CONTROL-VOLUME TECHNIQUES FOR ANALYSIS OF SHOCK-BOUNDARY LAYER INTERACTIONS IN SUPERSONIC INLETS**
Warren R. Hingst Washington Apr. 1975 15 p refs
(NASA-TM-X-3186; E-7866) Avail: NTIS HC $3.25 CSCL 20D

Various control-volume models used to analyze the shock boundary layer bleed interaction were investigated. The bleed assumptions of the models and their influence on the analytical solutions are discussed. The results of the analysis using these models are compared with experimental boundary-layer data taken in a supersonic inlet. The experimental Mach number upstream of the interaction was 1.66, and the oblique-shock pressure ratio was 1.33. The boundary layer data included bleed flow rates up to approximately 0.6 of the upstream boundary layer mass flow rate. The first model assumed the bleed was removed from the control volume with a momentum that was characterized by a pressure intermediate between the upstream and downstream pressures. The second model assumed the control volume was bounded by a streamline dividing the bleed and residual flows and eliminated the need to specify the momentum of the bleed flow. Comparison of the results using the models showed that specifying the bleed pressure in one model was equivalent to specifying the pressure along the dividing streamline in the other. Author

N75-20257# Weapons Research Establishment, Salisbury (Australia).
**BOUNDARY LAYER EFFECTS IN SUPERSONIC FLOW OVER CYLINDER-FLARE BODIES**
M. L. Robinson Jul. 1974 54 p refs
(WRE-Rept-1238(WR/D)) Avail: NTIS HC $4.25

The effects of shock wave-boundary layer interaction on the forces acting on cylinder-flare bodies have been investigated experimentally at a Mach number of 2.8. Detailed pressure measurements have been made on two axisymmetric bodies with 15 deg semi-angle flare afterbodies in the incidence range 0 deg to 10 deg. The Reynolds numbers of the tests based on the distance from the nose to the cylinder-flare junction varied between 0.8 million and 2.5 million. Force distributions and total forces and centre-of-pressure positions were obtained by integration of the measured pressure distributions. The experimental results are compared with the results of inviscid theory to gain an appreciation of the magnitude of shock wave-boundary layer interaction effects. The results have indicated that inviscid theory shows reasonable agreement with the experimental results where the length of the interaction region is short compared with the flare length. Author

N75-20258# Cranfield Inst. of Technology (England). Coll. of Aeronautics.
**LONGITUDINAL AERODYNAMIC DERIVATIVES OF A SLENDER DELTA-WING RESEARCH AIRCRAFT EXTRACTED FROM FLIGHT DATA**
V. Klein [1975] 85 p refs
(Cranfield-Aero-27) Avail: NTIS HC $4.75

The Maximum Likelihood parameter-estimation algorithm was used to extract the longitudinal aerodynamic derivatives from flight data for the Handley Page HP 115 slender delta-wing research aircraft. The responses in the rate of pitch and vertical acceleration were excited from the horizontal steady-state flights at different airspeeds by the elevon deflection. In some cases the measured time histories were converted into frequency response curves, from which the unknown parameters were estimated. For the low angle of attack measurements the linear model of the aircraft was adequate, whereas for the runs measured at high angle of attacks the non-linear model had to be used. Some identifiability problems were met because of the limited number of measured outputs and incorrect design of the experiment. The non-dimensional aerodynamic derivatives extracted were compared with those from wind-tunnel tests and steady-state measurements. A reasonable degree of consistency between the various sets of results was obtained. Author

N75-20259# Cranfield Inst. of Technology (England). Coll. of Aeronautics.
**PARAMETER IDENTIFICATION APPLIED TO AIRCRAFT**
V. Klein [1975] 153 p refs
(Cranfield-Aero-26) Avail: NTIS HC $6.25

All three steps in the identification as follows: (1) characterization, (2) parameter estimation and (3) verification are considered and applied to the determination of aircraft parameters from flight data. The estimation procedure includes the equation error method and the output error method with the weighted least squares, maximum likelihood and Bayesian estimation technique. The problems concerning accuracy and identifiability are also discussed. A general computing algorithm is developed covering all estimation techniques described. It is applicable to linear as well as nonlinear systems and is flexible enough for the solution of various identifiability problems. Using this algorithm the computing program has been compiled in general terms to enable the user to achieve the objectives mentioned. As examples, the results of the identification of aircraft parameters and aerodynamic derivatives for four different aircraft are presented. Author

N75-20260*# Boeing Co., Seattle, Wash.
**SIDESLIP OF WING-BODY COMBINATIONS**
Paul E. Rubbert Oct. 1972 55 p refs
(Contract NAS2-5006)
(NASA-CR-114716; D6-60160) Avail: NTIS HC $4.25 CSCL 01A

A small-disturbance theory is developed for predicting the aerodynamics of an airplane in sideslip. Second-order terms involving the interaction between sideslip angle and angle of attack, sideslip angle and wing camber, etc., are retained. It is found that the second-order terms can produce the dominant sideslip effects when the dihedral of the lifting surfaces is small. Numerical implementation of the theory requires a solution procedure capable of producing accurate velocity gradients in the first-order solution. Author

N75-20262# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
**COMPUTATION OF THE VELOCITY FIELD INDUCED BY A PLANAR SOURCE DISTRIBUTION APPROXIMATING A**

**SYMMETRICAL NON-LIFTING WING IN SUBSONIC FLOW**
J. A. Ledger London Aeron. Res. Council 1974 41 p refs Supersedes RAE-TR-72176; ARC-34383
(ARC-R/M-3751; RAE-TR-72176; ARC-34383) Avail: NTIS HC $3.75; HMSO £1.65; PHI $6.75

The singular double integrals which arise in the calculation of the components of perturbation velocity due to a swept wing with given thickness distribution by linearized theory, were evaluated by a numerical method. Two computer programs were written, one for points on the wing planform and one for points off. Following the techniques adopted by Sells, the integral over the wing was constructed from the sum of analytic spanwise integrals taken along lines of local sweep. The results obtained were tested against calculations by Freestone for points on the wing planform for both sheared and tapered wings. Further comparisons for points on the wing surface were made with results by the method of A. M. O. Smith. Author (ESRO)

**N75-20263#** City Univ., London (England).
**SOME REMARKS ON THE INDUCED VELOCITY FIELD OF A LIFTING ROTOR AND ON GLAUERT'S FORMULA**
A. R. S. Bramwell London Aeron. Res. Council 1974 35 p refs Supersedes ARC-34822
(ARC-CP-1301; ARC-34822) Avail: NTIS HC $3.75; HMSO 65p; PHI $2.75

The induced velocity field of a lifting rotor is discussed in relation to the pressure field rather than the vortex wake in an attempt to obtain a clearer understanding of the relationship between the induced velocity and rotor forces. A number of results are derived and, where appropriate, are compared with those obtained from the theory of the vortex wake. An investigation into the validity of Glauert's formula indicates that it appears to be true for all rotor loadings for the linearized, high speed, case. Calculations of the induced power show that for typical rotor loadings the power in hovering flight is about 10 per cent greater than the ideal induced power, rising to about 15 to 20 per cent greater in forward flight. Author (ESRO)

**N75-20264#** Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
**THE PREDICTION OF TURBULENT HEAT TRANSFER TO WEDGE COMPRESSION CORNERS AND CYLINDER-FLARE BODIES AT HYPERSONIC SPEEDS**
Colin Osborne Mar. 1973 38 p refs
(Contract AT/2037/057)
(IC-Aero-73-03) Avail: NTIS HC $3.75

A number of calculation methods were used to predict the heat transfer from hypersonic turbulent boundary layers on wedge compression corners and cylinder flare bodies. Only attached flows were considered. The results were compared with recent data of Coleman and Stollery (1972) and Coleman (1973). The prediction methods giving the best agreement with the data are the Gibson and Spalding (1971) method and the simplified Walker method. Author (ESRO)

**N75-20267#** European Space Research Organization, Paris (France).
**ON THE INSTABILITY OF A SOUND-INFLUENCED FREE JET**
Eberhard Pfizenmaier Jan. 1975 157 p refs Transl. into ENGLISH of "Zur Instabilitaet des Schallbeeinflussten Freistrahls", DFVLR, Berlin Report DLR-FB-73-69, 14 May 1973 Original German report available from DFVLR, Porz, West Ger. 48. 10 DM
(ESRO-TT-122; DLR-FB-73-69) Avail: NTIS HC $6.25

The reaction of an axisymmetric free jet to disturbances excited by a sound field was investigated. The exciting sound field was used as a diagnostic tool in order to synchronize disturbances in the free jet to a single Strouhal number. If the Strouhal number is small, disturbances are amplified exponentially. If the Strouhal number is high, the experiments no longer reveal exponential amplification, but standing wave patterns and even damped amplitudes. In this case agreement between stability theory and experimental results fails. The structure of the disturbances found experimentally can be interpreted as a superposition of two waves traveling downstream, namely, the exciting sound wave and the excited instability wave. Author (ESRO)

**N75-20271#** Douglas Aircraft Co., Inc., Long Beach, Calif.
**A THEORETICAL METHOD FOR CALCULATING THE AERODYNAMIC CHARACTERISTICS OR ARBITRARY EJECTOR-JET-FLAPPED WING: THEORETICAL ANALYSIS Final Report**
Michael L. Lopez and Norman F. Wasson Jun. 1974 142 p refs
(Contract F33615-73-C-3127)
(AD-A002319; MDC-J6063; AFFDL-TR-74-72) Avail: NTIS CSCL 01/1

A theoretical method has been developed to determine the aerodynamic characteristics of ejector-jet-flapped wings in incompressible flow. The ejector-jet-flap is a high-lift concept conceived as a means of generating lift by using the jet-flap principle. The ejector, which consists of a primary jet directed in the gap formed by the upper and lower sections of the flap, provides, as the result of the entrainment of a secondary fluid, a trailing edge jet momentum normally in excess of that of the primary jet. In the present method the ejector system inside the flap is considered as an internal mechanism and the total momentum at the trailing edge is considered as a single thin jet of known momentum flux. Thus, the external aerodynamics of the ejector-jet-flap wing is similar to that of a wing with a jet-augmented flap with a suction or sink effect in the region of the flap hinge. GRA

**N75-20272#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
**WIND TUNNEL STUDIES OF THE TURBULENT WAKE BEHIND SELF PROPELLED SLENDER BODIES Final Report**
J. A. Schetz and A. K. Jakubowski Jun. 1974 18 p refs
(Contract N00014-72-A-0136-0004)
(AD-A002396; VPI-AERO-014) Avail: NTIS CSCL 20/4

This report presents a summary of the data obtained for self-propelled, slender (10 x 1) bodies in a six-foot square, low turbulence wind tunnel. One model was propelled by axial air injection through a peripheral slot, and the other was propelled by a three-bladed, high pitch propeller. The tests were conducted at (Re sub D) equals approximately 600,000. Data for the mean flow, turbulence intensities and Reynolds stresses were obtained at five axial stations in the range greater than 2 and less than 40. GRA

**N75-20273#** National Aviation Facilities Experimental Center, Atlantic City, N.J.
**DEVELOPMENT OF A SCIENTIFIC BASIS FOR ANALYSIS OF AIRCRAFT SEATING SYSTEMS Final Report, Aug. 1972 - Apr. 1974**
David H. Laananen Jan. 1975 216 p refs
(Contract DOT-FA72WA-3101)
(AD-A004306; FAA-NA-74-175; FAA-RD-74-130) Avail: NTIS HC $7.50 CSCL 01/3

A three-dimensional mathematical model of an aircraft seat, occupant, and restraint system has been developed as an aid to the development of crashworthy seats and restraint systems for general aviation aircraft. The occupant model consists of eleven rigid mass segments whose dimensions and inertial properties have been determined from studies of human body anthropometry and kinematics. The seat model is made up of beam and membrane elements with provision for simulating plastic behavior by the introduction of plastic hinges in the beams. A user-oriented computer program called Seat Occupant Model-Light Aircraft (SOM-LA) based on the three-dimensional model has been developed for use by engineers concerned with design and analysis of general aviation seats and restraint systems in that detailed descriptions of both are used as input. The response of the seat and occupant, restraint system loads, and various injury criteria are predicted for any given set of crash conditions. Author

**N75-20274#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

**AIRCRAFT ACCIDENT REPORT. EASTERN AIR LINES, INC. MCDONNELL-DOUGLAS DC 9-31, N8967E AKRON-CONTON REGIONAL AIRPORT, NORTH CANTON, OHIO, 27 NOV. 1973**
5 Nov. 1974 54 p
(PB-238637/3; NTSB-AAR-74-12; File-1-0029) Avail: NTIS HC $4.25 CSCL 01B

An Eastern Air Lines McDonnell-Douglas DC-931 crashed at Akron-Canton Regional Airport, North Canton, Ohio, on November 27, 1973, at 2129 e.s.t. The aircraft ran off the end of runway 01 after completing a precision approach and landing, traversed 110 feet of unpaved ground, and plunged over a 38-foot embankment. The aircraft was damaged substantially by the impact, but there was no fire. The 21 passengers and 5 crewmembers sustained various injuries. The National Transportation Safety Board determines that the probable cause of the accident was the captain's decision to complete the landing at an excessive airspeed and at a distance too far down a wet runway to permit the safe stopping of the aircraft. Factors which contributed to the accident were: (1) lack of airspeed awareness during the final portion of the approach, (2) an erroneous indication of the speed command indicator, and (3) hydroplaning. GRA

**N75-20275#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**SPECIAL STUDY: SAFETY ASPECTS OF EMERGENCY EVACUATIONS FROM AIR CARRIER AIRCRAFT**
13 Nov. 1974 45 p
(PB-238269/5; NTSB-AAS-74-3) Avail: NTIS HC $3.75 CSCL 01B

Recent U.S. air carrier accidents in which an emergency evaculation occurred are examined. These accidents exemplify the factors most commonly identified as influencing evacuation success. The factors identified and discussed include the following: weather, terrain, aircraft attitude, fire and smoke, evacuation slides, emergency lighting, emergency communications equipment, obstructions to egress, passenger preparedness, crewmember training, and crewmember procedures. Safety recommendations regarding improvements in evacuation slides, megaphones, public address systems, passenger briefings, emergency lighting, and crewmember training are included. GRA

**N75-20276#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**ANNUAL REVIEWS OF AIRCRAFT ACCIDENT DATA US AIR CARRIER OPERATIONS, 1973**
24 Oct. 1974 93 p
(PB-238281/0; NTSB-ARC-74-2) Avail: NTIS HC $4.75 CSCL 01B

The record of aviation accidents which occurred in all operations of the U.S. Air Carriers for calendar year 1973 is presented. It includes an analysis by classes of carriers, causes and related factors, types of accidents, and phases of operation. Statistical tables which summarize the accidents, fatalities, and accident rates along with causal tables and the briefs of accidents are presented in the appendices. GRA

**N75-20277#** National Transportation Safety Board, Washington, D.C.
**PAN AMERICAN WORLD AIRWAYS, INCORPORATED BOEING 707-321B, N454PA, PAGO PAGO, AMERICAN SAMOA, 30 JANUARY 1974 Aircraft Accident Report**
8 Nov. 1974 32 p
(PB-238478/2; NTSB-AAR-74-15) Avail: NTIS HC $3.75 CSCL 01B

About 2341, American Samoa standard time, on January 30, 1974, Pan American World Airways, Flight 806, crashed 3,865 feet short of runway 5 at Pago Pago International Airport. The flight was making an ILS approach at night. Of the 101 persons aboard the aircraft, only 5 survived the accident. One survivor died of injuries 9 days after the accident. The aircraft was destroyed by impact and fire. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the pilot to correct an excessive rate of descent after the aircraft had passed decision height. VASI was available and operating but apparently was not used by the crew to monitor the approach. GRA

**N75-20278#** National Transportation Safety Board, Washington, D.C.
**DELTA AIR LINES INCORPORATED MCDONNELL DOUGLAS DC-9-32, N3323L, CHATTANOOGA MUNICIPAL AIRPORT, CHATTANOOGA, TENNESSEE Aircraft Accident Report**
27 Nov. 1974 45 p
(PB-238479/0; NTSB-AAR-74-13) Avail: NTIS HC $3.75 CSCL 01B

About 1851 e.s.t. on November 27, 1973, Delta Air Lines Flight 516, a McDonnell Douglas DC-9-32, N3323L, crashed while making an ILS approach to runway 20 at Chattanooga Municipal Airport, Chattanooga, Tennessee. Seventy-four passengers and five crewmembers were aboard the aircraft. Thirty-eight passengers and four crewmembers were injured; there were no fatalities. The aircraft was destroyed. The National Transportation Safety Board determines the probable cause of the accident was that the pilot did not recognize the need to correct an excessive rate of descent after the aircraft had passed decision height. GRA

**N75-20286#** Pan American World Airways, Inc., New York.
**OCEANIC AIR ROUTE NAVIGATION WITH ENVELOPE MATCH LORAN-C Final Report, Dec. 1974**
Patrick R. J. Reynolds Dec. 1974 117 p
(Contract DOT-FA74WA-3388)
(AD-A003800; FAA-RD-74-205) Avail: NTIS HC $5.75 CSCL 17/7

A Loran-C envelope matching receiver (Edo Model 600T) was evaluated as a potential replacement for Loran-A. The unit was installed on a Boeing 707 aircraft and data were collected primarily on North Atlantic routes. Results of this program indicate that where Loran-C coverage exists in adequate availability and geometry it may be considered a conditionally acceptable substitute for Loran-A as a pilot-operated updating reference for Doppler navigation systems on oceanic air routes. Author

**N75-20289** + Engineering Sciences Data Unit, London (England).
**NON-DIMENSIONAL METHODS FOR THE MEASUREMENT OF LEVEL FLIGHT PERFORMANCE OF TURBINE ENGINED HELICOPTERS**
Nov. 1974 22 p Sponsored by Roy. Aeron. Soc.
(ESDU-74042) Avail: NTIS HC $74.50

Methods are described for measuring and presenting the steady level-flight performance of turbine-engined helicopters in terms of nondimensional parameters. The three test methods described are distinguished by the atmospheric parameters used: density alone, density and temperature, and pressure and temperature. F.O.S.

**N75-20290*#** Scientific Translation Service, Santa Barbara, Calif.
**LIFTING SURFACE FOR AIRCRAFT**
Charles Fauvel and Henri Coltel Washington NASA Apr. 1975 22 p Transl. into ENGLISH from German patent no. 677527, class 62b, group 4 os. examiner's copy, div. 22. F79596 XI/62b, 29 Jun. 1935
(Contract NASw-2483)
(NASA-TT-F-16241) Avail: NTIS HC $3.25 CSCL 01C

A pre-World War 2 German patent is described for an airplane wing whose profile is automatically changed as a function of the flight parameters (velocity, angle of attack, etc.) in such a manner that the center of pressure always remains approximately at the same place. The patent includes an automatic steering device for aircraft. Conventional and wing-only aircraft are considered. Author

**N75-20291*#** Lockheed Aircraft Corp., Sunnyvale, Calif.
**EVALUATION OF ADVANCED LIFT CONCEPTS AND FUEL CONSERVATIVE SHORT-HAUL AIRCRAFT, VOLUME 1 Final Report**
J. H. Renshaw, M. K. Bowden, C. W. Narucki, J. A. Bennett, P. R. Smith, R. S. Ferrill, C. C. Randall, J. G. Tibbetts, R. W.

Patterson, R. T. Meyer et al Jun. 1974 312 p refs 2 Vol. (Contract NAS2-6995)
(NASA-CR-137525) Avail: NTIS HC $9.25 CSCL 01C

The performance and economics of a twin-engine augmentor wing airplane were evaluated in two phases. Design aspects of the over-the-wing/internally blown flap hybrid, augmentor wing, and mechanical flap aircraft were investigated for 910 m. field length with parametric extension to other field lengths. Fuel savings achievable by application of advanced lift concepts to short-haul aircraft were evaluated and the effect of different field lengths, cruise requirements, and noise levels on fuel consumption and airplane economics at higher fuel prices were determined. Conclusions and recommendations are presented.
Author

**N75-20292*#** Lockheed Aircraft Corp., Sunnyvale, Calif.
**EVALUATION OF ADVANCED LIFT CONCEPTS AND FUEL CONSERVATIVE SHORT-HAUL AIRCRAFT, VOLUME 2 Final Report**
J. H. Renshaw, M. K. Bowden, C. W. Narucki, J. A. Bennett, P. R. Smith, R. S. Ferrill, C. C. Randall, J. G. Tibbetts, R. W. Patterson, R. T. Meyer et al Jun. 1974 367 p refs 2 Vol. (Contract NAS2-6995)
(NASA-CR-137526) Avail: NTIS HC $10.00 CSCL 01C
For abstract, see N75-20291.

**N75-20293*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**DEVELOPMENT OF A REMOTE DIGITAL AUGMENTATION SYSTEM AND APPLICATION TO A REMOTELY PILOTED RESEARCH VEHICLE**
John W. Edwards and Dwain A. Deets Washington Apr. 1975 54 p refs
(NASA-TN-D-7941; H-854) Avail: NTIS HC $4.25 CSCL 01C

A cost-effective approach to flight testing advanced control concepts with remotely piloted vehicles is described. The approach utilizes a ground based digital computer coupled to the remotely piloted vehicle's motion sensors and control surface actuators through telemetry links to provide high bandwidth feedback control. The system was applied to the control of an unmanned 3/8-scale model of the F-15 airplane. The model was remotely augmented; that is, the F-15 mechanical and control augmentation flight control systems were simulated by the ground-based computer, rather than being in the vehicle itself. The results of flight tests of the model at high angles of attack are discussed.
Author

**N75-20294*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**WIND TUNNEL INVESTIGATION OF HELICOPTER ROTOR WAKE EFFECTS ON THREE HELICOPTER FUSELAGE MODELS**
John C. Wilson and Raymond E. Mineck [1974] 140 p Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.
(NASA-TM-X-3185-Suppl) Avail: NTIS HC $5.75 CSCL 01C

The effects of rotor downwash on helicopter fuselage aerodynamic characteristics were investigated. A rotor model for generating the downwash was mounted close to each of three fuselage models. The main report presents the force and moment data in both graphical and tabular form and the pressure data in graphical form. This supplement presents the pressure data in tabular form. Each run or parameter sweep is identified by a unique run number. The data points in each run are identified by a point number. The pressure data can be matched to the force data by matching the run and point number. Author

**N75-20295#** General Electric Co., Lynn, Mass. Aircraft Equipment Div.
**FEASIBILITY OF ADAPTING A THIN FILM PERMEABLE MEMBRANE TO JET TRANSPORT FUEL TANK INERTING SYSTEM Final Report**
Warella Browall, John W. Harrison, and Robert M. Salemme Jan. 1975 76 p
(Contract DOT-FA72WA-3134)
(AD-A003799; FAA-RD-74-194) Avail: NTIS HC $4.75 CSCL 01/3

A liquid nitrogen fuel tank inerting system has been certificated and is in operation in a DC-9 jet transport. This system reduces the fuel tank ullage space and vent system oxygen concentration to a non-combustible level by dilution with nitrogen which is stored aboard the airplane in a liquid state. The objective of this contractual effort was to investigate whether the new concept of on-board nitrogen generation by separating nitrogen from engine bleed air using ultrathin semi-permeable membranes will eliminate the requirement to carry liquid nitrogen in the airplane and thus reduce the logistics requirements of nitrogen inerting systems. The function of the inerting system is to reduce the oxygen concentration in the fuel tank vapor spaces and vent lines to a level below which combustion and thus explosion cannot occur, regardless of the presence of an ignition source. This is accomplished by replacing the oxygen in the tank ullage and vent system with nitrogen so that the oxygen concentration will always be nine percent or less by volume under all flight and ground conditions.
Author

**N75-20296#** Tennessee Univ. Space Inst., Tullahoma.
**AIR CUSHION LANDING SYSTEMS FOR AIRCRAFT**
B. H. Goethert [1974] 29 p refs
Avail: NTIS HC $3.75

A brief summary of the current state-of-the-art of air cushion landing systems for aircraft is presented. Aircraft equipped with such novel landing systems have the unique capability of operating on a variety of prepared and unprepared surfaces, such as hard runways, water, swamps, slush and loose snow without necessitating any changes of the landing system. Detailed descriptions of the special technical features are given, such as the design of the inflatable trunks, the flexible material with differential-directional stiffness, auxiliary cushion air compressor system, control system for ground operation, etc. The feasibility of this system was demonstrated in extensive tests with a single-engine LA-4 aircraft. The success of these demonstration tests resulted in installing an air cushion landing system in an operational two-engine aircraft in the 50,000 pound class.
Author

**N75-20297#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.
**THE VARIABILITY OF FATIGUE DAMAGE FROM FLIGHT TO FLIGHT**
N. I. Bullen London Aeron. Res. Council 1974 28 p refs Supersedes RAE-TR-73046; ARC-34723
(ARC-CP-1297; RAE-TR-73046; ARC-34723) Avail: NTIS HC $3.75; HMSO 55p; PHI $2.35

The variability of fatigue damage from flight to flight is examined for a fleet of aircraft, both within aircraft and between aircraft. A method is described of modifying the standard analysis of variance technique to take account of correlation between consecutive flights and an example is given. It is then shown how to use the estimates of variance so obtained in the derivation of factors for damage prediction, both on a short term basis for a few unmetered flights and also for complete life estimation.
Author (ESRO)

**N75-20298#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
**FLIGHT SIMULATION OF A WESSEX HELICOPTER: A VALIDATION EXERCISE**
T. Wilcock and Ann C. Thorpe London Aeron. Res. Council 1974 61 p refs Supersedes RAE-TR-73096; ARC-35005
(ARC-CP-1299; RAE-TR-73096; ARC-35005) Avail: NTIS HC $4.25; HMSO £1; PHI $3.90

A piloted flight simulation of the Westland Wessex helicopter which was intended to investigate the validity of simulation for the representation of flight handling behavior is described. Two areas were of concern: the representation of the Wessex within a limited computational capacity, and the suitable simulation of the flying environment so that handling characteristics were presented correctly to the pilots. By limiting the scope of the simulation to the normal flying regime of the helicopter, an

adequate representation of the Wessex was possible. Presentation of handling behavior was satisfactory in pitch and roll; some difficulties were experienced in the representation of yawing behavior and of height control near the hover, and were attributed to inadequate motion capability of the simulator. The results of this simulation were used to give confidence in the interpretation of future helicopter simulation. Author (ESRO)

**N75-20299#** Battelle Columbus Labs., Ohio.
**FATIGUE-CRACK GROWTH BEHAVIOR OF C-5A WING CONTROL POINTS Interim Report, 20 Oct. 1972 - 20 Oct. 1973**
Samuel H. Smith May 1974 52 p refs
(Contract F33657-73-C-0281)
(AD-A002553; ASD-TR-74-18) Avail: NTIS CSCL 01/3

An extensive fatigue-crack-growth analysis was conducted to evaluate the flight-by-flight crack-growth behavior of the C-5A wing structure control points. Fourteen missions of flight stress spectra and several mission mixes were considered in the analysis. Both linear and retarded (nonlinear) concepts of fatigue-crack growth were analyzed with the AFFDL CRACKS II computer program with the Willenborg effective stress retardation model. The model was found to adequately predict laboratory flight-by-flight test data. Fatigue-crack-growth behavior was found to be sensitive to stress increments as derived from a constant exceedance curve, mission severity, and stress sequence. The results of the flight-by-flight analysis for each of the wing structure control points defined the most critical locations for inspection purposes. In addition, fatigue-crack behavior was found to be very sensitive to mission stress spectra and mission mix. GRA

**N75-20300#** Army Materials and Mechanics Research Center, Watertown, Mass.
**DEVELOPMENT OF SCRATCH AND SPALL RESISTANT WINDSHIELDS Final Report**
John R. Plumer Aug. 1974 22 p refs Presented at Proc. of Conf. on Transparent Aircraft Enclosures, Las Vegas, Nev., 5-8 Feb. 1973
(DA Proj. 1728005)
(AD-A002513; AMMRC-TR-74-19) Avail: NTIS CSCL 01/3

Studies were performed to evaluate possible ways of improving the primary weaknesses in existing Army helicopter windshields, namely, scratching and spalling. Three experimental windshield material configurations offering a potential solution were fabricated for test and evaluation. The spall problem was approached by using polycarbonate as a backup material and was incorporated into each design. The scratch problem was approached by employing either (1) a hard surface coating, (2) an acrylic cladding, or (3) a thin glass cladding to the polycarbonate backup material. Commercially available materials and abrasion-resistant coatings were evaluated utilizing a windshield wiper apparatus, while spall performance was studied by ballistic testing and high-speed photography of each of three test configurations. GRA

**N75-20301#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 1: EXECUTIVE SUMMARY**
L. Ascani Jun. 1974 36 p refs
(Contract F33615-71-C-1922)
(AD-A002850; ASD/XR-74-10-Vol-1) Avail: NTIS CSCL 01/3

Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads, spectra, skin temperatures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention. This volume, Volume I, summarizes the program and its capabilities. GRA

**N75-20302#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 2: PROGRAM INTEGRATION AND DATA MANAGEMENT MODULE. PART 1: PROGRAM INTEGRATION**
G. Hayase, R. Hiyama, C. Martindale, and H. Rockwell Jun. 1974 224 p
(Contract F33615-71-C-1922)
(AD-A002852; ASD/XR-74-10-Vol-2-Pt-1) Avail: NTIS CSCL 01/3

The methodology, program description, and user's information for the SWEEP control program are presented along with the input data processing module, final output module, and the data management module. GRA

**N75-20303#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCUTRAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 2: PROGRAM INTEGRATION AND DATA MANAGEMENT MODULE. PART 2: DATA MANAGEMENT MODULE**
G. Hayase, R. Hiyama, C. Martindale, and H. Rockwell Jun. 1974 285 p
(Contract F33615-71-C-1922)
(AD-A002853; ASD/XR-74-10-Vol-2-Pt-2) Avail: NTIS CSCL 01/3

**N75-20304#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 2: PROGRAM INTEGRATION AND DATA MANAGEMENT MODULE. APPENDIX A: DATA MANAGEMENT MODULE FLOW CHARTS AND FORTRAN LISTS**
G. Hayase, R. Hiyama, C. Martindale, and H. Rockwell Jun. 1974 330 p refs
(Contract F33615-71-C-1922)
(AD-A002851; ASD/XR-74-10-Vol-2-App-A) Avail: NTIS CSCL 01/3

**N75-20305#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 3: AIRLOADS ESTIMATION MODULE**
P. Wildermuth, G. Rothammer, and R. Hiyama Jun. 1974 279 p refs
(Contract F33615-71-C-1922)
(AD-A002854; ASD/XR-74-10-Vol-3) Avail: NTIS CSCL 01/3

The methodology, program description, and user's information for the airload module of SWEEP are presented. GRA

**N75-20306#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 3: AIRLOADS ESTIMATION MODULE. APPENDIX A: MODULE FLOW CHARTS AND FORTRAN LISTS. APPENDIX B: SAMPLE OUTPUT**
P. Wildermuth, G. Rothammer, and R. Hiyama Jun. 1974 190 p
(Contract F33615-71-C-1922)

(AD-A002855; ASD/XR-74-10-Vol-3-App-A/8) Avail: NTIS CSCL 01/3

**N75-20307#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 4: MATERIAL PROPERTIES, STRUCTURE TEMPERATURE, FLUTTER AND FATIGUE**
H. Haroldson, C. Hodson, S. Mellin, H. Rockwell, and S. Tejani Jun. 1974 408 p refs
(Contract F33615-71-C-1922)
(AD-A002856; ASD/XR-74-10-Vol-4) Avail: NTIS CSCL 01/3
The methodology, program description, and user's information are presented for the use of material properties, flutter and temperature module, and fatigue module of SWEEP.
GRA

**N75-20308#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 5: AIR INDUCTION SYSTEM AND LANDING GEAR MODULES. PART 1: AIR INDUCTION SYSTEM MODULE**
D. Chaloff, R. Hiyama, and C. Martindale Jun. 1974 472 p refs
(Contract F33615-71-C-1922)
(AD-A002857; ASD/XR-74-10-Vol-5-Pt-1) Avail: NTIS CSCL 01/3
The methodology, program description, and user's information are presented for the air induction system and landing gear modules of SWEEP.
GRA

**N75-20309#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 5: AIR INDUCTION SYSTEM AND LANDING GEAR MODULES. PART 2: LANDING GEAR MODULE**
D. Chaloff, R. Hiyama, and C. Martindale Jun. 1974 180 p refs
(Contract F33615-71-C-1922)
(AD-A002858; ASD/XR-74-10-Vol-5-Pt-2) Avail: NTIS CSCL 01/3

**N75-20310#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. BOOK 1: TECHNICAL DISCUSSION SECTIONS 1 AND 2**
G. Hayase Jun. 1974 392 p
(Contract F33615-71-C-1922)
(AD-A002864; ASD/XR-74-10-Vol-6-Bk-1) Avail: NTIS CSCL 01/3
The methods and program description for the wing and empennage module of SWEEP are presented. Program listings and flow charts are included in the appendix.
GRA

**N75-20311#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. BOOK 2: TECHNICAL DISCUSSION, SECTIONS 3 AND 4**
G. Hayase Jun. 1974 353 p
(Contract F33615-71-C-1922)
(AD-A002865; ASD/XR-74-10-Vol-6-Bk-2) Avail: NTIS CSCL 01/3

**N75-20312#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. BOOK 3: TECHNICAL DISCUSSION, SECTION 5**
G. Hayase Jun. 1974 357 p refs
(Contract F33615-71-C-1922)
(AD-A002866; ASD/XR-74-10-Vol-6-Bk-3) Avail: NTIS CSCL 01/3

**N75-20313#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. APPENDIX A: GENERAL INFORMATION FOR MODULE FLOW CHARTS AND LISTINGS. APPENDIX B: PROGRAM FLOW CHARTS, OVERLAYS (8,0), (14,0), (15,0), (16,0) AND (17,0)**
G. Hayase Jun. 1974 472 p
(Contract F33615-71-C-1922)
(AD-A002859; ASD/XR-74-10-Vol-6-App-A/B) Avail: NTIS CSCL 01/3

**N75-20314#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. APPENDIX C: PROGRAM FLOW CHARTS, OVERLAYS (9,0) AND (10,0)**
G. Hayase Jun. 1974 340 p refs
(Contract F33615-71-C-1922)
(AD-A002860; ASD/XR-74-10-Vol-6-App-C) Avail: NTIS CSCL 01/3

**N75-20315#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. APPENDIX D: PROGRAM FLOW CHARTS, OVERLAY (18,0)**
G. Hayase Jun. 1974 243 p
(Contract F33615-71-C-1922)
(AD-A002861; ASD/XR-74-10-Vol-6-App-D) Avail: NTIS CSCL 01/3

**N75-20316#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. APPENDIX E: PROGRAM LISTINGS, OVERLAYS (8,0), (14,0), (15,0), (16,0), AND (17,0)**
G. Hayase Jun. 1974 239 p
(Contract F33615-71-C-1922)
(AD-A002862; ASD/XR-74-10-Vol-6-App-E) Avail: NTIS CSCL 01/3

**N75-20317#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 6: WING AND EMPENNAGE MODULE. APPENDIX F: PROGRAM LISTINGS, OVERLAYS (9,0), (10,0) AND (18,0)**
G. Hayase Jun. 1974 261 p
(Contract F33615-71-C-1922)
(AD-A002863; ASD/XR-74-10-Vol-6-App-F) Avail: NTIS CSCL 01/3

**N75-20318#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 7: FUSELAGE MODULE**

R. Hiyama Jun. 1974 439 p refs
(Contract F33615-71-C-1922)
(AD-A002867; ASD/XR-74-10-Vol-7) Avail: NTIS CSCL 01/3

The methodology, program description, and user's information are presented for the fuselage module of SWEEP.

GRA

**N75-20319#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 7: FUSELAGE MODULE. APPENDIX A: MODULE FLOW CHARTS AND FORTRAN LISTS. APPENDIX B: FUSELAGE MODULE SAMPLE OUTPUT**

R. Hiyama Jun. 1975 450 p
(Contract F33615-71-C-1922)
(AD-A002868; ASD/XR-74-10-Vol-7-App-A/B) Avail: NTIS CSCL 01/3

**N75-20320#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 8: PROGRAMMER'S MANUAL**

C. Martindale, H. Rockwell, G. Hayase, and R. Hiyama Jun. 1974 81 p
(Contract F33615-71-C-1922)
(AD-A002869; ASD/XR-74-10-Vol-8) Avail: NTIS CSCL 01/3

The program structure and operation of SWEEP is described. Information is given for modifying and debugging the program.

GRA

**N75-20321#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 9: USER'S MANUAL**

R. Allen, D. Chaloff, G. Hayase, R. Hiyama, and C. Martindale Jun. 1974 373 p refs
(Contract F33615-71-C-1922)
(AD-A002870; ASD/XR-74-10-Vol-9) Avail: NTIS CSCL 01/3

The instructions and input descriptions are presented for the integrated SWEEP program.

GRA

**N75-20322#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 9: USER'S MANUAL, APPENDIX A**

R. Allen, D. Chaloff, G. Hayase, R. Hiyama, and C. Martindale Jun. 1974 299 p
(Contract F33615-71-C-1922)
(AD-A002871; ASD/XR-74-10-Vol-9-App-A) Avail: NTIS CSCL 01/3

**N75-20323#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 10: FLUTTER OPTIMATION STAND-ALONE PROGRAM**

S. Siegel Jun. 1974 271 p
(Contract F33615-71-C-1922)
(AD-A002872; ASD/XR-74-10-Vol-10) Avail: NTIS CSCL 01/3

The methodology, program description, and user's information are presented for the flutter optimization stand-alone program of SWEEP.

GRA

**N75-20324#** Rockwell International Corp., Los Angeles, Calif. Aircraft Div.

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME 11: FLEXIBLE AIRLOADS STAND-ALONE PROGRAM**

P. Wildermuth, G. Rothammer, and T. Byar Jun. 1974 274 p refs
(Contract F33615-71-C-1922)
(AD-A002873; ASD/XR-74-10-Vol-11) Avail: NTIS CSCL 01/3

The methodology, program description, and user's information are presented for the flexible loads stand-alone program of SWEEP.

GRA

**N75-20325#** Army Aviation Systems Command, St. Louis, Mo.

**MAJOR ITEM SPECIAL STUDY (MISS), UH-1H TAIL ROTOR HANGERS Interim Technical Report, Jan. 1964 - Dec. 1973**

Dec. 1974 24 p
(AD-A003263; USAAVSCOM-TR-74-52) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components. These are time change items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From this data, removal distribution can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas.

GRA

**N75-20329*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

**EXPLORATORY WIND TUNNEL TESTS OF A SHOCK-SWALLOWING AIR DATA SENSOR AT A MACH NUMBER OF APPROXIMATELY 1.83**

Jack Nugent, Lana M. Couch, and Lannie D. Webb Mar. 1975 42 p refs
(NASA-TM-X-56030) Avail: NTIS HC $3.75 CSCL 01D

The test probe was designed to measure free-stream Mach number and could be incorporated into a conventional airspeed nose boom installation. Tests were conducted in the Langley 4-by 4-foot supersonic pressure tunnel with an approximate angle of attack test range of -5 deg to 15 deg and an approximate angle of sideslip test range of + or - 4 deg. The probe incorporated a variable exit area which permitted internal flow. The internal flow caused the bow shock to be swallowed. Mach number was determined with a small axially movable internal total pressure tube and a series of fixed internal static pressure orifices. Mach number error was at a minimum when the total pressure tube was close to the probe tip. For four of the five tips tested, the Mach number error derived by averaging two static pressures measured at horizontally opposed positions near the probe entrance were least sensitive to angle of attack changes. The same orifices were also used to derive parameters that gave indications of flow direction.

Author

**N75-20330#** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

**C-141 ALL WEATHER LANDING SYSTEM (AWLS) FLIGHT TEST REPORT: OPTIMIZATION AND PRE-EXPERIMENTAL PHASES Final Report, 1 Nov. 1972 - 19 Feb. 1974**

Robert J. Hovde Apr. 1974 142 p
(Contract DOT-FA70WAI-173)
(AD-A003952; AFFDL-TM-74-109-FGSA; FAA-RD-74-192)
Avail: NTIS HC $5.75 CSCL 01/4

A chronological description of C-141 aircraft flight tests and aircraft modification since Nov. 1, 1972, is given. The present aircraft (NC-1414, 61-2775) and All Weather Landing System (AWLS) configurations are described along with the pilot

procedures to be used initially in the Experimental Phase of the program. Individual mission reports are presented in Appendix A. Diagrams of each baseline approach are presented in Appendix B. The primary conclusion is that the aircraft is ready for Category III Weather Flight Testing. Some discussion is presented on equipment specifications for CAT III landings. Two areas are identified that need further developmental work: (1) For short runway operations and stop and go operations, an accurate Runway Distance Remaining Display is needed. (2) For zero visibility landings, the pilot requires some positive indication that the aircraft is almost stopped; otherwise the pilot tends to stop too abruptly, causing the aircraft to lurch violently at the moment of final stopping. Author

**N75-20331#** E-A Industrial Corp., Chamblee, Ga.
**INSTRUMENT SYSTEM TEST. ELLIOTT HELICOPTER AIR DATA SYSTEM Final Report**
I. John Carter 30 Oct. 1974 30 p refs
(Contract N00014-73-C-0291; NR Proj. 213-114)
(AD-A002332; EA-01-0032-A-11) Avail: NTIS CSCL 01/3

During 1973-1974, evaluation of a helicopter lift margin system was conducted on a NUH-1M helicopter. In order to provide air data references to the pilot and for assessment of the effects of airspeed and vertical speed variations on System accuracies an air data subsystem was supplied, consisting of a two- axis helicopter airspeed sensing equipment. Findings are reported and discussed. GRA

**N75-20332#** Boeing Vertol Co., Philadelphia, Pa.
**VISUAL AUGMENTATION SYSTEM (VAS) LABORATORY DEMONSTRATION AND TEST RESULTS Technology Development Report**
L. F. Simpson Oct. 1974 36 p
(Contract DAAJ01-71-C-0840)
(AD-A003323; USAAMRDL-TR-74-68) Avail: NTIS CSCL 01/3

This document describes the laboratory demonstration of the Visual Augmentation System (VAS) and components, later installed in the Model 347 helicopter, and the results of tests of operational parameters pertinent to the performance and suitability for in-flight evaluation; i.e., TV camera functions and optical characteristics such as focus, field of view, sensitivity, linearity resolution and vibration, electromagnetic compatibility environmental tolerance. Based on the results of the tests and demonstrations, it was concluded that the VAS was suitable for use in the flight evaluation test program. GRA

**N75-20336#** Oxford Univ. (England). Dept. of Engineering Science.
**INTERNAL-COMBUSTION ENGINE/VAPOUR CYCLE COMBINATION Ph.D. Thesis**
M. S. Radwan Sep. 1974 406 p refs Sponsored in part by Inst. of Mech. Engineers, Sci. Res. Council, and CAV Ltd., London
(OUEL-1097/74) Avail: NTIS HC $10.50

The possibility of using the heat rejected both in the cooling system and in the exhaust of an internal combustion engine for a vapor power cycle to increase the power production and the thermal efficiency of the combination is discussed. Heat transfer characteristics from cast iron and steel in distilled water and monochlorobenzene are presented, and the effect of nucleate boiling of the two liquids on the surface heat transfer properties of the two metals is dealt with. Diesel engine performance at elevated jacket temperatures with water and monochlorobenzene was determined. The performance to be expected at full and part load of a 1500 H.P. diesel engine with a water or monochlorobenzene vapor power cycle is compared. ESRO

**N75-20337#** AiResearch Mfg. Co., Phoenix, Ariz.
**IMPACT OF TURBINE MODULATION ON VARIABLE-CYCLE ENGINE PERFORMANCE. PHASE 1 AND 2: DESIGN FABRICATION AND RIG TEST, PART 1 Final Technical Report, 17 May 1971 - 31 Dec. 1974**
W. R. Davenport, G. J. Dixon, A. Fischer, K. R. Fledderjohn, J. R. Shearer, M. A. Steele, D. W. Stephenson, and F. Weber Dec. 1974 316 p
(Contract F33615-71-C-1625; AF Proj. 3066)
(AD-A002543; Rept-7-3-210173-Pt-1; AFAPL-TR-74-109-Pt-1) Avail: NTIS CSCL 21/5

Part I of this report documents the analysis, design, and rig tests conducted in Phases 1 and 2. Part 2 reports the engine work and sea-level tests completed in Phase 3. Parts 3A and 3B document the altitude tests conducted in Phase 4. This program was conducted to determine the impact of variable geometry compressor, turbine, and exhaust-nozzle components on turbofan engine performance. GRA

**N75-20338#** AiResearch Mfg. Co., Phoenix, Ariz.
**IMPACT OF TURBINE MODULATION ON VARIABLE-CYCLE ENGINE PERFORMANCE. PHASE 3: ENGINE MODIFICATION AND SEA LEVEL TEST, PART 2 Final Technical Report, May 1971 - 31 Dec. 1974**
W. R. Davenport, G. J. Dixon, A. Fischer, K. R. Fledderjohn, J. R. Shearer, M. A. Steele, D. W. Stephenson, and F. Weber Dec. 1974 245 p
(Contract F33615-71-C-1625; AF Proj. 3066)
(AD-A002544; Rept-73-210173-Pt-2; AFAPL-TR-74-109-Pt-2) Avail: NTIS CSCL 21/5

An AiResearch Model TFE731-2 Turbofan Engine was modified to incorporate production-type variable-geometry hardware and tested to determine the effects of turbine modulation at both sea-level static and simulated high-altitude flight conditions at subsonic and supersonic flight Mach numbers. GRA

**N75-20339#** AiResearch Mfg. Co., Phoenix, Ariz.
**IMPACT OF TURBINE MODULATION ON VARIABLE-CYCLE ENGINE PERFORMANCE. PHASE 4: ADDITIONAL HARDWARE DESIGN AND FABRICATION, ENGINE MODIFICATION, AND ALTITUDE TEST, PART 3A Final Technical Report, 17 May 1971 - 31 Dec. 1974**
W. R. Davenport, G. J. Dixon, A. Fischer, K. R. Fledderjohn, J. R. Shearer, M. A. Steele, D. W. Stephenson, and F. Weber Dec. 1974 306 p
(Contract F33615-71-C-1625; AF Proj. 3066)
(AD-A002545; Rept-73-210173-Pt-3A; AFAPL-TR-74-109-Pt-3A) Avail: NTIS CSCL 21/5

The Variable-Cycle TFE731 Turbofan Engine utilized in the altitude performance test is the same engine that was used in the Phase III sea-level test program. The engine description is presented in 3.1.1. The test engine, Part 3069600, Serial No. 7399, Build 2, was assembled with new hardware and instrumentation as required, and incorporated variable primary and fan exhaust nozzles. The variable compressor stator and LP turbine stator actuation systems were identical with those used during the Phase III test program. GRA

**N75-20340#** AiResearch Mfg. Co., Phoenix, Ariz.
**IMPACT OF TURBINE MODULATION ON VARIABLE-CYCLE ENGINE PERFORMANCE. PHASE 4: ADDITIONAL HARDWARE DESIGN AND FABRICATION, ENGINE MODIFICATION, AND ALTITUDE TEST, PART 3B Final Technical Report, 17 May 1971 - 31 Dec. 1974**
W. R. Davenport, G. J. Dixon, A. Fischer, K. R. Fledderjohn, J. R. Shearer, M. A. Steele, D. Stephenson, and F. Weber Dec. 1974 275 p refs
(Contract F33615-71-C-1625)
(AD-A002546; Rept-73-210173-Pt-3B; AFAPL-TR-74-109-Pt-3B) Avail: NTIS CSCL 21/5

The objective of this series of tests was to demonstrate that the net thrust and airflow of the TFE731 Engine may be increased at Mach 0.6, 20,000 feet, standard atmosphere with the use of variable geometry that tends to increase the low pressure rotor speed or the engine airflow at a constant LP rotor speed. GRA

**N75-20341#** Bell Helicopter Co., Fort Worth, Tex.
**OH-58A PROPULSION SYSTEM VIBRATION INVESTIGATION Final Report**
James A. White Aug. 1974 190 p refs

(Contract DAAJ02-73-C-0017; DA Proj. 1G2-62207-AH-89)
(AD-A002672; USAAMRDL-TR-74-67) Avail: NTIS CSCL 21/5

The report presents the results of an investigation of the OH-58A helicopter and Allison T-63 engine vibration characteristics. The investigation was directed toward the determination of engine response using impedance/mobility methods and NAsa STructural ANalysis (NASTRAN). The results of these studies are compared with each other, with results from independent vibration tests of the airframe and engine, and with engine vibration levels measured during flight testing of the OH-58A helicopter. The objective was to determine the parameters defining the vibratory interaction and to provide a common language for engine/airframe interface analysis and for preparation of engine/airframe specifications. GRA

N75-20342# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

**ROTATING ENGINE DESIGN AND CYCLE ANALYSIS PROGRAM**

I. A. Carnegis Oct. 1974 55 p refs
(AF Proj. 8224)
(AD-A002314; AFFDL-TR-74-128) Avail: NTIS CSCL 21/5

This report describes a computer program titled 'Rotating Engine Design and Cycle Analysis Program'. The program is capable of analyzing turbojets, two spool turbofans (both front and aft fans), turboprops, turboshafts, and subsonic burning ramjets. This program was developed with emphasis on high speed computation for cycle analysis and for propulsion/flight control sensor analysis. It is capable of computation time in the order of a few milliseconds per cycle case. The report includes a description of the program's capabilities and limitations, special features, complete listing, sample input data, and corresponding sample output data. GRA

N75-20343# Pennsylvania State Univ., University Park. Applied Research Lab.

**MEASUREMENT AND ANALYSIS OF THE UNSTEADY NORMAL FORCE AND PITCHING MOMENT ON AN AXIAL FLOW FAN ROTOR BLADE ELEMENT**

Edgar P. Bruce 3 May 1974 22 p refs Presented at the 2nd Interagency Symp. on Univ. Res. in Transportation Noise, Rayleigh, N. C., 5-7 Jun. 1974
(Contract N00014-67-A-0226-0005)
(AD-A002739; TM-74-124) Avail: NTIS CSCL 20/1

In recent years, the radiated noise problem has emerged as one of the most serious problems associated with the design of axial flow turbomachines. Prediction of the noise radiated from a turbomachine is dependent upon a knowledge of the fluctuating forces on the blades. The ARL axial flow research fan (AFRF) was designed specifically to provide a capability for detailed research which will define the response of axial flow turbomachinery blade elements and/or blade rows to subsonic incompressible unsteady flow of the type encountered in practice. The purpose of the memo is to describe this facility and the specialized equipment that has been developed for use in it, and to present some preliminary unsteady force data. GRA

N75-20344*# Lockheed Aircraft Corp., Burbank, Calif.

**EVALUATION OF ACTIVE CONTROL TECHNOLOGY FOR SHORT HAUL AIRCRAFT Final Report**

J. H. Renshaw, J. A. Bennett, O. C. Harris, J. F. Honrath, and R. W. Patterson Feb. 1975 156 p refs
(Contract NAS2-6995)
(NASA-CR-137634; LG75ER0029) Avail: NTIS HC $6.25 CSCL 01C

An evaluation of the economics of short-haul aircraft designed with active controls technology and low wing-loading to achieve short field performance with good ride quality is presented. Results indicate that for such a system incorporating gust load alleviation and augmented stability the direct operating cost is better than for aircraft without active controls. J.M.S.

N75-20345*# Boeing Commercial Airplane Co., Seattle, Wash.

**DEVELOPMENT OF LONGITUDINAL HANDLING QUALITIES CRITERIA FOR LARGE ADVANCED SUPERSONIC AIRCRAFT Final Report**

Robert W. Sudderth, Jeff G. Bohn, Martin A. Caniff, and Gregory R. Bennett Mar. 1975 212 p refs
(Contract NAS2-7966)
(NASA-CR-137635) Avail: NTIS HC $7.25 CSCL 01C

Longitudinal handling qualities criteria in terms of airplane response characteristics were developed. The criteria cover high speed cruise maneuvering, landing approach, and stall recovery. Data substantiating the study results are reported. Author

N75-20347# European Space Research Organization, Paris (France).

**EXTRACTION OF FLIGHT MECHANIC DERIVATIVES FROM FLIGHT DATA BY A MANUAL ANALOG MATCHING TECHNIQUE**

Alfred Pietrass Dec. 1974 82 p refs Transl. into ENGLISH of Ermittlung von flugmechanischen Derivativen aus Flugmessungen durch manuelle Variation der Modellparameter am Analogrechner, DLR-FB-73-111, DFVLR, 8 Sep. 1973 Original German report available from DFVLR, Porz, West Ger. 27. 90 DM
(ESRO-TT-118; DLR-FB-73-111) Avail: NTIS HC $4.75

Starting from linearized equations of motion of conventional jet aircraft, relations are established between single derivatives or groups of derivatives and characteristics of the transient motion in measured responses. An iterative procedure is given for parameter identification by manual analog model matching. Some parameters extracted from flight measurements of a business jet aircraft differ considerably from predicted values. Beyond the widely used linear equations with constant aerodynamic derivatives, parameters were identified of nonlinear increase of drag with incremental angle of attack, and nonstationary flap effectiveness. Author (ESRO)

N75-20348# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.

**DIGITAL FLIGHT CONTROL SYSTEM FOR TACTICAL FIGHTER. VOLUME 1: DIGITAL FLIGHT CONTROL SYSTEM ANALYSIS Interim Report, Feb. 1972 - Jun. 1973**

A. Ferit Konar, J. K. Mahesh, and B. Kizilos Jun. 1974 353 p refs
(Contract F33615-72-C-1058; AF Proj. 1987)
(AD-A002320; F0131-IR1-Vol-1; Honeywell-08001-Vol-1; AFFDL-TR-73-119-Vol-1) Avail: NTIS CSCL 01/3

The Digital Flight Control Systems for Tactical Fighters Program is a development program which defines the technology necessary to apply digital flight control techniques to the three-axis, multiple flight control configuration demands of advanced fighter aircraft. Analysis efforts to date have defined powerful computer program tools which permit determination of flight control system performance as a function of computational parameters -- word length, sample rate, and computational delays. An exercise of the programs using the F-4 as a model indicates 100 iterations per second as satisfactory for the longitudinal axis. GRA

N75-20349# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.

**DIGITAL FLIGHT CONTROL SYSTEMS FOR TACTICAL FIGHTERS. VOLUME 2: DOCUMENTATION OF THE DIGITAL CONTROL ANALYSIS SOFTWARE (DIGIKON) Interim Report, Feb. 1972 - Oct. 1973**

A. F. Konar, B. Kizilos, J. Gayl, J. K. Mahesh, and M. Borow Jun. 1974 478 p refs
(Contract F33615-72-C-1058; AF Proj. 1987)
(AD-A002327; F0131-IR1-Vol-2; Honeywell-08001-Vol-2; AFFDL-TR-73-119-Vol-2) Avail: NTIS CSCL 01/3

The computer programs which implement the mathematical analyses and models developed in Volume I are described. The programs are developed in Fortran IV language. Extensive use of subroutines is made to provide programming flexibility when considering alternate airframe/dynamics/control points/measurement systems/controllers effect on control system

performance. A demonstration example is included in Volume I to illustrate how these programs are used and how the computational requirements are derived. GRA

**N75-20350*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SHAKE TEST OF ROTOR TEST APPARATUS IN THE 40- BY 80-FOOT WIND TUNNEL**
Wayne Johnson (Army Air Mobility R and D Lab., Moffett Field, Calif.) and James C. Biggers Feb. 1975 74 p
(NASA-TM-X-62418; A-5973) Avail: NTIS HC $4.25 CSCL 14B

A shake test was conducted to determine the dynamic characteristics of a rotor test apparatus on strut systems. The rotor-off hub transfer function (acceleration per unit force as a function of frequency) was measured in the longitudinal and lateral directions, using a combination of broadband and discrete frequency excitation techniques. The dynamic data is summarized for the configurations tested, giving the following properties for each mode identified: the natural frequency, the hub response at resonance, and the fixed system damping. The complete transfer functions are presented, and the detailed test results are included as an appendix. Data analysis techniques developed to obtain on-line measurements of the system modal properties, including the damping coefficient and the damping ratio are discussed. Author

**N75-20352#** Boeing Commercial Airplane Co., Seattle, Wash.
**WIND MODELS FOR FLIGHT SIMULATOR CERTIFICATION OF LANDING AND APPROACH GUIDANCE AND CONTROL SYSTEMS Final Report**
Neal M. Barr, Dagfinn Gangaas, and Dwight R. Schaeffer Dec. 1974 623 p refs
(Contract DOT-FA72WA-2934)
(AD-A003801; FAA-RD-74-206) Avail: NTIS HC $15.25 CSCL 17/7

Analytic and probabilistic descriptions of low-altitude mean wind and turbulence are investigated and described. The effects of wind and turbulence on aerodynamics and aircraft motion are analyzed. A model of wind and turbulence, suitable for the certification of landing and approach guidance and control systems by flight simulations, is developed, and consideration given to implementation. Author

**N75-20353#** National Aviation Facilities Experimental Center, Atlantic City, N.J.
**EVALUATION OF THE RUBINO PROCEDURE FOR RADIO TELEMETRIC THEODOLITE POSITIONING Final Report, Oct. 1974**
D. S. Lerner Jan. 1975 46 p Revised
(Contract DOT-FA74NA-1027)
(AD-A004317; FAA-NA-74-177-Rev; FAA-EM-74-17) Avail: NTIS HC $3.75 CSCL 01/5

An evaluation of a procedure described in the Working Paper on Radio Telemetric Theodolite (RTT) Positioning was conducted. An analysis and evaluation was conducted by gathering information about the present glide slope system, difficulties that had been encountered, and changes that had been implemented. The analysis performed indicates that all factors affecting the glidepath are separated by the RTT placement into path structure (indicated by the flight recording), and the threshold crossing height (which is incorporated into the RTT placement). This study evaluation concludes that because of this separation the procedure is better because it provides a better description of the glidepath in space. Author

**N75-20548#** Battelle Columbus Labs., Ohio.
**DESIGN AND PURCHASE EXPECTATIONS FOR FRACTURE RESISTANCE OF 700-SERIES ALUMINUM AIRFRAME ALLOYS Interim Report, Oct. 1972 - Sep. 1973**
William E. Anderson Jan. 1974 38 p refs
(Contract F33657-73-C-0281)
(AD-A002552; ASD-TR-74-16) Avail: NTIS CSCL 11/6

When an airframe component breaks suddenly, under conditions well within the design envelope, the occurrence is usually termed brittle fracture. This report uses an analytical scheme which combines data from several different sources in order to provide diagrams of fracture resistance versus thickness for a number of standard yield strength levels. By using such diagrams, limited data on a new alloy or heat treatment may be compared, and the impact on designs where fracture resistance is important may be assessed. The data background employed in the analysis consisted of both iron- and aluminum-base airframe materials. However, this report focuses largely on the 7000-series aluminum alloys. Minimum expected behavior has been developed for this series of aluminum alloys by examining fracture toughness, yield strength, and thickness effect in accordance with the analytical scheme described. GRA

**N75-20554#** Boeing Commercial Airplane Co., Seattle, Wash.
**DEVELOPMENT OF STATISTICAL FATIGUE FAILURE CHARACTERISTICS OF 0.125 INCH 2024-T3 ALUMINUM UNDER SIMULATED FLIGHT-BY-FLIGHT LOADING Final Report, Aug. 1972 - Mar. 1974**
J. P. Butler and D. A. Rees Jul. 1974 186 p refs
(Contract F33615-72-C-2003; AF Proj. 7351)
(AD-A002310; AFML-TR-74-124) Avail: NTIS CSCL 11/6

Thirty-two unique multidetail specimens were tested to develop a data base for investigating the statistical materials/structures fatigue failure characteristics of 2024-T3 aluminum alloy in the form of 0.225-in.-thick sheet. The test loading was a random-load, flight-by-flight loading block spectrum repeated to obtain crack initiation. Six different basic spectra, representative of cargo/transport or gust load flights, were applied to the specimens. Fatigue crack initiation was detected and controlled to a nominal crack length of about 0.04 in. from the edge of the hole by a painted crack detection circuit system. After detection of crack initiation, each hole was restored to an undamaged state by oversizing and coldworking. A statistical analysis of the data by previously developed maximum likelihood methods is presented for both scale and shape parameters of the log-normal and two-parameter Weibull distributions. GRA

**N75-20676#** AiResearch Mfg. Co., Phoenix, Ariz.
**EVALUATION PROGRAM ON USING COMPRESSOR BLEED AIR AS A SOURCE OF PNEUMATIC POWER FOR FLUIDIC CIRCUITS Final Report, Oct. 1972 - Oct. 1973**
R. S. McCarty 5 Oct. 1973 75 p
(Contract N62269-73-C-0476)
(AD-A002483; AiResearch-73-410307) Avail: NTIS CSCL 13/7

The program activities encompassed study and analysis of the characteristics of compressor bleed air as it is affected by engine power settings, engine age, location of the extraction point, inlet ingestion, and how the contamination of all of these affect fluidic components. GRA

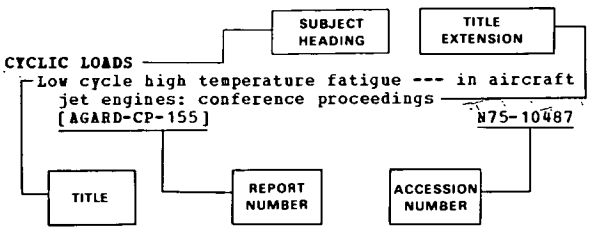
**N75-20777#** Battelle Columbus Labs., Ohio.
**FRACTURE MECHANICS OF TINY CRACKS NEAR FASTENERS**
William E. Anderson Jun. 1974 61 p refs
(Contract F33657-73-C-0281)
(AD-A002554; ASD-TR-74-24) Avail: NTIS CSCL 11/6

This report deals with the question of how tiny a crack might be in aluminum alloys of high strength and still be analytically treated by the methods of linear elastic fracture mechanics (LEFM). These techniques are used to obtain estimates of the expected rate of crack extension. Under simple cyclic loadings, LEFM-based predictions are usually within a factor of two from measured experimental results. GRA

# SUBJECT INDEX



## Typical Subject Index Listing




The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, a title extension is added, separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

## A

**ABSORBERS (MATERIALS)**
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939
**AC GENERATORS**
Program for the development of a superconducting generator. Part 1: Phase 1 --- including critical component tests
[AD-A001649] N75-19546
**ACCELERATION (PHYSICS)**
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential --- Book
A75-26700
**ACCIDENT PREVENTION**
General Aviation Aircraft Safety
[AD-A003124] N75-19199
**ACOUSTIC DUCTS**
Spinning mode sound propagation in ducts with acoustic treatment
A75-27854
Unified analysis of ducted turbomachinery noise
A75-27861
Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine
[AIAA PAPER 75-457] A75-27928
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
Aeroacoustics: Jet and combustion noise; duct acoustics --- Book
A75-28629
**ACOUSTIC INSTABILITY**
Development of acoustic disturbances in supersonic annular jets
A75-26234
**ACOUSTIC MEASUREMENTS**
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation --- Book
A75-28626
Comparison of parametric duct-burning turbofan and non-afterburning turbojet engines in a Mach 2.7 transport
[NASA-TM-X-71679] N75-19247
**ACOUSTIC NOZZLES**
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
**ACOUSTIC PROPERTIES**
Classification problems of aircraft noise --- far field measurements
A75-27943
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
Trends in aircraft noise control
N75-20229
**ACOUSTIC VELOCITY**
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier
A75-26881
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184
**ADAPTIVE CONTROL**
Adaptive digital system for aircraft control
A75-27182
Adaptive control system with reference model --- application to automatic pilots
A75-27912
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
**AERIAL RUDDERS**
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
**AERODYNAMIC BRAKES**
Some notes on the thermodynamics of thrust reversal in flight
N75-20212
**AERODYNAMIC CHARACTERISTICS**
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier
A75-26881
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations
A75-28522
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour
A75-28658
An exact solution for transonic potential flow past aerofoil sections
[NAL-TR-383] N75-19176
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-19177
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
Technical evaluation report on Fluid Dynamics Panel Symposium on V/STOL Aerodynamics
[AGARD-AR-78] N75-19585

AERODYNAMIC COEFFICIENTS
Lift coefficients on a supercavitating jet-flapped foil between rigid walls A75-26554
Critical analysis and improvement of the source-panel method --- for lift prediction A75-28095
Computation of airfoil DRAG profiles [REPT-35/1974] N75-19165
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it [NASA-TT-F-16133] N75-19179
AERODYNAMIC CONFIGURATIONS
Unsteady viscous flow past a lifting plate N75-19171
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0 [NASA-TM-X-3130] N75-19181
Problems of designing passenger aircraft [NASA-TT-F-808] N75-19223
Fuel conservation possibilities for terminal area compatible aircraft [NASA-CR-132608] N75-19224
AERODYNAMIC DRAG
The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface A75-27990
Opportunities for aerodynamic-drag reduction N75-20237
AERODYNAMIC FORCES
A method for calculating unsteady forces due to interaction between tail surfaces A75-26477
Unsteady lift forces on a vibrating cylinder in a supercritical flow A75-26480
Improvements to the SADSAM computer program for aeroelasticity analysis [NASA-CR-132617] N75-19173
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings [NAL-TR-368T-PT-1] N75-19174
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0 [NASA-TM-X-3178] N75-19180
Some remarks on the induced velocity field of a lifting rotor and on Glauert's formula [ARC-CP-1301] N75-20263
AERODYNAMIC INTERFERENCE
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode A75-26553
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise [AIAA PAPER 75-443] A75-27926
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models [NASA-TM-X-3185-SUPPL] N75-20294
AERODYNAMIC LOADS
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential --- Book A75-26700
TRW vortex-lattice method subsonic aerodynamic analysis for multiple-lifting-surfaces (N. surface) TRW program number HA010B [NASA-CR-128588] N75-19178
Calculations of generalised airforces on two parallel lifting surfaces oscillating harmonically in subsonic flow [ARC-R/M-3749] N75-19187
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module [AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output [AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program [AD-A002873] N75-20324
AERODYNAMIC NOISE
Development of acoustic disturbances in supersonic annular jets A75-26234
The generation of sound by aerodynamic sources in an inhomogeneous steady flow A75-26463
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise [AIAA PAPER 75-443] A75-27926
Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine [AIAA PAPER 75-457] A75-27928
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data [AIAA PAPER 75-477] A75-27933
Some recent developments in supersonic jet noise reduction [AIAA PAPER 75-502] A75-27937
Ratio of peak frequencies of jet self and shear noise spectra A75-28400
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation --- Book A75-28626
Aeroacoustics: Jet and combustion noise; duct acoustics --- Book A75-28629
Trends in aircraft noise control N75-20229
AERODYNAMIC STABILITY
Rotation in vibration, optimization, and aeroelastic stability problems N75-19167
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport --- aerodynamic control and stability [NASA-TM-X-72671] N75-19226
Determination of aircraft characteristics from flight tests [ESRO-TT-104] N75-19252
Comparison of evaluation procedures for the determination of flight-mechanical coefficients and derivatives from flight tests --- Fiat G-91 T3 aircraft N75-19254
Determination of aerodynamic derivatives of the FIAT G-91 T3 aircraft from flight tests by means of manual analog model matching N75-19257
Evaluation of flight test of the FIAT G-91 T3 by means of the method of forced oscillations N75-19258
Evaluation of flight tests of the FIAT G-91 T3 by means of regression analysis N75-19259
A SAAB-SCANIA developed method for obtaining stability derivatives from flight tests N75-19260
Characteristics of the AJ 37 aircraft: Comparison of the results of wind tunnel and flight tests --- noting elasticity correction for wind tunnel model N75-19261
Determination of derivatives by a model with automatic parameter --- analog circuit N75-19265
Extraction of flight mechanic derivatives from flight data by a manual analog matching technique [ESRO-TT-118] N75-20347
AERODYNAMIC STALLING
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil A75-26212
Design considerations for stall/spin avoidance N75-19205
AERODYNAMICS
A problem in supersonic jet theory A75-26697

**AEROELASTICITY**
Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing A75-28687
Rotation in vibration, optimization, and aeroelastic stability problems N75-19167
Improvements to the SADSAM computer program for aeroelasticity analysis
[NASA-CR-132617] N75-19173

**AERONAUTICAL ENGINEERING**
The future of aeronautics
[NASA-CR-142559] N75-20222
Aeronautics in the American society N75-20223
University research in aeronautics N75-20241
General aviation's future need for research N75-20242
University research in aeronautics N75-20243

**AERONAUTICAL SATELLITES**
Air Traffic Control demonstration aspects of the Applications Technology Satellite-6
[AIAA PAPER 75-562] A75-26723

**AEROSPACE INDUSTRY**
Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973 --- German book A75-27978
European aeronautics and astronautics at the crossroads A75-27981

**AEROTHERMODYNAMICS**
Some notes on the thermodynamics of thrust reversal in flight N75-20212

**AFTERBODIES**
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257

**AIR CARGO**
Important aspects of international air cargo --- rate structure, container handling and fuel costs effects A75-26948

**AIR FLOW**
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272

**AIR INTAKES**
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308

**AIR JETS**
Subsonic jet noise in flight based on some recent wind-tunnel tests
[AIAA PAPER 75-462] A75-27930

**AIR NAVIGATION**
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis
[AD-A001403/5] N75-19213
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286

**AIR POLLUTION**
Development of air transport and environmental requirements --- for air and noise pollution reduction A75-28228
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878

**AIR TRAFFIC CONTROL**
Digital avionics - An overview --- Air Traffic Control Radar Beacon System
[AIAA PAPER 75-553] A75-26721
Air Traffic Control demonstration aspects of the Applications Technology Satellite-6
[AIAA PAPER 75-562] A75-26723
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
Interaction of military/civil position location and reporting systems --- of ATC
[AIAA PAPER 75-561] A75-28467
SEEK BUS - A time division multiple access system --- ATC applications
[AIAA PAPER 75-564] A75-28468
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis
[AD-A001403/5] N75-19213
Multi-site intermittent positive control algorithms for the discrete address beacon system
[AD-A001112/2] N75-19214
Provisional message formats for the DABS/NAS interface (revision 1)
[FAA-RD-74-63-A] N75-19216
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220

**AIR TRANSPORTATION**
The aircraft accident --- German book A75-26498
Air Europe: The policy of cooperation among airline companies of the European Six --- French book A75-26499
Ride quality evaluation. I --- aircraft passenger comfort assessment A75-26849
Tiedown tests for air transport of the XM542 sprint container
[AD-A001844] N75-19210
The next forty years in aviation N75-20228

**AIRBORNE EQUIPMENT**
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
Reliability life cycle of a complex electronic airborne equipment A75-27839
Airborne equipment for use with the microwave landing system A75-28790
The range of airborne processing available to the future user of the Doppler MLS --- Microwave Landing Systems A75-28792
The development of a serial P.C.M. instrumentation system A75-28797

**AIRBORNE/SPACEBORNE COMPUTERS**
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
F-15 computational subsystem --- computer systems design
[AIAA PAPER 75-590] A75-28470
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
A new flight test data system for NASA aeronautical flight research A75-28774

**AIRCRAFT**
Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, 1 October - 31 December 1974 [DME/NAE-1974(4)] N75-20249

**AIRCRAFT ACCIDENT INVESTIGATION**
The aircraft accident --- German book A75-26498
Analysis of wreckage --- aircraft accident investigation A75-26533
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context A75-28769
Aircraft accident report. Eastern Air Lines, Inc. McDonnell-Douglas DC 9-31, N8967E Akron-Canton Regional Airport, North Canton, Ohio, 27 Nov. 1973 [PB-238637/3] N75-20274
Special study: Safety aspects of emergency evacuations from air carrier aircraft [PB-238269/5] N75-20275

**AIRCRAFT ACCIDENTS**
Analysis of in-flight disintegration accidents N75-19197
General Aviation Aircraft Safety [AD-A003124] N75-19199
Analysis of general aviation accident records N75-19200
General aviation accident patterns N75-19201
The accident record in terms of the pilot N75-19202
Crash survivability N75-19203
General aviation handling qualities research N75-19204
A study of carburetor/induction system icing in general aviation accidents [NASA-CR-143835] N75-19208
Environmental and operating requirements for fire extinguishing systems on advanced aircraft [AD-A001640] N75-19228
Annual reviews of aircraft accident data US Air Carrier operations, 1973 [PB-238281/0] N75-20276
Pan American World Airways, Incorporated Boeing 707-321B, N454PA, Pago Pago, American Samoa, 30 January 1974 [PB-238478/2] N75-20277
Delta Air Lines Incorporated McDonnell Douglas DC-9-32, N3323L, Chattanooga Municipal Airport, Chattanooga, Tennessee [PB-238479/0] N75-20278

**AIRCRAFT ANTENNAS**
Dual band airborne antenna study [AD-A002043] N75-19219

**AIRCRAFT COMMUNICATION**
SEEK BUS - A time division multiple access system --- ATC applications [AIAA PAPER 75-564] A75-28468
Multi-site intermittent positive control algorithms for the discrete address beacon system [AD-A001112/2] N75-19214

**AIRCRAFT COMPARTMENTS**
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis [AIAA PAPER 75-574] A75-26732

**AIRCRAFT CONFIGURATIONS**
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0 [NASA-TM-X-3178] N75-19180

**AIRCRAFT CONTROL**
Digital flight control systems - Considerations in implementation and acceptance [AIAA PAPER 75-577] A75-26734
Design of the DAIS control and display core element --- Digital Avionics Information System [AIAA PAPER 75-600] A75-26745
A concept of flight dynamics control --- for aircraft A75-27180
Adaptive digital system for aircraft control A75-27182
Fly-by-wire and control configured vehicles - Rewards and risks A75-27367
Stability analysis of stochastic composite systems --- application to control of aircraft and nonlinear systems A75-27919
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion A75-28676
A model based technique for the design of flight directors --- optimal control models N75-19140
Status and trends in active control technology N75-20236
Development of a remote digital augmentation system and application to a remotely piloted research vehicle [NASA-TN-D-7941] N75-20293
Evaluation of active control technology for short haul aircraft --- cost effectiveness [NASA-CR-137634] N75-20344

**AIRCRAFT DESIGN**
Digital avionics-overview - Airframe manufacturer's viewpoint [AIAA PAPER 75-552] A75-26720
A pilot's report concerning the VTOL VAK 191 B A75-26900
Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973 --- German book A75-27978
Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests A75-27980
Air cushion landing systems for aircraft A75-27983
Flight tests with the V/STOL experimental aircraft VAK 191 B A75-27985
General aviation accident patterns N75-19201
General aviation handling qualities research N75-19204
Design considerations for stall/spin avoidance N75-19205
Problems of designing passenger aircraft [NASA-TT-F-808] N75-19223
Fuel conservation possibilities for terminal area compatible aircraft [NASA-CR-132608] N75-19224
Engineering design handbook. Helicopter engineering, part 1: Preliminary design --- for VFR operation [AD-A002007] N75-19238
The future of aeronautics [NASA-CR-142559] N75-20222
Aeronautics in the American society N75-20223
Some trends in aircraft design: Structure N75-20235
Status and trends in active control technology N75-20236
Lifting surface for aircraft --- wing profiles [NASA-TT-F-16241] N75-20290
Air cushion landing systems for aircraft N75-20296

**AIRCRAFT ENGINES**
'By the application of power' /21st Cayley Memorial Lecture/ --- technical survey of aircraft engines A75-27368
High-temperature alloys and the aircraft gas turbine A75-27877
Development of an R.F. telemetry system --- for aircraft engine stress and temperature data A75-28778
Low speed and angle of attack effects on sonic and near-sonic inlets [NASA-CR-134778] N75-19184
Metal matrix composites for aircraft propulsion systems [NASA-TM-X-71685] N75-19245
PLT 27 gas turbine engine exhaust emission and noise measurements [AD-A001728] N75-19251

**AIRCRAFT EQUIPMENT**
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments A75-28781

General aviation accident patterns
N75-19201
Airborne electronics for automated flight systems
N75-20232
General aviation's future need for research
N75-20242
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
Instrument system test. Elliott helicopter air data system
[AD-A002332] N75-20331

**AIRCRAFT FUEL SYSTEMS**
Investigation of 14.5mm API self-sealing/crashworthy fuel tank material
[AD-A001752] N75-19249
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295

**AIRCRAFT GUIDANCE**
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
Aircraft guidance for automatic collision avoidance
A75-27178
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352

**AIRCRAFT HAZARDS**
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073

**AIRCRAFT INDUSTRY**
Digital avionics-overview - Airframe manufacturer's viewpoint
[AIAA PAPER 75-552] A75-26720
Manufacturer's overview
N75-19207

**AIRCRAFT INSTRUMENTS**
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
A new centralised warning display for aircraft
A75-28785
A new J band pulsed radar altimeter
A75-28787
Altimeters - The way ahead
A75-28788
A display evaluation methodology applied to vertical situation displays
N75-19137
Improvements in pilot/aircraft-integration by advanced contact analog displays
N75-19141
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases
[AD-A003952] N75-20330

**AIRCRAFT LANDING**
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
Air cushion landing systems for aircraft
A75-27983
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
A tactual pilot aid for the approach-and-landing task: Inflight studies
N75-19131
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
Harowe altitude warning system evaluation
[AD-A002583] N75-19241
Pan American World Airways, Incorporated Boeing 707-321B, N454PA, Pago Pago, American Samoa, 30 January 1974
[PB-238478/2] N75-20277
Delta Air Lines Incorporated McDonnell Douglas DC-9-32, N3323L, Chattanooga Municipal Airport, Chattanooga, Tennessee
[PB-238479/0] N75-20278
Air cushion landing systems for aircraft
N75-20296

**AIRCRAFT MAINTENANCE**
Organization of centralized maintenance of aircraft assemblies --- Russian book
A75-27838
CH-47A assessment and comparative fleet evaluation: Executive summary report
[AD-A002057] N75-19232
Computer simulation of maintenance for multi-mission RPV's
[AD-A003351] N75-20253

**AIRCRAFT MANEUVERS**
Aircraft guidance for automatic collision avoidance
A75-27178
Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests --- longitudinal and lateral stability of G-91-T3 aircraft
N75-19255

**AIRCRAFT MODELS**
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
Extension of the lifting line model for the helicopter rotor
A75-28194
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201

**AIRCRAFT NOISE**
Spinning mode sound propagation in ducts with acoustic treatment
A75-27854
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939
Classification problems of aircraft noise --- far field measurements
A75-27943
Problem of aircraft noise in the vicinity of airports
A75-28222
Noise certification of aircraft
A75-28223
Development of air transport and environmental requirements --- for air and noise pollution reduction
A75-28228
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation --- Book
A75-28626
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246
Trends in aircraft noise control
N75-20229

**AIRCRAFT PERFORMANCE**
A pilot's report concerning the VTOL VAK 191 B
A75-26900
The 'definition' of the motorsegler
[DFVLR-SONDDR-424] A75-27596
Roll paper pilot --- mathematical model for predicting pilot rating of aircraft in roll task
N75-19134
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-19177
General aviation handling qualities research
N75-19204
Problems of designing passenger aircraft
[NASA-TT-F-808] N75-19223
An aircraft application of system identification in the presence of state noise
[AD-A001936] N75-19234
Some aspects of performance measurements in nonsteady flight --- angle of attack and rate of climb
N75-19262
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-20259

Sideslip of wing-body combinations --- disturbance theory for predicting aerodynamics of aircraft in sideslip
[NASA-CR-114716] N75-20260
Non-dimensional methods for the measurement of level flight performance of turbine engined helicopters
[ESDU-74042] N75-20289
Air cushion landing systems for aircraft
N75-20296
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft
[NASA-CR-137635] N75-20345

AIRCRAFT RELIABILITY
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
General Aviation Aircraft Safety
[AD-A003124] N75-19199

AIRCRAFT STABILITY
Fly-by-wire and control configured vehicles - Rewards and risks
A75-27367
Adaptive control system with reference model --- application to automatic pilots
A75-27912
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432
Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing
A75-28687
The dynamic response of aircraft encountering aircraft wake turbulence
N75-19170

AIRCRAFT STRUCTURES
Characterization of advanced composite materials for structural design --- of aircraft
A75-27695
Stress intensity factors for some through-cracked fastener holes
A75-28236
Shear lag analysis of thick skin aircraft structures
[ATN-7404] N75-19225
An improved automated structural optimization program
[AD-A002688] N75-19237
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4
[NAL-TR-360] N75-19414
The variability of fatigue damage from flight to flight
[ARC-CP-1297] N75-20297
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary
[AD-A002850] N75-20301
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module
[AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2
[AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4
[AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5
[AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module
[AD-A002867] N75-20318
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Fuselage module sample output
[AD-A002868] N75-20319
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322
A structural weight estimation program (SWEEP) for aircraft. Volume 10: Flutter optimation stand-alone program
[AD-A002872] N75-20323
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program
[AD-A002873] N75-20324

AIRCRAFT WAKES
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations
A75-28522
The dynamic response of aircraft encountering aircraft wake turbulence
N75-19170
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172
A flight test investigation of the rolling moments induced on a T-37B airplane in the wake of a B-747 airplane
[NASA-TM-X-56031] N75-20221
On wake vortex alleviation
N75-20231

**AIRFOIL PROFILES**
Nonlinear problem of the unsteady flow past an airfoil lattice A75-28671
Computation of airfoil DRAG profiles [REPT-35/1974] N75-19165
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings [NAL-TR-368T-PT-1] N75-19174
An exact solution for transonic potential flow past aerofoil sections [NAL-TR-383] N75-19176

**AIRFOILS**
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil A75-26212
Critical analysis and improvement of the source-panel method --- for lift prediction A75-28095
Survey on two calculation methods in transonic regime A75-28096
Wind tunnel tests of a symmetrical airfoil with scoop fed slots [NASA-CR-132568] N75-19183

**AIRFRAMES**
Digital avionics-overview - Airframe manufacturer's viewpoint [AIAA PAPER 75-552] A75-26720
Operational use of the UH-1 H helicopters in Arctic environment [AD-A002603] N75-19236

**AIRLINE OPERATIONS**
Ride quality evaluation. I --- aircraft passenger comfort assessment A75-26849
Important aspects of international air cargo --- rate structure, container handling and fuel costs effects A75-26948
The next forty years in aviation N75-20228
Annual reviews of aircraft accident data US Air Carrier operations, 1973 [PB-238281/0] N75-20276

**AIRPORT PLANNING**
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality A75-27859
Problem of aircraft noise in the vicinity of airports A75-28222

**AIRPORT SURFACE DETECTION EQUIPMENT**
New horizons in air traffic control [AIAA PAPER 75-569] A75-26728

**AIRPORTS**
Comparison of airport measurements of approach noise produced by jet aircraft A75-27852

**AIRSPEED**
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83 [NASA-TM-X-56030] N75-20329
Instrument system test. Elliott helicopter air data system [AD-A002332] N75-20331

**ALGORITHMS**
Computation of airfoil DRAG profiles [REPT-35/1974] N75-19165
Multi-site intermittent positive control algorithms for the discrete address beacon system [AD-A001112/2] N75-19214

**ALL-WEATHER AIR NAVIGATION**
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases [AD-A003952] N75-20330

**ALPHANUMERIC CHARACTERS**
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height A75-27526

**ALTIMETERS**
Altimeters - The way ahead A75-28788
Harowe altitude warning system evaluation [AD-A002583] N75-19241

**ALTITUDE**
Harowe altitude warning system evaluation [AD-A002583] N75-19241

**ALTITUDE CONTROL**
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator N75-19127

**ALUMINUM ALLOYS**
Metallurgical factors affecting high strength aluminum alloy production A75-28529
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate A75-28866
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens [NAL-TR-359] N75-19413
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4 [NAL-TR-360] N75-19414
Design and purchase expectations for fracture resistance of 700-series aluminum airframe alloys [AD-A002552] N75-20548
Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading [AD-A002310] N75-20554
Fracture mechanics of tiny cracks near fasteners --- in high strength aluminum alloys [AD-A002554] N75-20777

**AMPLITUDE MODULATION**
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz [RAE-TR-74032] N75-19217

**ANALOG CIRCUITS**
Determination of derivatives by a model with automatic parameter --- analog circuit N75-19265

**ANALOG COMPUTERS**
Determination of aerodynamic derivatives of the FIAT G-91 T3 aircraft from flight tests by means of manual analog model matching N75-19257
Extraction of flight mechanic derivatives from flight data by a manual analog matching technique [ESRO-TT-118] N75-20347

**ANALOG SIMULATION**
Adaptive control system with reference model --- application to automatic pilots A75-27912

**ANALYSIS OF VARIANCE**
The variability of fatigue damage from flight to flight [ARC-CP-1297] N75-20297

**ANECHOIC CHAMBERS**
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility [AIAA PAPER 75-529] A75-27939

**ANGLE OF ATTACK**
Some aspects of performance measurements in nonsteady flight --- angle of attack and rate of climb N75-19262

**ANNULAR NOZZLES**
Development of acoustic disturbances in supersonic annular jets A75-26234

**ANTENNA RADIATION PATTERNS**
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz [RAE-TR-74032] N75-19217
Antennas, a collection, issue 15 [AD-A002646] N75-19557

**ANTENNAS**
Antennas, a collection, issue 15 [AD-A002646] N75-19557

**APPROACH CONTROL**
Comparison of airport measurements of approach noise produced by jet aircraft A75-27852

Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352
APPROACH INDICATORS
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
APPROXIMATION
Notes on the approximate solution of lifting-surface theory used in the RAE standard method
[ARC-R/M-3752] N75-19188
ARCTIC REGIONS
Operational use of the UH-1 H helicopters in Arctic environment
[AD-A002603] N75-19236
AREA NAVIGATION
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469
ASPECT RATIO
The 'definition' of the motorsegler
[DFVLR-SONDDR-424] A75-27596
ATS 6
Air Traffic Control demonstration aspects of the Applications Technology Satellite-6
[AIAA PAPER 75-562] A75-26723
AUTOMATIC FLIGHT CONTROL
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
Aircraft guidance for automatic collision avoidance A75-27178
A concept of flight dynamics control --- for aircraft A75-27180
Adaptive digital system for aircraft control A75-27182
Adaptive control system with reference model --- application to automatic pilots A75-27912
Digital avionics from the viewpoint of ATA --- Air Transport Association of America
[AIAA PAPER 75-551] A75-28466
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems A75-28791
Airborne electronics for automated flight systems N75-20232
Status and trends in active control technology N75-20236
AUTOMATIC PILOTS
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
Adaptive control system with reference model --- application to automatic pilots A75-27912
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems A75-28791
AVIONICS
Digital avionics-overview - Airframe manufacturer's viewpoint
[AIAA PAPER 75-552] A75-26720
Digital avionics - An overview --- Air Traffic Control Radar Beacon System
[AIAA PAPER 75-553] A75-26721
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
Design of the DAIS control and display core element --- Digital Avionics Information System
[AIAA PAPER 75-600] A75-26745
Reliability life cycle of a complex electronic airborne equipment A75-27839
Digital avionics from the viewpoint of ATA --- Air Transport Association of America
[AIAA PAPER 75-551] A75-28466
F-15 computational subsystem --- computer systems design
[AIAA PAPER 75-590] A75-28470
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
Integrated avionics - Controls and displays for helicopter IFR operation A75-28786
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231
AXIAL FLOW TURBINES
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity A75-26671
Measurement and analysis of the unsteady normal force and pitching moment on an axial flow fan rotor blade element
[AD-A002739] N75-20343
AXISYMMETRIC FLOW
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity A75-26671
A subsonic axisymmetric wake in a viscous gas A75-26891
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191

## B

BALANCING
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
BEAMS (SUPPORTS)
Nonlinear torsional vibrations of thin-walled beams of open section A75-26410
BELL AIRCRAFT
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data N75-20250
BENDING MOMENTS
Influence of fuselage flexibility on the stress-strain state of the wing A75-28668
BIBLIOGRAPHIES
Heat transfer in separated and reattached flows - An annotated review A75-26685
BIRDS
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300
BLOCKING
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927
BLOWDOWN WIND TUNNELS
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number A75-26414
BLUFF BODIES
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191
BLUNT BODIES
Hypersonic flow past pointed and blunt bodies with a concave generatrix A75-26896
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle A75-28652

**BODIES OF REVOLUTION**
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181

**BODY-WING CONFIGURATIONS**
Noise of model target type thrust reversers for engine-over-the-wing applications
A75-27853

**BOEING 707 AIRCRAFT**
Pan American World Airways, Incorporated Boeing 707-321B, N454PA, Pago Pago, American Samoa, 30 January 1974
[PB-238478/2] N75-20277
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286

**BOEING 747 AIRCRAFT**
A flight test investigation of the rolling moments induced on a T-37B airplane in the wake of a B-747 airplane
[NASA-TM-X-56031] N75-20221

**BOUNDARY LAYER CONTROL**
Opportunities for aerodynamic-drag reduction
N75-20237
Evaluation of some control-volume techniques for analysis of shock-boundary layer interactions in supersonic inlets
[NASA-TM-X-3186] N75-20256

**BOUNDARY LAYER EQUATIONS**
Hypersonic, viscous gas flow around a wing of small aspect ratio
A75-28653

**BOUNDARY LAYER FLOW**
Heat transfer in separated and reattached flows - An annotated review
A75-26685
Interpretation of merged layer behavior for wedges
A75-27496
An example of boundary layer flow with two instability regions
A75-28680

**BOUNDARY LAYER SEPARATION**
An experimental investigation of compressor stall using an on-line distortion indicator and signal conditioner
[NASA-TM-X-3182] N75-20248

**BOUNDARY LAYER TRANSITION**
Influence of sound upon separated flow over wings
A75-27495

**BOUNDARY LAYERS**
Boundary-layer pressure fluctuations at high Reynolds numbers on a second free-flight test vehicle
[ARC-CP-1302] N75-19189
Evaluation of some control-volume techniques for analysis of shock-boundary layer interactions in supersonic inlets
[NASA-TM-X-3186] N75-20256
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257

**BROADCASTING**
TACAN/DME digital data broadcast design plan. Volume 5: Flight test program
[AD-A001405/0] N75-19212
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis
[AD-A001403/5] N75-19213

**BUBBLES**
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212


## C


**C BAND**
Dual band airborne antenna study
[AD-A002043] N75-19219

**C-5 AIRCRAFT**
Fatigue-crack growth behavior of C-5A wing control points
[AD-A002553] N75-20299

**C-141 AIRCRAFT**
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases
[AD-A003952] N75-20330

**CANADA**
Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, 1 October - 31 December 1974
[DME/NAE-1974(4)] N75-20249
Some air cushion technology research in Canada
N75-20251

**CARBON DIOXIDE**
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888

**CARBURETORS**
A study of carburetor/induction system icing in general aviation accidents
[NASA-CR-143835] N75-19208

**CARGO AIRCRAFT**
Important aspects of international air cargo --- rate structure, container handling and fuel costs effects
A75-26948

**CASCADE FLOW**
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode
A75-26553
Determination by means of hydraulic analogy of the transonic flow in a blade cascade
N75-20213

**CAVITATION FLOW**
Cavitating flow past a vibrating thin-section wing profile
A75-26895

**CERTIFICATION**
Noise certification of aircraft
A75-28223

**CH-47 HELICOPTER**
CH-47A assessment and comparative fleet evaluation: Executive summary report
[AD-A002057] N75-19232

**CHANNELS (DATA TRANSMISSION)**
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724

**CIRCULAR CYLINDERS**
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
The three-dimensional character of a cross flow around a circular cylinder
A75-28654
Analysis of thick turbulent jet flowing round: A circular cylinder
N75-19168

**CIVIL AVIATION**
Air Europe: The policy of cooperation among airline companies of the European Six --- French book
A75-26499
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
Digital avionics from the viewpoint of ATA --- Air Transport Association of America
[AIAA PAPER 75-551] A75-28466
Interaction of military/civil position location and reporting systems --- of ATC
[AIAA PAPER 75-561] A75-28467
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469

**CLIMBING FLIGHT**
Some aspects of performance measurements in nonsteady flight --- angle of attack and rate of climb
N75-19262

**COCKPITS**
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211

COLLISION AVOIDANCE
Aircraft guidance for automatic collision avoidance A75-27178
Flight test evaluation of SECANT VECAS collision avoidance system [AD-A002281] N75-19220
COMBUSTION CHAMBERS
Noise generation and transmission in duct combustors [AIAA PAPER 75-527] A75-27938
Investigation of aircraft combustor noise [AD-A001737] N75-19250
COMBUSTION PHYSICS
Aeroacoustics: Jet and combustion noise; duct acoustics --- Book A75-28629
COMBUSTION PRODUCTS
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins A75-27073
COMFORT
Ride quality evaluation. I --- aircraft passenger comfort assessment A75-26849
COMMAND AND CONTROL
An experimental TDMA network for airborne warning and control systems interoperability demonstrations [AIAA PAPER 75-563] A75-26724
COMMERCIAL AIRCRAFT
Development of air transport and environmental requirements --- for air and noise pollution reduction A75-28228
Annual reviews of aircraft accident data US Air Carrier operations, 1973 [PB-238281/0] N75-20276
COMPLEX SYSTEMS
Stability analysis of stochastic composite systems --- application to control of aircraft and nonlinear systems A75-27919
COMPOSITE MATERIALS
Characterization of advanced composite materials for structural design --- of aircraft A75-27695
Some trends in aircraft design: Structure N75-20235
COMPRESSIBLE FLOW
The prediction of turbulent heat transfer to wedge compression corners and cylinder-flare bodies at hypersonic speeds [IC-AERO-73-03] N75-20264
COMPRESSOR BLADES
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise [AIAA PAPER 75-443] A75-27926
COMPRESSOR ROTORS
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1 [AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2 [AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A [AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B [AD-A002546] N75-20340
Evaluation program on using compressor bleed air as a source of pneumatic power for fluidic circuits [AD-A002483] N75-20676
COMPUTER ASSISTED INSTRUCTION
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer [AD-A002705] N75-19278
COMPUTER PROGRAMMING
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary [AD-A002850] N75-20301
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration [AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module [AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists [AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module [AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output [AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue [AD-A002856] N75-20307
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module [AD-A002857] N75-20308
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module [AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2 [AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4 [AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5 [AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0) [AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0) [AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0) [AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0) [AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0) [AD-A002863] N75-20317
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module [AD-A002867] N75-20318
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Fuselage module sample output [AD-A002868] N75-20319
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual [AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual [AD-A002870] N75-20321

A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322
A structural weight estimation program (SWEEP) for aircraft. Volume 10: Flutter optimation stand-alone program
[AD-A002872] N75-20323
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program
[AD-A002873] N75-20324
COMPUTER PROGRAMS
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
Improvements to the SADSAM computer program for aeroelasticity analysis
[NASA-CR-132617] N75-19173
TRW vortex-lattice method subsonic aerodynamic analysis for multiple-lifting-surfaces (N. surface) TRW program number HA010B
[NASA-CR-128588] N75-19178
An improved automated structural optimization program
[AD-A002688] N75-19237
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
COMPUTER SYSTEMS DESIGN
Digital computer design guidelines for a full authority fly-by-wire flight control system
[AIAA PAPER 75-570] A75-26729
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
F-15 computational subsystem --- computer systems design
[AIAA PAPER 75-590] A75-28470
A new flight test data system for NASA aeronautical flight research
A75-28774
The development of a serial P.C.M. instrumentation system
A75-28797
COMPUTER TECHNIQUES
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity
A75-26671
The benefits of real time computer analysis of experimental aircraft flight test data
A75-28801
COMPUTERIZED DESIGN
Rotating engine design and cycle analysis program
[AD-A002314] N75-20342
COMPUTERIZED SIMULATION
Paper pilot ponders supersonic transports
N75-19135
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
Computer simulation of maintenance for multi-mission RPV's
[AD-A003351] N75-20253
CONCAVITY
Hypersonic flow past pointed and blunt bodies with a concave generatrix
A75-26896
CONCORDE AIRCRAFT
A comparison of flight loads counting methods and their effects on fatigue life estimates using data from Concorde
[ARC-CP-1304] N75-19227
CONDUCTIVE HEAT TRANSFER
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
CONFERENCES
General Aviation Aircraft Safety
[AD-A003124] N75-19199
Determination of aircraft characteristics from flight tests
[ESRO-TT-104] N75-19252
Technical evaluation report on Fluid Dynamics Panel Symposium on V/STOL Aerodynamics
[AGARD-AR-78] N75-19585
The future of aeronautics
[NASA-CR-142559] N75-20222
CONICAL CAMBER
Flow past conically-cambered slender delta wings with leading-edge separation
[ARC-R/M-3748] N75-19186
CONICAL FLOW
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle
A75-28652
CONICAL NOZZLES
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
CONSTRUCTION MATERIALS
Some trends in aircraft design: Structure
N75-20235
CONTROL BOARDS
A model based technique for the design of flight directors --- optimal control models
N75-19140
CONTROL CONFIGURED VEHICLES
Fly-by-wire and control configured vehicles - Rewards and risks
A75-27367
CONTROL SIMULATION
Adaptive control system with reference model --- application to automatic pilots
A75-27912
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
CONTROL STABILITY
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport --- aerodynamic control and stability
[NASA-TM-X-72671] N75-19226
CONTROL SURFACES
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183
CONTROL THEORY
A concept of flight dynamics control --- for aircraft
A75-27180
CONTROLLABILITY
General aviation handling qualities research
N75-19204
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
CONVECTIVE HEAT TRANSFER
Heat transfer in separated and reattached flows - An annotated review
A75-26685
CONVERGENT-DIVERGENT NOZZLES
A method of profiling short two-dimensional nozzles --- for transonic wind tunnels
A75-26880
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937
Survey on two calculation methods in transonic regime
A75-28096
COOLING SYSTEMS
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336
CORE STORAGE
Design of the DAIS control and display core element --- Digital Avionics Information System
[AIAA PAPER 75-600] A75-26745
CORNER FLOW
The expansion of a hypersonic turbulent boundary layer at a sharp corner
A75-26466

**COST ANALYSIS**
Economics: General aviation cost factors N75-19206

**COST EFFECTIVENESS**
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis [AIAA PAPER 75-574] A75-26732
Important aspects of international air cargo --- rate structure, container handling and fuel costs effects A75-26948
Evaluation of active control technology for short haul aircraft --- cost effectiveness [NASA-CR-137634] N75-20344

**CRACK PROPAGATION**
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens [NAL-TR-359] N75-19413
Fatigue-crack growth behavior of C-5A wing control points [AD-A002553] N75-20299
Fracture mechanics of tiny cracks near fasteners --- in high strength aluminum alloys [AD-A002554] N75-20777

**CRACKING (FRACTURING)**
Stress intensity factors for some through-cracked fastener holes A75-28236

**CRASH INJURIES**
Users manual for UCIN vehicle occupant crash study model, version 2 [AD-A001801] N75-19211

**CRASH LANDING**
Analysis of wreckage --- aircraft accident investigation A75-26533

**CRASHES**
The aircraft accident --- German book A75-26498

**CREEP PROPERTIES**
High-temperature alloys and the aircraft gas turbine A75-27877

**CROSS FLOW**
An experimental study of the structure and acoustic field of a jet in a cross stream [AIAA PAPER 75-460] A75-28348
The three-dimensional character of a cross flow around a circular cylinder A75-28654

**CYCLIC LOADS**
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate A75-28866


## D


**DATA ACQUISITION**
Analysis of general aviation accident records N75-19200
An aircraft application of system identification in the presence of state noise [AD-A001936] N75-19234
Computer simulation of maintenance for multi-mission RPV's [AD-A003351] N75-20253
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83 [NASA-TM-X-56030] N75-20329

**DATA LINKS**
SEEK BUS - A time division multiple access system --- ATC applications [AIAA PAPER 75-564] A75-28468
Provisional message formats for the DABS/NAS interface (revision 1) [FAA-RD-74-63-A] N75-19216

**DATA MANAGEMENT**
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module [AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists [AD-A002851] N75-20304

**DATA PROCESSING**
The benefits of real time computer analysis of experimental aircraft flight test data A75-28801
Testing the MLS Doppler concept A75-28802
Parameter identification applied to aircraft [CRANFIELD-AERO-26] N75-19177
An aircraft application of system identification in the presence of state noise [AD-A001936] N75-19234
Determination of the parameters of a system of equations of motion from flight test data --- least squares method N75-19263

**DATA RECORDING**
A specialised recording system for the measurement of helicopter rotor blade performance in flight A75-28770
The development of a serial P.C.M. instrumentation system A75-28797

**DATA SYSTEMS**
A new flight test data system for NASA aeronautical flight research A75-28774

**DATA TRANSMISSION**
SEEK BUS - A time division multiple access system --- ATC applications [AIAA PAPER 75-564] A75-28468
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis [AD-A001403/5] N75-19213
Flight test evaluation of SECANT VECAS collision avoidance system [AD-A002281] N75-19220

**DC 9 AIRCRAFT**
Aircraft accident report. Eastern Air Lines, Inc. McDonnell-Douglas DC 9-31, N8967E Akron-Conton Regional Airport, North Canton, Ohio, 27 Nov. 1973 [PB-238637/3] N75-20274
Delta Air Lines Incorporated McDonnell Douglas DC-9-32, N3323L, Chattanooga Municipal Airport, Chattanooga, Tennessee [PB-238479/0] N75-20278
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system [AD-A003799] N75-20295

**DC 10 AIRCRAFT**
Flight test of a digital guidance and control system in a DC-10 aircraft [AIAA PAPER 75-567] A75-26726

**DELTA WINGS**
Longitudinal aerodynamic derivatives of a slender delta wing research aircraft extracted from flight data [CRANFIELD-AERO-27] N75-19175
Flow past conically-cambered slender delta wings with leading-edge separation [ARC-R/M-3748] N75-19186
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data [CRANFIELD-AERO-27] N75-20258

**DESIGN ANALYSIS**
Digital computer design guidelines for a full authority fly-by-wire flight control system [AIAA PAPER 75-570] A75-26729

**DIFFERENTIAL EQUATIONS**
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it [NASA-TT-F-16133] N75-19179

**DIGITAL COMMAND SYSTEMS**
Development of a remote digital augmentation system and application to a remotely piloted research vehicle [NASA-TN-D-7941] N75-20293

**DIGITAL COMPUTERS**
Digital computer design guidelines for a full authority fly-by-wire flight control system [AIAA PAPER 75-570] A75-26729
Paper pilot ponders supersonic transports N75-19135
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator [RAE-LIB-TRANS-1768] N75-19274

**DIGITAL NAVIGATION**
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469
**DIGITAL SYSTEMS**
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
Design of the DAIS control and display core element --- Digital Avionics Information System
[AIAA PAPER 75-600] A75-26745
Adaptive digital system for aircraft control
A75-27182
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432
Digital avionics from the viewpoint of ATA --- Air Transport Association of America
[AIAA PAPER 75-551] A75-28466
TACAN/DME digital data broadcast design plan. Volume 5: Flight test program
[AD-A001405/0] N75-19212
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis
[AD-A001403/5] N75-19213
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
**DIGITAL TECHNIQUES**
Digital avionics-overview - Airframe manufacturer's viewpoint
[AIAA PAPER 75-552] A75-26720
Digital avionics - An overview --- Air Traffic Control Radar Beacon System
[AIAA PAPER 75-553] A75-26721
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis
[AIAA PAPER 75-574] A75-26732
**DIRECTIONAL CONTROL**
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
Major Item Special Study (MISS), UH-1C tail rotor blade
[AD-A001714] N75-19230
**DIRECTIONAL STABILITY**
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
**DISPLAY DEVICES**
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744
Design of the DAIS control and display core element --- Digital Avionics Information System
[AIAA PAPER 75-600] A75-26745
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
A new centralised warning display for aircraft
A75-28785
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
Altimeters - The way ahead
A75-28788
A study on aircraft map display location and orientation --- effects of map display location on manual piloting performance
N75-19128
A tactual pilot aid for the approach-and-landing task: Inflight studies
N75-19131
Evaluation of tactual displays for flight control
N75-19132
A display evaluation methodology applied to vertical situation displays
N75-19137
Improvements in pilot/aircraft-integration by advanced contact analog displays
N75-19141
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3
[AD-A002014] N75-19269
**DISTANCE MEASURING EQUIPMENT**
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context
A75-28769
**DOPPLER NAVIGATION**
Airborne equipment for use with the microwave landing system
A75-28790
The range of airborne processing available to the future user of the Doppler MLS --- Microwave Landing Systems
A75-28792
Testing the MLS Doppler concept
A75-28802
**DOWNWASH**
Notes on the approximate solution of lifting-surface theory used in the RAE standard method
[ARC-R/M-3752] N75-19188
**DRAG**
Computation of airfoil DRAG profiles
[REPT-35/1974] N75-19165
**DRAG REDUCTION**
Opportunities for aerodynamic-drag reduction
N75-20237
**DUCTED FAN ENGINES**
Unified analysis of ducted turbomachinery noise
A75-27861
**DUCTED FLOW**
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
**DYNAMIC CHARACTERISTICS**
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel
[NASA-TM-X-62418] N75-20350
**DYNAMIC CONTROL**
A concept of flight dynamics control --- for aircraft
A75-27180
**DYNAMIC LOADS**
Dynamic loads and structural criteria study --- military helicopters
[AD-A001739] N75-19195
**DYNAMIC STRUCTURAL ANALYSIS**
Rotation in vibration, optimization, and aeroelastic stability problems
N75-19167
Dynamic loads and structural criteria study --- military helicopters
[AD-A001739] N75-19195

## E

**ECONOMIC ANALYSIS**
Air Europe: The policy of cooperation among airline companies of the European Six --- French book
A75-26499
**ECONOMIC FACTORS**
Important aspects of international air cargo --- rate structure, container handling and fuel costs effects
A75-26948
Economics: General aviation cost factors
N75-19206
Problems of designing passenger aircraft
[NASA-TT-F-808] N75-19223

EDUCATION
Aeronautics in the American society
N75-20223

EIGENVALUES
Eigenvalue/eigenvector assignment for multivariable systems --- linear state feedback control
A75-26312

EIGENVECTORS
Eigenvalue/eigenvector assignment for multivariable systems --- linear state feedback control
A75-26312

ELASTIC DEFORMATION
Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing
A75-28687

ELECTRIC EQUIPMENT
Airborne electronics for automated flight systems
N75-20232

ELECTRO-OPTICS
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793

ELECTROMAGNETIC PULSES
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781

ELECTRON BEAM WELDING
Sound welds in wing boxes assured by three techniques
A75-26898

ELECTRONIC COUNTERMEASURES
Reliability life cycle of a complex electronic airborne equipment
A75-27839

ELECTRONIC EQUIPMENT TESTS
Reliability life cycle of a complex electronic airborne equipment
A75-27839

ELEVATORS (CONTROL SURFACES)
A method for calculating unsteady forces due to interaction between tail surfaces
A75-26477

ENERGY METHODS
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676

ENGINE DESIGN
'By the application of power' /21st Cayley Memorial Lecture/ --- technical survey of aircraft engines
A75-27368

The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927

Part load specific fuel consumption of gas turbines
A75-28650

Metal matrix composites for aircraft propulsion systems
[NASA-TM-X-71685] N75-19245

Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337

Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338

Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339

Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340

Rotating engine design and cycle analysis program
[AD-A002314] N75-20342

ENGINE INLETS
Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied
A75-26672

Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184

ENGINE NOISE
Spinning mode sound propagation in ducts with acoustic treatment
A75-27854

Unified analysis of ducted turbomachinery noise
A75-27861

Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine
[AIAA PAPER 75-457] A75-27928

An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929

Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938

The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939

Classification problems of aircraft noise --- far field measurements
A75-27943

Jet noise suppressors for turbojet engines
A75-28227

Aeroacoustics: Jet and combustion noise; duct acoustics --- Book
A75-28629

Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246

Comparison of parametric duct-burning turbofan and non-afterburning turbojet engines in a Mach 2.7 transport
[NASA-TM-X-71679] N75-19247

ENGINE TESTS
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589

Development of an R.F. telemetry system --- for aircraft engine stress and temperature data
A75-28778

Performance of an isolated two-dimensional variable-geometry wedge nozzle with translating shroud and collapsing wedge at speeds up to Mach 2.01
[NASA-TM-D-7906] N75-20247

ENVIRONMENT SIMULATION
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352

ENVIRONMENTAL MONITORING
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878

ENVIRONMENTAL TESTS
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231

EQUATIONS OF MOTION
Determination of the parameters of a system of equations of motion from flight test data --- least squares method
N75-19263

EUROPEAN AIRBUS
Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests
A75-27980

EUROPEAN SPACE PROGRAMS
European aeronautics and astronautics at the crossroads
A75-27981

EVALUATION
Comparison of evaluation procedures for the determination of flight-mechanical coefficients and derivatives from flight tests --- Fiat G-91 T3 aircraft
N75-19254

EXHAUST GASES
PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878
EXHAUST NOZZLES
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
EXHAUST SYSTEMS
An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336
EXTERNALLY BLOWN FLAPS
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931
EXTREMUM VALUES
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676

## F

F-14 AIRCRAFT
Sound welds in wing boxes assured by three techniques
A75-26898
F-15 AIRCRAFT
F-15 computational subsystem --- computer systems design
[AIAA PAPER 75-590] A75-28470
F-100 AIRCRAFT
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-20259
FAILURE ANALYSIS
Reliability life cycle of a complex electronic airborne equipment
A75-27839
FASTENERS
Stress intensity factors for some through-cracked fastener holes
A75-28236
FATIGUE (MATERIALS)
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens
[NAL-TR-359] N75-19413
Fatigue-crack growth behavior of C-5A wing control points
[AD-A002553] N75-20299
FATIGUE LIFE
A comparison of flight loads counting methods and their effects on fatigue life estimates using data from Concorde
[ARC-CP-1304] N75-19227
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4
[NAL-TR-360] N75-19414
The variability of fatigue damage from flight to flight
[ARC-CP-1297] N75-20297
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading
[AD-A002310] N75-20554
FATIGUE TESTS
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate
A75-28866
Design and fatigue testing of integral armored servo actuator modified trunnion
[AD-A002069] N75-19235
FD 2 AIRCRAFT
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
FEEDBACK CONTROL
Eigenvalue/eigenvector assignment for multivariable systems --- linear state feedback control
A75-26312
FIGHTER AIRCRAFT
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
FINITE DIFFERENCE THEORY
Survey on two calculation methods in transonic regime
A75-28096
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle
A75-28652
FINITE ELEMENT METHOD
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
FIRE EXTINGUISHERS
Environmental and operating requirements for fire extinguishing systems on advanced aircraft
[AD-A001640] N75-19228
FIRES
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073
FLAME RETARDANTS
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073
FLAT PLATES
A non-uniqueness of the hypersonic boundary layer
A75-26195
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
Interpretation of merged layer behavior for wedges
A75-27496
A wake source model for an inclined flat plate in a uniform stream
[IC-AERO-74-08] N75-19192
FLEXIBLE BODIES
Influence of fuselage flexibility on the stress-strain state of the wing
A75-28668
FLIGHT ALTITUDE
A new J band pulsed radar altimeter
A75-28787
Altimeters - The way ahead
A75-28788
FLIGHT CHARACTERISTICS
Pitch paper pilot revisited --- methods for predicting handling qualities of aircraft in pitch
N75-19133
Helicopter flight regimes
[AD-A001220] N75-19268
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-20259
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
Extraction of flight mechanic derivatives from flight data by a manual analog matching technique
[ESRO-TT-118] N75-20347
FLIGHT CONTROL
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
Digital computer design guidelines for a full authority fly-by-wire flight control system
[AIAA PAPER 75-570] A75-26729
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676
Evaluation of tactual displays for flight control
N75-19132

Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3
[AD-A002014] N75-19269
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
Status and trends in active control technology N75-20236
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349

**FLIGHT HAZARDS**
The dynamic response of aircraft encountering aircraft wake turbulence N75-19170
Analysis of general aviation accident records N75-19200
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300

**FLIGHT INSTRUMENTS**
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator N75-19127
A study on aircraft map display location and orientation --- effects of map display location on manual piloting performance N75-19128
A tactual pilot aid for the approach-and-landing task: Inflight studies N75-19131
A conformal head-up display for the visual approach N75-19138
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases
[AD-A003952] N75-20330
Instrument system test. Elliott helicopter air data system
[AD-A002332] N75-20331

**FLIGHT MECHANICS**
A concept of flight dynamics control --- for aircraft A75-27180
Extraction of flight mechanic derivatives from flight data by a manual analog matching technique
[ESRO-TT-118] N75-20347

**FLIGHT PATHS**
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context A75-28769
The STRADA flight path tracking system
[RAE-LIB-TRANS-1813] N75-19209

**FLIGHT SAFETY**
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
Design considerations for stall/spin avoidance N75-19205
Economics: General aviation cost factors N75-19206
Manufacturer's overview N75-19207

**FLIGHT SIMULATION**
Paper pilot ponders supersonic transports N75-19135
An aircraft application of system identification in the presence of state noise
[AD-A001936] N75-19234
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading
[AD-A002310] N75-20554

**FLIGHT SIMULATORS**
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator N75-19127
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352

**FLIGHT STABILITY TESTS**
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data A75-28201

**FLIGHT TEST VEHICLES**
Boundary-layer pressure fluctuations at high Reynolds numbers on a second free-flight test vehicle
[ARC-CP-1302] N75-19189

**FLIGHT TESTS**
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
A pilot's report concerning the VTOL YAK 191 B A75-26900
Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests A75-27980
Flight tests with the V/STOL experimental aircraft YAK 191 B A75-27985
A specialised recording system for the measurement of helicopter rotor blade performance in flight A75-28770
Application of a new slip-ringless propeller blade measurement system A75-28771
A new flight test data system for NASA aeronautical flight research A75-28774
Astrolabe - A synthetic circular aperture system for landing and navigation A75-28793
The development of a serial P.C.M. instrumentation system A75-28797
The benefits of real time computer analysis of experimental aircraft flight test data A75-28801
A tactual pilot aid for the approach-and-landing task: Inflight studies N75-19131
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-19177
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
TACAN/DME digital data broadcast design plan. Volume 5: Flight test program
[AD-A001405/0] N75-19212
An aircraft application of system identification in the presence of state noise
[AD-A001936] N75-19234
Determination of aircraft characteristics from flight tests
[ESRO-TT-104] N75-19252
Comparison of evaluation procedures for the determination of flight-mechanical coefficients and derivatives from flight tests --- Fiat G-91 T3 aircraft N75-19254
Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests --- longitudinal and lateral stability of G-91-T3 aircraft N75-19255

Determination of aerodynamic derivatives of the FIAT G-91 T3 aircraft from flight tests by means of manual analog model matching N75-19257
Evaluation of flight test of the FIAT G-91 T3 by means of the method of forced oscillations N75-19258
Evaluation of flight tests of the FIAT G-91 T3 by means of regression analysis N75-19259
A SAAB-SCANIA developed method for obtaining stability derivatives from flight tests N75-19260
Characteristics of the AJ 37 aircraft: Comparison of the results of wind tunnel and flight tests --- noting elasticity correction for wind tunnel model N75-19261
Some aspects of performance measurements in nonsteady flight --- angle of attack and rate of climb N75-19262
Determination of the parameters of a system of equations of motion from flight test data --- least squares method N75-19263
Determination of derivatives by a model with automatic parameter --- analog circuit N75-19265
Selected examples of the evaluation of VAK 191 B flight tests --- roll control characteristic in hovering flight N75-19266
A flight test investigation of the rolling moments induced on a T-37B airplane in the wake of a B-747 airplane
[NASA-TM-X-56031] N75-20221

**FLIGHT TRAINING**
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278

**FLOW CHARACTERISTICS**
Study of transonic flow over various bodies N75-19169
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172
On wake vortex alleviation N75-20231

**FLOW CHARTS**
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315

**FLOW DISTORTION**
The generation of sound by aerodynamic sources in an inhomogeneous steady flow A75-26463
An experimental investigation of compressor stall using an on-line distortion indicator and signal conditioner
[NASA-TM-X-3182] N75-20248

**FLOW DISTRIBUTION**
Study of transonic flow over various bodies N75-19169
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586

**FLOW MEASUREMENT**
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel A75-26476
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589
Determination by means of hydraulic analogy of the transonic flow in a blade cascade N75-20213

**FLOW STABILITY**
An example of boundary layer flow with two instability regions A75-28680

**FLOW VELOCITY**
An example of boundary layer flow with two instability regions A75-28680

**FLOW VISUALIZATION**
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations A75-28522

**FLUID DYNAMICS**
Technical evaluation report on Fluid Dynamics Panel Symposium on V/STOL Aerodynamics
[AGARD-AR-78] N75-19585

**FLUIDIC CIRCUITS**
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183
Evaluation program on using compressor bleed air as a source of pneumatic power for fluidic circuits
[AD-A002483] N75-20676

**FLUTTER**
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
A structural weight estimation program (SWEEP) for aircraft. Volume 10: Flutter optimation stand-alone program
[AD-A002872] N75-20323

**FLUTTER ANALYSIS**
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode A75-26553

**FLY BY WIRE CONTROL**
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
Digital computer design guidelines for a full authority fly-by-wire flight control system
[AIAA PAPER 75-570] A75-26729
Fly-by-wire and control configured vehicles - Rewards and risks A75-27367
Status and trends in active control technology N75-20236

**FORCE DISTRIBUTION**
Lifting surface theory for a rotating subsonic or transonic blade row
[ARC-R/M-3740] N75-19185
Notes on the approximate solution of lifting-surface theory used in the RAE standard method
[ARC-R/M-3752] N75-19188

**FORCED VIBRATION**
Evaluation of flight test of the FIAT G-91 T3 by means of the method of forced oscillations N75-19258

**FORTRAN**
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316

A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317
FRACTURE MECHANICS
Design and purchase expectations for fracture resistance of 700-series aluminum airframe alloys
[AD-A002552] N75-20548
Fracture mechanics of tiny cracks near fasteners --- in high strength aluminum alloys
[AD-A002554] N75-20777
FRACTURE STRENGTH
Metallurgical factors affecting high strength aluminum alloy production
A75-28529
FREE FLIGHT
Boundary-layer pressure fluctuations at high Reynolds numbers on a second free-flight test vehicle
[ARC-CP-1302] N75-19189
FREE FLOW
A non-uniqueness of the hypersonic boundary layer
A75-26195
FREE JETS
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
On the instability of a sound-influenced free jet
[ESRO-TT-122] N75-20267
FREQUENCY MODULATION
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz
[RAE-TR-74032] N75-19217
FRICTION FACTOR
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
FRICTIONLESS ENVIRONMENTS
The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface
A75-27990
FUEL CONSUMPTION
Part load specific fuel consumption of gas turbines
A75-28650
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676
Fuel conservation possibilities for terminal area compatible aircraft
[NASA-CR-132608] N75-19224
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
FUEL TANKS
Investigation of 14.5mm API self-sealing/crashworthy fuel tank material
[AD-A001752] N75-19249
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
FUSELAGES
Influence of fuselage flexibility on the stress-strain state of the wing
A75-28668
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module
[AD-A002867] N75-20318
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Fuselage module sample output
[AD-A002868] N75-20319

# G

G-91 AIRCRAFT
Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests --- longitudinal and lateral stability of G-91-T3 aircraft
N75-19255
Determination of aerodynamic derivatives of the FIAT G-91 T3 aircraft from flight tests by means of manual analog model matching
N75-19257
Evaluation of flight test of the FIAT G-91 T3 by means of the method of forced oscillations
N75-19258
Evaluation of flight tests of the FIAT G-91 T3 by means of regression analysis
N75-19259
GALLIUM ARSENIDES
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
GAS EXPANSION
The expansion of a hypersonic turbulent boundary layer at a sharp corner
A75-26466
A problem in supersonic jet theory
A75-26697
GAS FLOW
A subsonic axisymmetric wake in a viscous gas
A75-26891
Theory of transonic flow around a profile
A75-28651
Hypersonic, viscous gas flow around a wing of small aspect ratio
A75-28653
GAS TEMPERATURE
Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied
A75-26672
GAS TURBINE ENGINES
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
High-temperature alloys and the aircraft gas turbine
A75-27877
Part load specific fuel consumption of gas turbines
A75-28650
Development of self-acting seals for helicopter engines
[NASA-CR-134739] N75-19243
PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251
Rotating engine design and cycle analysis program
[AD-A002314] N75-20342
GENERAL AVIATION AIRCRAFT
Application of a new slip-ringless propeller blade measurement system
A75-28771
Analysis of in-flight disintegration accidents
N75-19197
General Aviation Aircraft Safety
[AD-A003124] N75-19199
Analysis of general aviation accident records
N75-19200
General aviation accident patterns
N75-19201
The accident record in terms of the pilot
N75-19202
Crash survivability
N75-19203
General aviation handling qualities research
N75-19204
Design considerations for stall/spin avoidance
N75-19205
Economics: General aviation cost factors
N75-19206
Manufacturer's overview
N75-19207
The next forty years in aviation
N75-20228

General aviation's future need for research
N75-20242
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
GLIDE LANDINGS
Comparison of airport measurements of approach noise produced by jet aircraft
A75-27852
GLIDE PATHS
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
GLIDERS
The 'definition' of the motorsegler
[DFVLR-SONDDR-424] A75-27596
GOVERNMENT PROCUREMENT
Aeronautics in the American society
N75-20223
GRAPHS (CHARTS)
Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied
A75-26672
GROUND EFFECT MACHINES
Air cushion landing systems for aircraft
A75-27983
Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, 1 October - 31 December 1974
[DME/NAE-1974(4)] N75-20249
Some air cushion technology research in Canada
N75-20251
Air cushion landing systems for aircraft
N75-20296
GROUND STATIONS
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
GROUND TESTS
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
GUIDANCE SENSORS
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
GUST ALLEVIATORS
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432
Status and trends in active control technology
N75-20236
GUST LOADS
Improvements to the SADSAM computer program for aeroelasticity analysis
[NASA-CR-132617] N75-19173

## H

HARMONIC OSCILLATION
Calculations of generalised airforces on two parallel lifting surfaces oscillating harmonically in subsonic flow
[ARC-R/M-3749] N75-19187
HARNESSES
Crash survivability
N75-19203
HEAD-UP DISPLAYS
A conformal head-up display for the visual approach
N75-19138
HEAT TRANSFER
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336
HEAT TRANSFER COEFFICIENTS
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888
Interpretation of merged layer behavior for wedges
A75-27496
HELICOPTER CONTROL
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
Major Item Special Study (MISS), UH-1C tail rotor blade
[AD-A001714] N75-19230
HELICOPTER DESIGN
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479
Design and fatigue testing of integral armored servo actuator modified trunnion
[AD-A002069] N75-19235
Major Item Special Study (MISS), UH-1H tail rotor hangers
[AD-A003263] N75-20325
HELICOPTER ENGINES
Development of self-acting seals for helicopter engines
[NASA-CR-134739] N75-19243
HELICOPTER PERFORMANCE
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201
A specialised recording system for the measurement of helicopter rotor blade performance in flight
A75-28770
Helicopter flight regimes
[AD-A001220] N75-19268
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
HELICOPTER PROPELLER DRIVE
Extension of the lifting line model for the helicopter rotor
A75-28194
HELICOPTERS
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential --- Book
A75-26700
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz
[RAE-TR-74032] N75-19217
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3
[AD-A002014] N75-19269
Non-dimensional methods for the measurement of level flight performance of turbine engined helicopters
[ESDU-74042] N75-20289
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300
Instrument system test. Elliott helicopter air data system
[AD-A002332] N75-20331
Visual Augmentation System (VAS) laboratory demonstration and test results --- onboard helicopter
[AD-A003323] N75-20332
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
HIGH STRENGTH ALLOYS
Metallurgical factors affecting high strength aluminum alloy production
A75-28529
Fracture mechanics of tiny cracks near fasteners --- in high strength aluminum alloys
[AD-A002554] N75-20777
HODOGRAPHS
An exact solution for transonic potential flow past aerofoil sections
[NAL-TR-383] N75-19176
HORIZONTAL TAIL SURFACES
Calculations of generalised airforces on two parallel lifting surfaces oscillating harmonically in subsonic flow
[ARC-R/M-3749] N75-19187
HOVERING
Aerodynamic design of a rotor blade for minimum noise radiation
N75-19221
HOVERING STABILITY
Selected examples of the evaluation of VAK 191 B flight tests --- roll control characteristic in hovering flight
N75-19266

HP-115 AIRCRAFT
Longitudinal aerodynamic derivatives of a slender delta wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-19175
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-20259
HUMAN FACTORS ENGINEERING
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis
[AIAA PAPER 75-574] A75-26732
Crash survivability
N75-19203
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
HYDRAULIC ANALOGIES
Determination by means of hydraulic analogy of the transonic flow in a blade cascade
N75-20213
HYDROFOIL OSCILLATIONS
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879
HYPERSONIC BOUNDARY LAYER
A non-uniqueness of the hypersonic boundary layer
A75-26195
The expansion of a hypersonic turbulent boundary layer at a sharp corner
A75-26466
The prediction of turbulent heat transfer to wedge compression corners and cylinder-flare bodies at hypersonic speeds
[IC-AERO-73-03] N75-20264
HYPERSONIC FLIGHT
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
HYPERSONIC FLOW
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888
Hypersonic flow past pointed and blunt bodies with a concave generatrix
A75-26896
Hypersonic, viscous gas flow around a wing of small aspect ratio
A75-28653
HYPERSONIC HEAT TRANSFER
The expansion of a hypersonic turbulent boundary layer at a sharp corner
A75-26466
HYPERSONIC NOZZLES
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour
A75-28658

## I

ICE FORMATION
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
A study of carburetor/induction system icing in general aviation accidents
[NASA-CR-143835] N75-19208
ICE PREVENTION
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
IDEAL GAS
Theory of transonic flow around a profile
A75-28651
ILLUMINANCE
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
IMPACT LOADS
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879
IMPACT TESTS
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300
IN-FLIGHT MONITORING
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
A specialised recording system for the measurement of helicopter rotor blade performance in flight
A75-28770
Application of a new slip-ringless propeller blade measurement system
A75-28771
The development of a serial P.C.M. instrumentation system
A75-28797
INCOMPRESSIBLE FLOW
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
INERT ATMOSPHERE
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
INFORMATION SYSTEMS
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
INLET FLOW
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184
INSTRUMENT APPROACH
Pan American World Airways, Incorporated Boeing 707-321B, N454PA, Pago Pago, American Samoa, 30 January 1974
[PB-238478/2] N75-20277
Delta Air Lines Incorporated McDonnell Douglas DC-9-32, N3323L, Chattanooga Municipal Airport, Chattanooga, Tennessee
[PB-238479/0] N75-20278
INSTRUMENT FLIGHT RULES
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
INSTRUMENT LANDING SYSTEMS
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases
[AD-A003952] N75-20330
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
INTAKE SYSTEMS
A study of carburetor/induction system icing in general aviation accidents
[NASA-CR-143835] N75-19208
INTERNAL COMBUSTION ENGINES
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336
INTERNATIONAL COOPERATION
Air Europe: The policy of cooperation among airline companies of the European Six --- French book
A75-26499
European aeronautics and astronautics at the crossroads
A75-27981
INVISCID FLOW
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
Study of transonic flow over various bodies
N75-19169
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586

IRON ALLOYS
Design and purchase expectations for fracture resistance of 700-series aluminum airframe alloys
[AD-A002552] N75-20548

## J

J-85 ENGINE
An experimental investigation of compressor stall using an on-line distortion indicator and signal conditioner
[NASA-TM-X-3182] N75-20248
JET AIRCRAFT
Environmental and operating requirements for fire extinguishing systems on advanced aircraft
[AD-A001640] N75-19228
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246
Interior noise considerations for powered-lift STOL aircraft
[NASA-TM-X-72675] N75-19248
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878
JET AIRCRAFT NOISE
Comparison of airport measurements of approach noise produced by jet aircraft
A75-27852
Noise of model target type thrust reversers for engine-over-the-wing applications
A75-27853
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality
A75-27859
Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine
[AIAA PAPER 75-457] A75-27928
An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929
Subsonic jet noise in flight based on some recent wind-tunnel tests
[AIAA PAPER 75-462] A75-27930
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
Jet noise suppressors for turbojet engines
A75-28227
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348
Aeroacoustics: Jet and combustion noise; duct acoustics --- Book
A75-28629
Interaction between a sonic boom N-wave and an obstacle near corner points
A75-28665
New evidence of the mechanisms of noise generation and radiation of a subsonic jet
A75-28717
Investigation of aircraft combustor noise
[AD-A001737] N75-19250
JET ENGINES
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
JET FLAPS
Lift coefficients on a supercavitating jet-flapped foil between rigid walls
A75-26554
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
JET FLOW
Analysis of thick turbulent jet flowing round: A circular cylinder
N75-19168
JET IMPINGEMENT
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
JET MIXING FLOW
Some notes on the thermodynamics of thrust reversal in flight
N75-20212
JET PROPULSION
On the future of jet propulsion in subsonic transport aviation
A75-27777

## L

LAMINAR FLOW
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
LANDING AIDS
A conformal head-up display for the visual approach
N75-19138
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
LANDING GEAR
Air cushion landing systems for aircraft
A75-27983
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
LASER APPLICATIONS
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
LASER HEATING
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
LASER OUTPUTS
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
LATERAL CONTROL
Selected examples of the evaluation of VAK 191 B flight tests --- roll control characteristic in hovering flight
N75-19266
LATERAL STABILITY
Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests --- longitudinal and lateral stability of G-91-T3 aircraft
N75-19255
LEADING EDGES
A non-uniqueness of the hypersonic boundary layer
A75-26195
Interpretation of merged layer behavior for wedges
A75-27496
Flow past conically-cambered slender delta wings with leading-edge separation
[ARC-R/M-3748] N75-19186
LEAST SQUARES METHOD
Determination of the parameters of a system of equations of motion from flight test data --- least squares method
N75-19263
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
N75-20250
LIFT
Unsteady lift forces on a vibrating cylinder in a supercritical flow
A75-26480
Lift coefficients on a supercavitating jet-flapped foil between rigid walls
A75-26554

The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface
A75-27990

Critical analysis and improvement of the source-panel method --- for lift prediction
A75-28095

Lifting surface theory for a rotating subsonic or transonic blade row
[ARC-R/M-3740] N75-19185

LIFT AUGMENTATION
Noise of model target type thrust reversers for engine-over-the-wing applications
A75-27853

Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291

Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292

LIFT DEVICES
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931

LIFTING BODIES
Unsteady viscous flow past a lifting plate
N75-19171

TRW vortex-lattice method subsonic aerodynamic analysis for multiple-lifting-surfaces (N. surface) TRW program number HA010B
[NASA-CR-128588] N75-19178

A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271

Lifting surface for aircraft --- wing profiles
[NASA-TT-F-16241] N75-20290

LIFTING ROTORS
Extension of the lifting line model for the helicopter rotor
A75-28194

Some remarks on the induced velocity field of a lifting rotor and on Glauert's formula
[ARC-CP-1301] N75-20263

LIGHT EMITTING DIODES
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526

LINEAR PREDICTION
Notes on the approximate solution of lifting-surface theory used in the RAE standard method
[ARC-R/M-3752] N75-19188

LINEAR SYSTEMS
Eigenvalue/eigenvector assignment for multivariable systems --- linear state feedback control
A75-26312

LIQUID NITROGEN
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295

LIQUID SURFACES
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879

The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface
A75-27990

LOADS (FORCES)
A comparison of flight loads counting methods and their effects on fatigue life estimates using data from Concorde
[ARC-CP-1304] N75-19227

Some air cushion technology research in Canada
N75-20251

Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading
[AD-A002310] N75-20554

LOGISTICS MANAGEMENT
Major Item Special Study (MISS), UH-1C tail rotor blade
[AD-A001714] N75-19230

CH-47A assessment and comparative fleet evaluation: Executive summary report
[AD-A002057] N75-19232

LONGITUDINAL CONTROL
Adaptive digital system for aircraft control
A75-27182

Pitch paper pilot revisited --- methods for predicting handling qualities of aircraft in pitch
N75-19133

LONGITUDINAL STABILITY
Longitudinal aerodynamic derivatives of a slender delta wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-19175

Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests --- longitudinal and lateral stability of G-91-T3 aircraft
N75-19255

Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258

Development of longitudinal handling qualities criteria for large advanced supersonic aircraft
[NASA-CR-137635] N75-20345

LORAN C
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286

LOW ASPECT RATIO WINGS
Hypersonic, viscous gas flow around a wing of small aspect ratio
A75-28653

Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing
A75-28687


## M


MACH NUMBER
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83
[NASA-TM-X-56030] N75-20329

MACHINING
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591

MAN MACHINE SYSTEMS
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744

MANEUVERABILITY
Helicopter flight regimes
[AD-A001220] N75-19268

MATHEMATICAL MODELS
Unified analysis of ducted turbomachinery noise
A75-27861

Roll paper pilot --- mathematical model for predicting pilot rating of aircraft in roll task
N75-19134

Extraction of flight mechanic derivatives from flight data by a manual analog matching technique
[ESRO-TT-118] N75-20347

MAXIMUM LIKELIHOOD ESTIMATES
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258

MEASURE AND INTEGRATION
Computation of the velocity field induced by a planar source distribution approximating a symmetrical non-lifting wing in subsonic flow
[ARC-R/M-3751] N75-20262

MEASURING INSTRUMENTS
Analysis of wreckage --- aircraft accident investigation
A75-26533

MECHANICAL PROPERTIES
Characterization of advanced composite materials for structural design --- of aircraft
A75-27695

MEMBRANE STRUCTURES
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
MERIDIONAL FLOW
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity
A75-26671
METAL FATIGUE
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate
A75-28866
METAL MATRIX COMPOSITES
Metal matrix composites for aircraft propulsion systems
[NASA-TM-X-71685] N75-19245
Processable high temperature resistant polymer matrix materials
[NASA-TM-X-71682] N75-19367
METEOROLOGICAL PARAMETERS
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878
MICROSTRUCTURE
Metallurgical factors affecting high strength aluminum alloy production
A75-28529
MICROWAVE ANTENNAS
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
Dual band airborne antenna study
[AD-A002043] N75-19219
MICROWAVE LANDING SYSTEMS
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
Airborne equipment for use with the microwave landing system
A75-28790
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems
A75-28791
The range of airborne processing available to the future user of the Doppler MLS --- Microwave Landing Systems
A75-28792
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
Testing the MLS Doppler concept
A75-28802
MIDAIR COLLISIONS
Aircraft guidance for automatic collision avoidance
A75-27178
MILITARY AIRCRAFT
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744
Flight tests with the V/STOL experimental aircraft VAK 191 B
A75-27985
Aeronautics in the American society
N75-20223
The next forty years in aviation
N75-20228
MILITARY AVIATION
Interaction of military/civil position location and reporting systems --- of ATC
[AIAA PAPER 75-561] A75-28467
MILITARY HELICOPTERS
Dynamic loads and structural criteria study --- military helicopters
[AD-A001739] N75-19195
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231
CH-47A assessment and comparative fleet evaluation: Executive summary report
[AD-A002057] N75-19232
Engineering design handbook. Helicopter engineering, part 1: Preliminary design --- for VFR operation
[AD-A002007] N75-19238
MILITARY TECHNOLOGY
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
MINIATURE ELECTRONIC EQUIPMENT
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589
MODAL RESPONSE
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479

## N

NACELLES
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0
[NASA-TM-X-3178] N75-19180
NASA PROGRAMS
A new flight test data system for NASA aeronautical flight research
A75-28774
NAVIGATION AIDS
Airborne equipment for use with the microwave landing system
A75-28790
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems
A75-28791
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286
NEAR WAKES
A subsonic axisymmetric wake in a viscous gas
A75-26891
NEUMANN PROBLEM
Cavitating flow past a vibrating thin-section wing profile
A75-26895
NIGHT VISION
Visual Augmentation System (VAS) laboratory demonstration and test results --- onboard helicopter
[AD-A003323] N75-20332
NIMONIC ALLOYS
High-temperature alloys and the aircraft gas turbine
A75-27877
NOISE (SOUND)
Measurement and analysis of the unsteady normal force and pitching moment on an axial flow fan rotor blade element
[AD-A002739] N75-20343
NOISE GENERATORS
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
New evidence of the mechanisms of noise generation and radiation of a subsonic jet
A75-28717
NOISE INTENSITY
Comparison of airport measurements of approach noise produced by jet aircraft
A75-27852
NOISE MEASUREMENT
Comparison of airport measurements of approach noise produced by jet aircraft
A75-27852
An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931
Classification problems of aircraft noise --- far field measurements
A75-27943
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation --- Book
A75-28626
Interior noise considerations for powered-lift STOL aircraft
[NASA-TM-X-72675] N75-19248

PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251

NOISE POLLUTION
Problem of aircraft noise in the vicinity of airports A75-28222
Noise certification of aircraft A75-28223
Development of air transport and environmental requirements --- for air and noise pollution reduction A75-28228
Aeroacoustics: Jet and combustion noise; duct acoustics --- Book A75-28629

NOISE PROPAGATION
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927
Interaction between a sonic boom N-wave and an obstacle near corner points A75-28665
New evidence of the mechanisms of noise generation and radiation of a subsonic jet A75-28717

NOISE REDUCTION
Spinning mode sound propagation in ducts with acoustic treatment A75-27854
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality A75-27859
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937
Jet noise suppressors for turbojet engines A75-28227
Aerodynamic design of a rotor blade for minimum noise radiation N75-19221
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246
Trends in aircraft noise control N75-20229

NOISE SPECTRA
Noise of model target type thrust reversers for engine-over-the-wing applications A75-27853
Unified analysis of ducted turbomachinery noise A75-27861
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
Ratio of peak frequencies of jet self and shear noise spectra A75-28400

NONDESTRUCTIVE TESTS
Sound welds in wing boxes assured by three techniques A75-26898

NONLINEAR EQUATIONS
Nonlinear problem of the unsteady flow past an airfoil lattice A75-28671

NONLINEAR SYSTEMS
Stability analysis of stochastic composite systems --- application to control of aircraft and nonlinear systems A75-27919

NONLINEARITY
Nonlinear torsional vibrations of thin-walled beams of open section A75-26410

NONUNIFORM FLOW
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow A75-26894

NOSE FINS
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181

NOZZLE DESIGN
A method of profiling short two-dimensional nozzles --- for transonic wind tunnels A75-26880
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier A75-26881
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour A75-28658
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340

NOZZLE FLOW
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340

NOZZLE GEOMETRY
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour A75-28658
Performance of an isolated two-dimensional variable-geometry wedge nozzle with translating shroud and collapsing wedge at speeds up to Mach 2.01
[NASA-TN-D-7906] N75-20247

NUMERICAL ANALYSIS
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity A75-26671
Nonlinear problem of the unsteady flow past an airfoil lattice A75-28671
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it
[NASA-TT-F-16133] N75-19179

Computation of the velocity field induced by a planar source distribution approximating a symmetrical non-lifting wing in subsonic flow
[ARC-R/M-3751] N75-20262
NUMERICAL CONTROL
Adaptive digital system for aircraft control
A75-27182
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432

## O

OHIO
Aircraft accident report. Eastern Air Lines, Inc. McDonnell-Douglas DC 9-31, N8967E Akron-Conton Regional Airport, North Canton, Ohio, 27 Nov. 1973
[PB-238637/3] N75-20274
OPTICAL COMMUNICATION
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
OPTICAL PATHS
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
OPTICAL PROPERTIES
A new centralised warning display for aircraft
A75-28785
OPTICAL TRACKING
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator
N75-19127
OPTIMAL CONTROL
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676
A model based technique for the design of flight directors --- optimal control models
N75-19140
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182
OPTIMIZATION
An improved automated structural optimization program
[AD-A002688] N75-19237
OSCILLATING CYLINDERS
Unsteady lift forces on a vibrating cylinder in a supercritical flow
A75-26480
OSCILLATING FLOW
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings
[NAL-TR-368T-PT-1] N75-19174

## P

PACKINGS (SEALS)
Development of self-acting seals for helicopter engines
[NASA-CR-134739] N75-19243
PARACHUTES
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
PARALLEL FLOW
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209
PARTICLE SIZE DISTRIBUTION
Metallurgical factors affecting high strength aluminum alloy production
A75-28529
PASSENGER AIRCRAFT
Problems of designing passenger aircraft
[NASA-TT-F-808] N75-19223
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
PASSENGERS
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis
[AIAA PAPER 75-574] A75-26732
Ride quality evaluation. I --- aircraft passenger comfort assessment
A75-26849
PERFORATED PLATES
Stress intensity factors for some through-cracked fastener holes
A75-28236
PERFORMANCE PREDICTION
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927
Pitch paper pilot revisited --- methods for predicting handling qualities of aircraft in pitch
N75-19133
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278
Sideslip of wing-body combinations --- disturbance theory for predicting aerodynamics of aircraft in sideslip
[NASA-CR-114716] N75-20260
PERFORMANCE TESTS
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context
A75-28769
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems
A75-28791
Testing the MLS Doppler concept
A75-28802
Development of self-acting seals for helicopter engines
[NASA-CR-134739] N75-19243
Some aspects of performance measurements in nonsteady flight --- angle of attack and rate of climb
N75-19262
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286
PERSONNEL DEVELOPMENT
Aeronautics in the American society
N75-20223
PERTURBATION
On the instability of a sound-influenced free jet
[ESRO-TT-122] N75-20267
PERTURBATION THEORY
Sideslip of wing-body combinations --- disturbance theory for predicting aerodynamics of aircraft in sideslip
[NASA-CR-114716] N75-20260
PILOT ERROR
The accident record in terms of the pilot
N75-19202
PILOT PERFORMANCE
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
A study on aircraft map display location and orientation --- effects of map display location on manual piloting performance
N75-19128
PILOT TRAINING
The accident record in terms of the pilot
N75-19202
PITCHING MOMENTS
Measurement and analysis of the unsteady normal force and pitching moment on an axial flow fan rotor blade element
[AD-A002739] N75-20343

PNEUMATIC CONTROL
Evaluation program on using compressor bleed air as a source of pneumatic power for fluidic circuits
[AD-A002483] N75-20676
POLLUTION CONTROL
Development of air transport and environmental requirements --- for air and noise pollution reduction
A75-28228
POLYIMIDE RESINS
Processable high temperature resistant polymer matrix materials
[NASA-TM-X-71682] N75-19367
POSITIONING DEVICES (MACHINERY)
Tiedown tests for air transport of the XM542 sprint container
[AD-A001844] N75-19210
POTENTIAL FLOW
Cavitating flow past a vibrating thin-section wing profile
A75-26895
Critical analysis and improvement of the source-panel method --- for lift prediction
A75-28095
Nonlinear problem of the unsteady flow past an airfoil lattice
A75-28671
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191
A wake source model for an inclined flat plate in a uniform stream
[IC-AERO-74-08] N75-19192
POTENTIAL THEORY
A method for calculating unsteady forces due to interaction between tail surfaces
A75-26477
PREDICTION ANALYSIS TECHNIQUES
Critical analysis and improvement of the source-panel method --- for lift prediction
A75-28095
PRESSURE DISTRIBUTION
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0
[NASA-TM-X-3178] N75-19180
Lifting surface theory for a rotating subsonic or transonic blade row
[ARC-R/M-3740] N75-19185
A wake source model for an inclined flat plate in a uniform stream
[IC-AERO-74-08] N75-19192
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257
Some remarks on the induced velocity field of a lifting rotor and on Glauert's formula
[ARC-CP-1301] N75-20263
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272
PRESSURE DRAG
Opportunities for aerodynamic-drag reduction
N75-20237
PRESSURE GRADIENTS
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209
PRESSURE MEASUREMENTS
A specialised recording system for the measurement of helicopter rotor blade performance in flight
A75-28770
Boundary-layer pressure fluctuations at high Reynolds numbers on a second free-flight test vehicle
[ARC-CP-1302] N75-19189
PRESSURE OSCILLATIONS
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052
PRESSURE REDUCTION
Evaluation program on using compressor bleed air as a source of pneumatic power for fluidic circuits
[AD-A002483] N75-20676
PRODUCTION PLANNING
Organization of centralized maintenance of aircraft assemblies --- Russian book
A75-27838
PROJECT MANAGEMENT
General aviation's future need for research
N75-20242
University research in aeronautics
N75-20243
PROPELLER BLADES
Application of a new slip-ringless propeller blade measurement system
A75-28771
PROPELLER DRIVE
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations
A75-28522
PROPULSION SYSTEM CONFIGURATIONS
'By the application of power' /21st Cayley Memorial Lecture/ --- technical survey of aircraft engines
A75-27368
On the future of jet propulsion in subsonic transport aviation
A75-27777
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931
PROPULSION SYSTEM PERFORMANCE
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
PULSE CODE MODULATION
The development of a serial P.C.M. instrumentation system
A75-28797
PULSE RADAR
A new J band pulsed radar altimeter
A75-28787
PYROLYSIS
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073

## Q

QUALITY CONTROL
Major Item Special Study (MISS), UH-1H tail rotor hangers
[AD-A003263] N75-20325
QUIET ENGINE PROGRAM
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184

## R

RADAR BEACONS
Digital avionics - An overview --- Air Traffic Control Radar Beacon System
[AIAA PAPER 75-553] A75-26721
Multi-site intermittent positive control algorithms for the discrete address beacon system
[AD-A001112/2] N75-19214
RADAR TRACKING
The STRADA flight path tracking system
[RAE-LIB-TRANS-1813] N75-19209
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278
RADIO ALTIMETERS
A new J band pulsed radar altimeter
A75-28787
RADIO TELEMETRY
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
RAYLEIGH-RITZ METHOD
Flapping response characteristics of hingeless rotor blades by a generalized harmonic balance method
N75-19166
REAL TIME OPERATION
The benefits of real time computer analysis of experimental aircraft flight test data
A75-28801
REATTACHED FLOW
Heat transfer in separated and reattached flows - An annotated review
A75-26685

RECIPROCAL THEOREMS
The generation of sound by aerodynamic sources in an inhomogeneous steady flow
A75-26463
RECONNAISSANCE AIRCRAFT
Flight tests with the V/STOL experimental aircraft VAK 191 B
A75-27985
REDUNDANT COMPONENTS
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
REGRESSION ANALYSIS
Evaluation of flight tests of the FIAT G-91 T3 by means of regression analysis
N75-19259
RELIABILITY ANALYSIS
Airborne electronics for automated flight systems
N75-20232
RELIABILITY ENGINEERING
Reliability life cycle of a complex electronic airborne equipment
A75-27839
REMOTE CONTROL
Development of a remote digital augmentation system and application to a remotely piloted research vehicle
[NASA-TN-D-7941] N75-20293
REMOTELY PILOTED VEHICLES
Computer simulation of maintenance for multi-mission RPV's
[AD-A003351] N75-20253
RESEARCH AIRCRAFT
Development of a remote digital augmentation system and application to a remotely piloted research vehicle
[NASA-TN-D-7941] N75-20293
RESEARCH FACILITIES
University research in aeronautics
N75-20241
RESEARCH PROJECTS
Manufacturer's overview
N75-19207
University research in aeronautics
N75-20241
General aviation's future need for research
N75-20242
University research in aeronautics
N75-20243
Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, 1 October - 31 December 1974
[DME/NAE-1974(4)] N75-20249
RETARDING
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens
[NAL-TR-359] N75-19413
REYNOLDS NUMBER
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
RIGID ROTORS
Flapping response characteristics of hingeless rotor blades by a generalized harmonic balance method
N75-19166
ROLL
Roll paper pilot --- mathematical model for predicting pilot rating of aircraft in roll task
N75-19134
Selected examples of the evaluation of VAK 191 B flight tests --- roll control characteristic in hovering flight
N75-19266
ROLLING MOMENTS
A flight test investigation of the rolling moments induced on a T-37B airplane in the wake of a B-747 airplane
[NASA-TM-X-56031] N75-20221
ROTARY WINGS
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential --- Book
A75-26700
Extension of the lifting line model for the helicopter rotor
A75-28194
A specialised recording system for the measurement of helicopter rotor blade performance in flight
A75-28770
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz
[RAE-TR-74032] N75-19217
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
Major Item Special Study (MISS), UH-1H tail rotor hangers
[AD-A003263] N75-20325
ROTATING BODIES
Rotation in vibration, optimization, and aeroelastic stability problems
N75-19167
ROTOR AERODYNAMICS
Flapping response characteristics of hingeless rotor blades by a generalized harmonic balance method
N75-19166
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
ROTOR BLADES
Aerodynamic design of a rotor blade for minimum noise radiation
N75-19221
ROTOR BLADES (TURBOMACHINERY)
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode
A75-26553
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927
ROTORS
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel
[NASA-TM-X-62418] N75-20350

## S

S WAVES
Ratio of peak frequencies of jet self and shear noise spectra
A75-28400
S-N DIAGRAMS
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4
[NAL-TR-360] N75-19414
SAAB AIRCRAFT
A SAAB-SCANIA developed method for obtaining stability derivatives from flight tests
N75-19260
SAAB 37 AIRCRAFT
Characteristics of the AJ 37 aircraft: Comparison of the results of wind tunnel and flight tests --- noting elasticity correction for wind tunnel model
N75-19261
SAFETY DEVICES
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220
SAFETY FACTORS
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300
SAMOA
Pan American World Airways, Incorporated Boeing 707-321B, N454PA, Pago Pago, American Samoa, 30 January 1974
[PB-238478/2] N75-20277
SCALE MODELS
An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931

SCOOPS
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183
SEAT BELTS
Crash survivability
N75-19203
SEATS
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
SELF ADAPTIVE CONTROL SYSTEMS
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727
SELF OSCILLATION
Ratio of peak frequencies of jet self and shear noise spectra
A75-28400
SEPARATED FLOW
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212
Heat transfer in separated and reattached flows - An annotated review
A75-26685
Influence of sound upon separated flow over wings
A75-27495
The three-dimensional character of a cross flow around a circular cylinder
A75-28654
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209
SERVOMECHANISMS
Design and fatigue testing of integral armored servo actuator modified trunnion
[AD-A002069] N75-19235
SHARP LEADING EDGES
Hypersonic flow past pointed and blunt bodies with a concave generatrix
A75-26896
SHEAR FLOW
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
SHEAR STRESS
Shear lag analysis of thick skin aircraft structures
[ATN-7404] N75-19225
SHOCK WAVE GENERATORS
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
SHOCK WAVE INTERACTION
Interaction between a sonic boom N-wave and an obstacle near corner points
A75-28665
Evaluation of some control-volume techniques for analysis of shock-boundary layer interactions in supersonic inlets
[NASA-TM-X-3186] N75-20256
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257
SHOCK WAVE PROFILES
Hypersonic flow past pointed and blunt bodies with a concave generatrix
A75-26896
SHOCK WAVE PROPAGATION
Theory of transonic flow around a profile
A75-28651
SHOCK WAVES
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257
SHORT HAUL AIRCRAFT
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
Evaluation of active control technology for short haul aircraft --- cost effectiveness
[NASA-CR-137634] N75-20344
SHORT TAKEOFF AIRCRAFT
Interior noise considerations for powered-lift STOL aircraft
[NASA-TM-X-72675] N75-19248
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
SIDE INLETS
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183
SIDESLIP
Sideslip of wing-body combinations --- disturbance theory for predicting aerodynamics of aircraft in sideslip
[NASA-CR-114716] N75-20260
SIGNAL ANALYSIS
Characteristics of MLS signals and their effect on flight control systems --- Microwave Landing Systems
A75-28791
SIGNAL PROCESSING
The range of airborne processing available to the future user of the Doppler MLS --- Microwave Landing Systems
A75-28792
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
SKIN (STRUCTURAL MEMBER)
Shear lag analysis of thick skin aircraft structures
[ATN-7404] N75-19225
SLENDER BODIES
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272
SLENDER CONES
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
SLENDER WINGS
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258
SMALL PERTURBATION FLOW
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential --- Book
A75-26700
SONIC BOOMS
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation --- Book
A75-28626
Interaction between a sonic boom N-wave and an obstacle near corner points
A75-28665
SOUND FIELDS
Development of acoustic disturbances in supersonic annular jets
A75-26234
Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine
[AIAA PAPER 75-457] A75-27928
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348
On the instability of a sound-influenced free jet
[ESRO-TT-122] N75-20267
SOUND GENERATORS
The generation of sound by aerodynamic sources in an inhomogeneous steady flow
A75-26463
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939
SOUND PRESSURE
New evidence of the mechanisms of noise generation and radiation of a subsonic jet
A75-28717
SOUND PROPAGATION
Influence of sound upon separated flow over wings
A75-27495

Spinning mode sound propagation in ducts with acoustic treatment
A75-27854
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality
A75-27859
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
SOUND TRANSMISSION
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
SPACECRAFT COMMUNICATION
Air Traffic Control demonstration aspects of the Applications Technology Satellite-6
[AIAA PAPER 75-562] A75-26723
SPHERES
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888
SPRINT MISSILE
Tiedown tests for air transport of the XM542 sprint container
[AD-A001844] N75-19210
STABILITY DERIVATIVES
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201
Longitudinal aerodynamic derivatives of a slender delta wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-19175
Determination of aircraft characteristics from flight tests
[ESRO-TT-104] N75-19252
A SAAB-SCANIA developed method for obtaining stability derivatives from flight tests
N75-19260
Determination of derivatives by a model with automatic parameter --- analog circuit
N75-19265
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
N75-20250
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258
STAGNATION POINT
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888
STATE VECTORS
Eigenvalue/eigenvector assignment for multivariable systems --- linear state feedback control
A75-26312
STATISTICAL ANALYSIS
Annual reviews of aircraft accident data US Air Carrier operations, 1973
[PB-238281/0] N75-20276
STEADY FLOW
The generation of sound by aerodynamic sources in an inhomogeneous steady flow
A75-26463
STOCHASTIC PROCESSES
Stability analysis of stochastic composite systems --- application to control of aircraft and nonlinear systems
A75-27919
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432
STRATIFIED FLOW
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209
STRESS ANALYSIS
Shear lag analysis of thick skin aircraft structures
[ATN-7404] N75-19225
STRESS CONCENTRATION
Stress intensity factors for some through-cracked fastener holes
A75-28236
Influence of fuselage flexibility on the stress-strain state of the wing
A75-28668
STRESS MEASUREMENT
Development of an R.P. telemetry system --- for aircraft engine stress and temperature data
A75-28778
STRUCTURAL ANALYSIS
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
STRUCTURAL DESIGN
Characterization of advanced composite materials for structural design --- of aircraft
A75-27695
STRUCTURAL DESIGN CRITERIA
Aerodynamic design of a rotor blade for minimum noise radiation
N75-19221
Operational use of the UH-1 H helicopters in Arctic environment
[AD-A002603] N75-19236
Some trends in aircraft design: Structure
N75-20235
STRUCTURAL ENGINEERING
An improved automated structural optimization program
[AD-A002688] N75-19237
The future of aeronautics
[NASA-CR-142559] N75-20222
STRUCTURAL FAILURE
Analysis of in-flight disintegration accidents
N75-19197
STRUCTURAL MEMBERS
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary
[AD-A002850] N75-20301
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
STRUCTURAL VIBRATION
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479
STRUCTURAL WEIGHT
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary
[AD-A002850] N75-20301
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module
[AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308

A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2
[AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4
[AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5
[AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module
[AD-A002867] N75-20318
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Fuselage module sample output
[AD-A002868] N75-20319
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322
A structural weight estimation program (SWEEP) for aircraft. Volume 10: Flutter optimation stand-alone program
[AD-A002872] N75-20323
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program
[AD-A002873] N75-20324

**SUBSONIC AIRCRAFT**
On the future of jet propulsion in subsonic transport aviation
A75-27777
New evidence of the mechanisms of noise generation and radiation of a subsonic jet
A75-28717

**SUBSONIC FLOW**
A subsonic axisymmetric wake in a viscous gas
A75-26891
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926
Subsonic jet noise in flight based on some recent wind-tunnel tests
[AIAA PAPER 75-462] A75-27930

**SUBSONIC SPEED**
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181

**SUBSONIC WIND TUNNELS**
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348

**SUCTION**
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052

**SUPERCAVITATING FLOW**
Lift coefficients on a supercavitating jet-flapped foil between rigid walls
A75-26554

**SUPERCONDUCTIVITY**
Program for the development of a superconducting generator. Part 1: Phase 1 --- including critical component tests
[AD-A001649] N75-19546

**SUPERCRITICAL FLOW**
Unsteady lift forces on a vibrating cylinder in a supercritical flow
A75-26480

**SUPERCRITICAL WINGS**
Opportunities for aerodynamic-drag reduction
N75-20237

**SUPERHIGH FREQUENCIES**
Dual band airborne antenna study
[AD-A002043] N75-19219

**SUPERSONIC AIRCRAFT**
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft
[NASA-CR-137635] N75-20345

**SUPERSONIC COMPRESSORS**
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209

**SUPERSONIC FLOW**
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
Supersonic flow past intersecting surfaces --- wings
A75-26882
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209

**SUPERSONIC INLETS**
Evaluation of some control-volume techniques for analysis of shock-boundary layer interactions in supersonic inlets
[NASA-TM-X-3186] N75-20256

**SUPERSONIC JET FLOW**
Development of acoustic disturbances in supersonic annular jets
A75-26234
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
A problem in supersonic jet theory
A75-26697
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937

**SUPERSONIC NOZZLES**
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel
A75-26476
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier
A75-26881
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937

**SUPERSONIC TRANSPORTS**
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725

Paper pilot ponders supersonic transports
N75-19135
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport --- aerodynamic control and stability
[NASA-TM-X-72671] N75-19226
Comparison of parametric duct-burning turbofan and non-afterburning turbojet engines in a Mach 2.7 transport
[NASA-TM-X-71679] N75-19247
SUPERSONIC WAKES
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
SURFACE PROPERTIES
Supersonic flow past intersecting surfaces --- wings
A75-26882
SURVEILLANCE RADAR
Multi-site intermittent positive control algorithms for the discrete address beacon system
[AD-A001112/2] N75-19214
Provisional message formats for the DABS/NAS interface (revision 1)
[FAA-RD-74-63-A] N75-19216
SWEPT WINGS
An example of boundary layer flow with two instability regions
A75-28680
SYSTEMS ENGINEERING
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
Interaction of military/civil position location and reporting systems --- of ATC
[AIAA PAPER 75-561] A75-28467
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469
Development of an R.F. telemetry system --- for aircraft engine stress and temperature data
A75-28778
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary
[AD-A002850] N75-20301
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
SYSTEMS STABILITY
Stability analysis of stochastic composite systems --- application to control of aircraft and nonlinear systems
A75-27919

## T

TACAN
TACAN/DME digital data broadcast design plan. Volume 1: Operational analysis
[AD-A001403/5] N75-19213
TAIL ASSEMBLIES
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2
[AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4
[AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5
[AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317
Major Item Special Study (MISS), UH-1H tail rotor hangers
[AD-A003263] N75-20325
TAIL SURFACES
A method for calculating unsteady forces due to interaction between tail surfaces
A75-26477
TAKEOFF RUNS
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context
A75-28769
TECHNOLOGICAL FORECASTING
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
On the future of jet propulsion in subsonic transport aviation
A75-27777
The next forty years in aviation
N75-20228
TECHNOLOGY ASSESSMENT
Digital avionics - An overview --- Air Traffic Control Radar Beacon System
[AIAA PAPER 75-553] A75-26721
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
Fly-by-wire and control configured vehicles - Rewards and risks
A75-27367
'By the application of power' /21st Cayley Memorial Lecture/ --- technical survey of aircraft engines
A75-27368
Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973 --- German book
A75-27978
European aeronautics and astronautics at the crossroads
A75-27981
TECHNOLOGY TRANSFER
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
TELEMETRY
Development of an R.F. telemetry system --- for aircraft engine stress and temperature data
A75-28778
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
Provisional message formats for the DABS/NAS interface (revision 1)
[FAA-RD-74-63-A] N75-19216
TEMPERATURE MEASURING INSTRUMENTS
Development of an R.F. telemetry system --- for aircraft engine stress and temperature data
A75-28778
TENNESSEE
Delta Air Lines Incorporated McDonnell Douglas DC-9-32, N3323L, Chattanooga Municipal Airport, Chattanooga, Tennessee
[PB-238479/0] N75-20278
TEST EQUIPMENT
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739

THEODOLITES
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
THERMAL INSULATION
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239
THERMAL RESISTANCE
Processable high temperature resistant polymer matrix materials
[NASA-TM-X-71682] N75-19367
THERMODYNAMIC CYCLES
On the future of jet propulsion in subsonic transport aviation
A75-27777
Part load specific fuel consumption of gas turbines
A75-28650
THERMODYNAMIC EFFICIENCY
Part load specific fuel consumption of gas turbines
A75-28650
Quarterly bulletin of the Division of Mechanical Engineering and the National Aeronautical Establishment, 1 October - 31 December 1974
[DME/NAE-1974(4)] N75-20249
THIN AIRFOILS
Cavitating flow past a vibrating thin-section wing profile
A75-26895
THIN FILMS
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
THIN WALLS
Nonlinear torsional vibrations of thin-walled beams of open section
A75-26410
THREE DIMENSIONAL BOUNDARY LAYER
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel
A75-26476
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
THREE DIMENSIONAL FLOW
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle
A75-28652
The three-dimensional character of a cross flow around a circular cylinder
A75-28654
THREE DIMENSIONAL MOTION
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182
THRUST REVERSAL
Noise of model target type thrust reversers for engine-over-the-wing applications
A75-27853
Some notes on the thermodynamics of thrust reversal in flight
N75-20212
Performance of an isolated two-dimensional variable-geometry wedge nozzle with translating shroud and collapsing wedge at speeds up to Mach 2.01
[NASA-TN-D-7906] N75-20247
TIME DIVISION MULTIPLEXING
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
What have we learned from applying digital technology to cabin/passenger multiplex systems --- cost and weight analysis
[AIAA PAPER 75-574] A75-26732
SEEK BUS - A time division multiple access system --- ATC applications
[AIAA PAPER 75-564] A75-28468
TIME SIGNALS
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
TORSIONAL VIBRATION
Nonlinear torsional vibrations of thin-walled beams of open section
A75-26410
TOXIC HAZARDS
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073
TRACKING (POSITION)
The STRADA flight path tracking system
[RAE-LIB-TRANS-1813] N75-19209
TRAILING EDGES
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172
TRAJECTORY ANALYSIS
Analysis of in-flight disintegration accidents
N75-19197
TRAJECTORY CONTROL
A concept of flight dynamics control --- for aircraft
A75-27180
TRANSONIC FLOW
Survey on two calculation methods in transonic regime
A75-28096
Theory of transonic flow around a profile
A75-28651
Study of transonic flow over various bodies
N75-19169
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings
[NAL-TR-368T-PT-1] N75-19174
An exact solution for transonic potential flow past aerofoil sections
[NAL-TR-383] N75-19176
Determination by means of hydraulic analogy of the transonic flow in a blade cascade
N75-20213
TRANSONIC NOZZLES
A method of profiling short two-dimensional nozzles --- for transonic wind tunnels
A75-26880
TRANSONIC SPEED
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181
TRANSONIC WIND TUNNELS
A method of profiling short two-dimensional nozzles --- for transonic wind tunnels
A75-26880
TRANSPORT AIRCRAFT
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0
[NASA-TM-X-3178] N75-19180
Fuel conservation possibilities for terminal area compatible aircraft
[NASA-CR-132608] N75-19224
Special study: Safety aspects of emergency evacuations from air carrier aircraft
[PB-238269/5] N75-20275
TRANSPORTATION
Some air cushion technology research in Canada
N75-20251
TURBINE BLADES
High-temperature alloys and the aircraft gas turbine
A75-27877
Metal matrix composites for aircraft propulsion systems
[NASA-TM-X-71685] N75-19245
Determination by means of hydraulic analogy of the transonic flow in a blade cascade
N75-20213

Measurement and analysis of the unsteady normal force and pitching moment on an axial flow fan rotor blade element
[AD-A002739] N75-20343
TURBINE ENGINES
Non-dimensional methods for the measurement of level flight performance of turbine engined helicopters
[ESDU-74042] N75-20289
TURBOCOMPRESSORS
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode
A75-26553
Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied
A75-26672
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926
TURBOFAN ENGINES
On the future of jet propulsion in subsonic transport aviation
A75-27777
Radiation of duct noise out through a jet flow --- acoustic field model for aircraft engine
[AIAA PAPER 75-457] A75-27928
Comparison of parametric duct-burning turbofan and non-afterburning turbojet engines in a Mach 2.7 transport
[NASA-TM-X-71679] N75-19247
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
TURBOFANS
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927
TURBOJET ENGINES
An investigation of the noise from a scale model of an engine exhaust system --- turbojet noise measurement
[AIAA PAPER 75-459] A75-27929
Jet noise suppressors for turbojet engines
A75-28227
Rotating engine design and cycle analysis program
[AD-A002314] N75-20342
TURBOMACHINE BLADES
Lifting surface theory for a rotating subsonic or transonic blade row
[ARC-R/M-3740] N75-19185
TURBOMACHINERY
Unified analysis of ducted turbomachinery noise
A75-27861
TURBULENCE EFFECTS
Analysis of thick turbulent jet flowing round: A circular cylinder
N75-19168
TURBULENT BOUNDARY LAYER
The expansion of a hypersonic turbulent boundary layer at a sharp corner
A75-26466
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel
A75-26476
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052
TURBULENT FLOW
Analysis of thick turbulent jet flowing round: A circular cylinder
N75-19168
TURBULENT HEAT TRANSFER
The prediction of turbulent heat transfer to wedge compression corners and cylinder-flare bodies at hypersonic speeds
[IC-AERO-73-03] N75-20264
TURBULENT JETS
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
Ratio of peak frequencies of jet self and shear noise spectra
A75-28400
TURBULENT WAKES
The three-dimensional character of a cross flow around a circular cylinder
A75-28654
The dynamic response of aircraft encountering aircraft wake turbulence
N75-19170
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172
On wake vortex alleviation
N75-20231
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
TWISTED WINGS
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879
TWO DIMENSIONAL FLOW
Heat transfer in separated and reattached flows - An annotated review
A75-26685
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings
[NAL-TR-368T-PT-1] N75-19174
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191
TWO DIMENSIONAL JETS
A problem in supersonic jet theory
A75-26697

## U

UH-1 HELICOPTER
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
Major Item Special Study (MISS), UH-1C tail rotor blade
[AD-A001714] N75-19230
Operational use of the UH-1 H helicopters in Arctic environment
[AD-A002603] N75-19236
UNIVERSITIES
University research in aeronautics
N75-20241
General aviation's future need for research
N75-20242
University research in aeronautics
N75-20243
UNSTEADY FLOW
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212
A method for calculating unsteady forces due to interaction between tail surfaces
A75-26477
Nonlinear problem of the unsteady flow past an airfoil lattice
A75-28671
Unsteady viscous flow past a lifting plate
N75-19171

USER MANUALS (COMPUTER PROGRAMS)
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322

## V

V/STOL AIRCRAFT
A pilot's report concerning the VTOL YAK 191 B A75-26900
Flight tests with the V/STOL experimental aircraft YAK 191 B A75-27985
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data A75-28201
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations A75-28522
Technical evaluation report on Fluid Dynamics Panel Symposium on V/STOL Aerodynamics
[AGARD-AR-78] N75-19585
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data N75-20250
VAPORS
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336
VELOCITY DISTRIBUTION
Computation of the velocity field induced by a planar source distribution approximating a symmetrical non-lifting wing in subsonic flow
[ARC-R/M-3751] N75-20262
Some remarks on the induced velocity field of a lifting rotor and on Glauert's formula
[ARC-CP-1301] N75-20263
VERTICAL PERCEPTION
A display evaluation methodology applied to vertical situation displays N75-19137
VERTICAL TAKEOFF AIRCRAFT
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
VIBRATION
Rotation in vibration, optimization, and aeroelastic stability problems N75-19167
VIBRATION EFFECTS
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231
VIBRATION METERS
Application of a new slip-ringless propeller blade measurement system A75-28771
VIBRATION TESTS
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel
[NASA-TM-X-62418] N75-20350
VISCOUS FLOW
A non-uniqueness of the hypersonic boundary layer A75-26195
On the viscous flow about the trailing edge of a rapidly oscillating plate A75-26469
A subsonic axisymmetric wake in a viscous gas A75-26891
Hypersonic, viscous gas flow around a wing of small aspect ratio A75-28653
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
VISCOUS FLUIDS
Unsteady viscous flow past a lifting plate N75-19171
VISUAL CONTROL
A conformal head-up display for the visual approach N75-19138
VISUAL FLIGHT RULES
Engineering design handbook. Helicopter engineering, part 1: Preliminary design --- for VFR operation
[AD-A002007] N75-19238
VISUAL TASKS
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator N75-19127
Evaluation of tactual displays for flight control N75-19132
VOLTERRA EQUATIONS
Supersonic flow past intersecting surfaces --- wings A75-26882
VORTEX SHEETS
The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface A75-27990
Flow past conically-cambered slender delta wings with leading-edge separation
[ARC-R/M-3748] N75-19186
VORTICES
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations A75-28522
The dynamic response of aircraft encountering aircraft wake turbulence N75-19170
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
On wake vortex alleviation N75-20231
VORTICITY EQUATIONS
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil A75-26212

## W

WAKES
A wake source model for an inclined flat plate in a uniform stream
[IC-AERO-74-08] N75-19192
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
WALL FLOW
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel A75-26476
WALL PRESSURE
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer A75-27052
WARNING SYSTEMS
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
A new centralised warning display for aircraft A75-28785
Harowe altitude warning system evaluation
[AD-A002583] N75-19241
WAVE DIFFRACTION
Supersonic flow past intersecting surfaces --- wings A75-26882
WEAPON SYSTEMS
F-15 computational subsystem --- computer systems design
[AIAA PAPER 75-590] A75-28470
WEDGE FLOW
The expansion of a hypersonic turbulent boundary layer at a sharp corner A75-26466

Interpretation of merged layer behavior for wedges
A75-27496
WEDGES
The prediction of turbulent heat transfer to wedge compression corners and cylinder-flare bodies at hypersonic speeds
[IC-AERO-73-03] N75-20264
WELD TESTS
Sound welds in wing boxes assured by three techniques
A75-26898
WESTLAND AIRCRAFT
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
WIND PROFILES
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352
WIND TUNNEL MODELS
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0
[NASA-TM-X-3178] N75-19180
WIND TUNNEL TESTS
Subsonic jet noise in flight based on some recent wind-tunnel tests
[AIAA PAPER 75-462] A75-27930
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests
A75-27980
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport --- aerodynamic control and stability
[NASA-TM-X-72671] N75-19226
Characteristics of the AJ 37 aircraft: Comparison of the results of wind tunnel and flight tests --- noting elasticity correction for wind tunnel model
N75-19261
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83
[NASA-TM-X-56030] N75-20329
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel
[NASA-TM-X-62418] N75-20350
WIND TUNNELS
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
WINDSHIELDS
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300
WING FLAPS
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
WING LOADING
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052
The 'definition' of the motorsegler
[DFVLR-SONDDR-424] A75-27596
Influence of fuselage flexibility on the stress-strain state of the wing
A75-28668
WING OSCILLATIONS
Cavitating flow past a vibrating thin-section wing profile
A75-26895
Nonlinear problem of the unsteady flow past an airfoil lattice
A75-28671
Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing
A75-28687
WING PROFILES
Cavitating flow past a vibrating thin-section wing profile
A75-26895
Theory of transonic flow around a profile
A75-28651
Lifting surface for aircraft --- wing profiles
[NASA-TT-F-16241] N75-20290
WING TIPS
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
WINGS
Supersonic flow past intersecting surfaces --- wings
A75-26882
Sound welds in wing boxes assured by three techniques
A75-26898
Influence of sound upon separated flow over wings
A75-27495
The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface
A75-27990
Calculations of generalised airforces on two parallel lifting surfaces oscillating harmonically in subsonic flow
[ARC-R/M-3749] N75-19187
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
Fatigue-crack growth behavior of C-5A wing control points
[AD-A002553] N75-20299
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2
[AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4
[AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5
[AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317

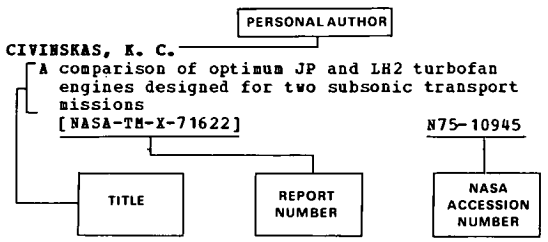
## X

X-15 AIRCRAFT
A new flight test data system for NASA aeronautical flight research
A75-28774

# 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. N75-10945. Under any one author's name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first.

## A


**AFONINA, N. E.**
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas A75-26888

**AHUJA, K. K.**
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937

**AKAMATSU, Y.**
A method for calculating unsteady forces due to interaction between tail surfaces A75-26477

**AL-BAHRANI, H. M. S.**
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression A75-28432

**ALLEN, J. G.**
Digital computer design guidelines for a full authority fly-by-wire flight control system
[AIAA PAPER 75-570] A75-26729

**ALLEN, R.**
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322

**ANDERSON, S. B.**
Design considerations for stall/spin avoidance N75-19205

**ANDERSON, W. E.**
Design and purchase expectations for fracture resistance of 700-series aluminum airframe alloys
[AD-A002552] N75-20548
Fracture mechanics of tiny cracks near fasteners
[AD-A002554] N75-20777

**ANDRISANI, D., II**
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271

**ARNOLD, J. D.**
Pitch paper pilot revisited N75-19133

**ASCANI, L.**
A structural weight estimation program (SWEEP) for aircraft. Volume 1: Executive summary
[AD-A002850] N75-20301

**ASHLEY, H.**
University research in aeronautics N75-20243

**ATVARS, J.**
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936

**AUERBACH, E.**
PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251


## B


**BARON, J. R.**
Interpretation of merged layer behavior for wedges A75-27496

**BARON, S.**
A display evaluation methodology applied to vertical situation displays N75-19137

**BARR, N. M.**
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352

**BARSBY, J. E.**
Flow past conically-cambered slender delta wings with leading-edge separation
[ARC-R/M-3748] N75-19186

**BARTON, C. K.**
Interior noise considerations for powered-lift STOL aircraft
[NASA-TM-X-72675] N75-19248

**BARTON, P.**
The range of airborne processing available to the future user of the Doppler MLS A75-28792

**BASSIOUNI, M. R.**
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937

**BATY, D. L.**
A study on aircraft map display location and orientation N75-19128

**BAZELYAN, L.**
Antennas, a collection, issue 15
[AD-A002646] N75-19557

**BAZZHIN, A. P.**
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle A75-28652

**BEARMAN, P. W.**
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191

**BEDDOE, S.**
A new centralised warning display for aircraft A75-28785

**BELOTSERKOVSKIY, S. M.**
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it
[NASA-TT-F-16133] N75-19179

**BELOUS, V. A.**
Influence of fuselage flexibility on the stress-strain state of the wing A75-28668

**BELSTERLING, C. A.**
Wind tunnel tests of a symmetrical airfoil with scoop fed slots
[NASA-CR-132568] N75-19183

**BENNETT, G. R.**
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft
[NASA-CR-137635] N75-20345

**BENNETT, J. A.**
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1 [NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2 [NASA-CR-137526] N75-20292
Evaluation of active control technology for short haul aircraft [NASA-CR-137634] N75-20344

**BETEILLE, R.**
Airbus A 300 - Comparison of the flight test results with the flight performance and flight characteristics determined on the basis of theory and wind tunnel tests A75-27980

**BETTERIDGE, W.**
High-temperature alloys and the aircraft gas turbine A75-27877

**BHAT, W. V.**
Effect of forward speed on jet wing/flap interaction noise [AIAA PAPER 75-475] A75-27932

**BHUTIANI, P. K.**
Some recent developments in supersonic jet noise reduction [AIAA PAPER 75-502] A75-27937

**BIGGERS, J. C.**
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel [NASA-TM-X-62418] N75-20350

**BIRCHENOUGH, J. P.**
Airborne equipment for use with the microwave landing system A75-28790

**BISHOP, D. E.**
Comparison of airport measurements of approach noise produced by jet aircraft A75-27852

**BLACK, J. M.**
Reliability life cycle of a complex electronic airborne equipment A75-27839

**BLAHA, B. J.**
Integration of aft-fuselage-mounted flow through engine nacelles on an advanced transport configuration at Mach numbers from 0.6 to 1.0 [NASA-TM-X-3178] N75-19180

**BLAIR, P. K.**
The range of airborne processing available to the future user of the Doppler MLS A75-28792

**BLAUGHER, R. D.**
Program for the development of a superconducting generator. Part 1: Phase 1 [AD-A001649] N75-19546

**BLENK, H.**
Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973 A75-27978

**BLOY, A. W.**
The expansion of a hypersonic turbulent boundary layer at a sharp corner A75-26466

**BOELKOW, L.**
European aeronautics and astronautics at the crossroads A75-27981

**BOHN, J. G.**
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft [NASA-CR-137635] N75-20345

**BOIKO, G. L.**
Determination of load factors for the impact of a profile against the surface of a liquid A75-26879

**BORN, G. J.**
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3 [AD-A002014] N75-19269

**BOROW, M.**
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON) [AD-A002327] N75-20349

**BOWDEN, M. K.**
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1 [NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2 [NASA-CR-137526] N75-20292

**BOWER, H. E.**
Opportunities for aerodynamic-drag reduction N75-20237

**BRADWELL, A. R. S.**
Some remarks on the induced velocity field of a lifting rotor and on Glauert's formula [ARC-CP-1301] N75-20263

**BRIGGS, D. G.**
Heat transfer in separated and reattached flows - An annotated review A75-26685

**BRINDLEY, A. E.**
Testing the MLS Doppler concept A75-28802

**BROOKS, G. W.**
Some trends in aircraft design: Structure N75-20235

**BROWALL, W.**
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system [AD-A003799] N75-20295

**BROWN, S. N.**
A non-uniqueness of the hypersonic boundary layer A75-26195
On the viscous flow about the trailing edge of a rapidly oscillating plate A75-26469

**BRUCE, E. P.**
Measurement and analysis of the unsteady normal force and pitching moment on an axial flow fan rotor blade element [AD-A002739] N75-20343

**BRYCE, W. D.**
An investigation of the noise from a scale model of an engine exhaust system [AIAA PAPER 75-459] A75-27929
Subsonic jet noise in flight based on some recent wind-tunnel tests [AIAA PAPER 75-462] A75-27930

**BUKHANOVA, R. S.**
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere [NASA-TT-F-777] N75-19182

**BULLEN, N. I.**
The variability of fatigue damage from flight to flight [ARC-CP-1297] N75-20297

**BURDORF, R.**
Selected examples of the evaluation of VAK 191 B flight tests N75-19266

**BURNS, B. R. A.**
Fly-by-wire and control configured vehicles - Rewards and risks A75-27367

**BURRELL, G. J.**
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height A75-27526

**BUTLER, J. P.**
Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading [AD-A002310] N75-20554

**BYAR, T.**
A structural weight estimation program (SWEEP) for aircraft. Volume II: Flexible airloads stand-alone program [AD-A002873] N75-20324

## C

**CALHOUN, L. C.**
Testing the MLS Doppler concept A75-28802

**CAMELIER, I.**
An experimental study of the structure and acoustic field of a jet in a cross stream [AIAA PAPER 75-460] A75-28348

**CANIFF, M. A.**
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft [NASA-CR-137635] N75-20345

CARNEGIS, I. A.
Rotating engine design and cycle analysis program
[AD-A002314] N75-20342
CARTER, I. J.
Instrument system test. Elliott helicopter air data system
[AD-A002332] N75-20331
CASTELLON, P. F.
Crash survivability
N75-19203
CHALOFF, D.
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322
CHALUPOVA, V.
Classification problems of aircraft noise
A75-27943
CHANDLER, G. G., JR.
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
CHEN, R. T. N.
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
CHISTOV, IU. I.
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour
A75-28658
CLINE, T. B.
Aircraft guidance for automatic collision avoidance
A75-27178
COCKING, B. J.
Subsonic jet noise in flight based on some recent wind-tunnel tests
[AIAA PAPER 75-462] A75-27930
COLLINS, F. G.
Influence of sound upon separated flow over wings
A75-27495
COLTEL, H.
Lifting surface for aircraft
[NASA-TT-P-16241] N75-20290
CONRAD, E. W.
Trends in aircraft noise control
N75-20229
COSTAKIS, W. G.
An experimental investigation of compressor stall using an on-line distortion indicator and signal conditioner
[NASA-TM-X-3182] N75-20248
COUCH, L. M.
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83
[NASA-TM-X-56030] N75-20329
COUSTEIX, J.
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel
A75-26476

## D

DANIELS, P. G.
On the viscous flow about the trailing edge of a rapidly oscillating plate
A75-26469
DASARO, J. A.
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
DAUGHADAY, H.
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
DAVENPORT, W. B.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
DAVIES, D. E.
Calculations of generalised airforces on two parallel lifting surfaces oscillating harmonically in subsonic flow
[ARC-R/M-3749] N75-19187
DAVIES, M. E.
A wake source model for an inclined flat plate in a uniform stream
[IC-AERO-74-08] N75-19192
DEETS, D. A.
Development of a remote digital augmentation system and application to a remotely piloted research vehicle
[NASA-TN-D-7941] N75-20293
DELEPIERRE-NYS, C.
Air Europe: The policy of cooperation among airline companies of the European Six
A75-26499
DEMAN, J. A.
PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251
DENISOVA, N. V.
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour
A75-28658
DEVLIN, B. T.
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
DEWEY, D. E.
Design of the DAIS control and display core element
[AIAA PAPER 75-600] A75-26745
DILLOW, J. D.
Pitch paper pilot revisited
N75-19133
Roll paper pilot
N75-19134
DIXON, G. J.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
DOREY, J.
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
DOSANJH, D. S.
Some recent developments in supersonic jet noise reduction
[AIAA PAPER 75-502] A75-27937
DU PEU, A. N.
Altimeters - The way ahead
A75-28788

DUBERG, J. E.
University research in aeronautics
N75-20241
DUKES, T. A.
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3
[AD-A002014] N75-19269
DUNN, R.
Digital avionics-overview - Airframe manufacturer's viewpoint
[AIAA PAPER 75-552] A75-26720
DURBIN, E. J.
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3
[AD-A002014] N75-19269
DYER, W. J.
An improved automated structural optimization program
[AD-A002688] N75-19237

## E

EDWARDS, J. L.
'By the application of power' /21st Cayley Memorial Lecture/
A75-27368
EDWARDS, J. W.
Development of a remote digital augmentation system and application to a remotely piloted research vehicle
[NASA-TN-D-7941] N75-20293
EFREMOV, I. I.
Cavitating flow past a vibrating thin-section wing profile
A75-26895
EGGSPUEHLER, J. J.
The accident record in terms of the pilot
N75-19202
EISENBERG, J. D.
Preliminary evaluation of turbofan cycle parameters and acoustical suppression on the noise and direct operating cost of a commercial Mach 0.85 transport
[NASA-TM-X-71664] N75-19244
ELLIS, B.
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
ELLIS, D. R.
General aviation handling qualities research
N75-19204
ELLISON, T. A.
System approach to civil aircraft navigation using digital technology
[AIAA PAPER 75-572] A75-28469
EMBLETON, T. F. W.
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality
A75-27859
ERDOS, J. I.
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239
EROSHIN, V. A.
Determination of load factors for the impact of a profile against the surface of a liquid
A75-26879

## F

FACKRELL, J. E.
Calculation of two-dimensional and axisymmetric bluff body potential flow
[IC-AERO-74-07] N75-19191
FAIRBANKS, L. E.
Flight-critical digital control system evaluation
[AIAA PAPER 75-566] A75-26725
FAUVEL, C.
Lifting surface for aircraft
[NASA-TT-F-16241] N75-20290
FEDOSOV, V. P.
Supersonic flow past intersecting surfaces
A75-26882
FENTON, R. E.
A tactual pilot aid for the approach-and-landing task: Inflight studies
N75-19131
FERRILL, R. S.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
FERRIS, J. E.
Dual band airborne antenna study
[AD-A002043] N75-19219
FINNEGAN, P.
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220
FIORINI, V.
Noise certification of aircraft
A75-28223
FISCHER, A.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
FISHER, M. J.
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
FIVEL, H. J.
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
FLEDDERJOHN, K. R.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
FLEMING, D. P.
Tests of laser metal removal for future flexible rotor balancing in engines
[SAE PAPER 750170] A75-26591
FLETCHER, J. C.
Aeronautics in the American society
N75-20223
FLETCHER, L. S.
Heat transfer in separated and reattached flows - An annotated review
A75-26685
FOWLER, H. S.
Some air cushion technology research in Canada
N75-20251
FRIEDRICH, H.
Comparison of evaluation procedures for the determination of flight-mechanical coefficients and derivatives from flight tests
N75-19254
Evaluation of flight tests of the FIAT G-91 T3 by means of regression analysis
N75-19259
FROUZ, J.
Adaptive control system with reference model
A75-27912

FRYE, D. E., JR.
Investigation of aircraft combustor noise
[AD-A001737] N75-19250
FURST, A.
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073

## G

GALLO ROSSO, D.
Effect of forward speed on jet wing/flap interaction noise
[AIAA PAPER 75-475] A75-27932
GANGAAS, D.
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352
GARNIER, G.
Astrolabe - A synthetic circular aperture system for landing and navigation
A75-28793
GARONNE, X.
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient
N75-20209
GARRIERE, P.
Some notes on the thermodynamics of thrust reversal in flight
N75-20212
GAYL, J.
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
GILSON, R. D.
A tactual pilot aid for the approach-and-landing task: Inflight studies
N75-19131
GLASER, M.
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
GLAWE, G. E.
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589
GOETHERT, B. H.
Air cushion landing systems for aircraft
A75-27983
Air cushion landing systems for aircraft
N75-20296
GOMEZ, A. V.
TRW vortex-lattice method subsonic aerodynamic analysis for multiple-lifting-surfaces (N. surface) TRW program number HA010B
[NASA-CR-128588] N75-19178
GOODSTEIN, R.
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
GOODWILLIE, A. G.
A comparison of flight loads counting methods and their effects on fatigue life estimates using data from Concorde
[ARC-CP-1304] N75-19227
GORDON, R.
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
GOULD, D. G.
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
N75-20250
GRANDT, A. F., JR.
Stress intensity factors for some through-cracked fastener holes
A75-28236
GRAVES, G. B., JR.
Airborne electronics for automated flight systems
N75-20232
GRAY, G. W.
Tiedown tests for air transport of the XM542 sprint container
[AD-A001844] N75-19210
GRIFFITH, W. E., II
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
GROESBECK, D.
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding
[NASA-TM-X-71681] N75-19246
GROMOV, V. G.
Numerical study of heat exchange at the stagnation point of a sphere situated in a hypersonic stream of carbon dioxide gas
A75-26888
GROVER, J. H. H.
Take-off instrument for assessing achieved performance during take-off and a take-off accident analysed in context
A75-28769
GUMBEL, H.
Interaction of military/civil position location and reporting systems
[AIAA PAPER 75-561] A75-28467
GUMMER, J. H.
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
GUTIERREZ, O. A.
Noise of model target type thrust reversers for engine-over-the-wing applications
A75-27853

## H

HAMAGUCHI, Y.
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4
[NAL-TR-360] N75-19414
HANKS, M. L.
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194
HANNEN, R. A.
Roll paper pilot
N75-19134
HARLOW, M. W.
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211
HARNED, M.
General aviation's future need for research
N75-20242
HAROLDSON, H.
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
HARRIS, O. C.
Evaluation of active control technology for short haul aircraft
[NASA-CR-137634] N75-20344
HARRISON, J. W.
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
HASHIMOTO, T.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
HASSAN, H. A.
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
HAWKINS, T. D. F.
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
HAWKINS, W. M.
The next forty years in aviation
N75-20228
HAYASE, G.
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302

A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 1: Technical discussion sections 1 and 2
[AD-A002864] N75-20310
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 2: Technical discussion, sections 3 and 4
[AD-A002865] N75-20311
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Book 3: Technical discussion, section 5
[AD-A002866] N75-20312
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix A: General information for module flow charts and listings. Appendix B: Program flow charts, overlays (8,0), (14,0), (15,0), (16,0) and (17,0)
[AD-A002859] N75-20313
A struttural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix C: Program flow charts, overlays (9,0) and (10,0)
[AD-A002860] N75-20314
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix D: Program flow charts, overlay (18,0)
[AD-A002861] N75-20315
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix E: Program listings, overlays (8,0), (14,0), (15,0), (16,0), and (17,0)
[AD-A002862] N75-20316
A structural weight estimation program (SWEEP) for aircraft. Volume 6: Wing and empennage module. Appendix F: Program listings, overlays (9,0), (10,0) and (18,0)
[AD-A002863] N75-20317
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322

HEALEY, M.
Design of a digital-stability augmentation and control system with gust alleviation and modal suppression
A75-28432

HENDRICK, R. C.
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727

HICKCOX, T. E.
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184

HILL, C. D.
Self-testing digital flight control applications
[AIAA PAPER 75-568] A75-26727

HILLE, R.
Extension of the lifting line model for the helicopter rotor
A75-28194

HILTON, R. J.
Air Traffic Control demonstration aspects of the Applications Technology Satellite-6
[AIAA PAPER 75-562] A75-26723

HINDS, J.
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220

HINDSON, W. S.
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
A75-28201
Estimates of the stability derivatives of a helicopter and a V/STOL aircraft from flight data
N75-20250

HINGST, W. R.
Evaluation of some control-volume techniques for analysis of shock-boundary layer interactions in supersonic inlets
[NASA-TM-X-3186] N75-20256

HIYAMA, H.
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module
[AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module
[AD-A002867] N75-20318
A structural weight estimation program (SWEEP) for aircraft. Volume 7: Fuselage module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Fuselage module sample output
[AD-A002868] N75-20319
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322

HODDER, B.
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348

HODGE, G. L.
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414

HODSON, C.
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307

HOMICZ, G. F.
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926

HONRATH, J. F.
Evaluation of active control technology for short haul aircraft
[NASA-CR-137634] N75-20344

HOVDE, R. J.
C-141 All Weather Landing System (AWLS) flight test report: Optimization and pre-experimental phases
[AD-A003952] N75-20330

HOWE, M. S.
The generation of sound by aerodynamic sources in an inhomogeneous steady flow
A75-26463
HOWE, R. M.
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator
N75-19127
HUBBARD, H. H.
Trends in aircraft noise control
N75-20229
HUERRE, P.
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
HUFF, E. M.
A study on aircraft map display location and orientation
N75-19128
HUNT, B. L.
The impingement of non-uniform, axisymmetric, supersonic jets on a perpendicular flat plate
A75-26684
HUSTON, R. L.
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211

## I

IACOB, C.
A problem in supersonic jet theory
A75-26697
ICHIKAWA, H.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
ILIFF, K. W.
An aircraft application of system identification in the presence of state noise
[AD-A001936] N75-19234
ILLARIONOV, V. F.
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion
A75-28676
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182
INGLE, G.
Flight determination of the rudder power and directional stability of the Fairey Delta 2 aircraft using a wingtip parachute
[ARC-CP-1298] N75-19267
INTANO, G. P.
Harowe altitude warning system evaluation
[AD-A002583] N75-19241
INYUTIN, G.
Antennas, a collection, issue 15
[AD-A002646] N75-19557
ISOGAI, K.
A method for predicting unsteady aerodynamic forces on oscillating wings with thickness in transonic flow near Mach number 1. Part 1: Two-dimensional theory. Part 2: Rectangular wings
[NAL-TR-368T-PT-1] N75-19174
IVERSEN, J. D.
Inviscid to turbulent transition of trailing vortices
[NASA-CR-142298] N75-19172

## J

JACKSON, R. M.
Important aspects of international air cargo
A75-26948
JACOBSON, I. D.
Ride quality evaluation. I
A75-26849
JAKUBOWSKI, A. K.
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272
JERIE, J.
Part load specific fuel consumption of gas turbines
A75-28650
JOHNSON, R. B.
Pitch paper pilot revisited
N75-19133
JOHNSON, R. B., JR.
Operational use of the UH-1 H helicopters in Arctic environment
[AD-A002603] N75-19236
JOHNSON, W.
Shake test of rotor test apparatus in the 40- by 80-foot wind tunnel
[NASA-TM-X-62418] N75-20350
JORGENSEN, L. H.
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181
JOUZEAU, J. L.
The STRADA flight path tracking system
[RAE-LIB-TRANS-1813] N75-19209

## K

KAKUTA, Y.
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens
[NAL-TR-359] N75-19413
KARAMCHETI, K.
An experimental study of the structure and acoustic field of a jet in a cross stream
[AIAA PAPER 75-460] A75-28348
Effects of friction and heat conduction on sound propagation in ducts
[AIAA PAPER 75-520] A75-28349
KARLASHOV, A. V.
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate
A75-28866
KARMARKAR, J. S.
Aircraft guidance for automatic collision avoidance
A75-27178
KAZA, K. R. V.
Rotation in vibration, optimization, and aeroelastic stability problems
N75-19167
KEMP, D. E.
General aviation accident patterns
N75-19201
KIDA, T.
Lift coefficients on a supercavitating jet-flapped foil between rigid walls
A75-26554
KIZILOS, B.
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
KLEIN, V.
Longitudinal aerodynamic derivatives of a slender delta wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-19175
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-19177
Longitudinal aerodynamic derivatives of a slender delta-wing research aircraft extracted from flight data
[CRANFIELD-AERO-27] N75-20258
Parameter identification applied to aircraft
[CRANFIELD-AERO-26] N75-20259
KOBAYASHI, H.
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode
A75-26553
KOCHETKOV, Y. A.
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it
[NASA-TT-F-16133] N75-19179
KOEHLER, R.
Determination of derivatives by a model with automatic parameter
N75-19265

KONAR, A. F.
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
KOPCHICK, N. A.
Design of the DAIS control and display core element
[AIAA PAPER 75-600] A75-26745
KOROTKIN, A. I.
The three-dimensional character of a cross flow around a circular cylinder
A75-28654
KOSHINUMA, T.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
KOSKI, E. J.
Investigation of 14.5mm API self-sealing/crashworthy fuel tank material
[AD-A001752] N75-19249
KOVALEV, B. D.
A subsonic axisymmetric wake in a viscous gas
A75-26891
KOZLOVSKIY, V. I.
Problems of designing passenger aircraft
[NASA-TT-F-808] N75-19223
KRAUSE, L. N.
Miniature probes for use in gas turbine testing
[SAE PAPER 750094] A75-26589

## L

LAAHANEN, D. H.
Development of a scientific basis for analysis of aircraft seating systems
[AD-A004306] N75-20273
LACHMANN, S. G.
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
LAING, E. J.
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231
LANGRISH, W. W.
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz
[RAE-TR-74032] N75-19217
LAVAN, Z.
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212
LAWRENCE, R. L.
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184
LAWSON, K.
Airborne equipment for use with the microwave landing system
A75-28790
LEBEDEV, N. G.
Development of acoustic disturbances in supersonic annular jets
A75-26234
LECANN, R. P.
The benefits of real time computer analysis of experimental aircraft flight test data
A75-28801
LEDGER, J. A.
Computation of the velocity field induced by a planar source distribution approximating a symmetrical non-lifting wing in subsonic flow
[ARC-R/M-3751] N75-20262
LERNER, D. S.
Evaluation of the Rubino procedure for radio telemetric theodolite positioning
[AD-A004317] N75-20353
LESTER, H. C.
Unified analysis of ducted turbomachinery noise
A75-27861
LEVISON, W. H.
Evaluation of tactual displays for flight control
N75-19132
A display evaluation methodology applied to vertical situation displays
N75-19137
A model based technique for the design of flight directors
N75-19140
LEY, J. M.
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
LIAMSHEV, L. M.
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052
LIPSHITS, IU. B.
Theory of transonic flow around a profile
A75-28651
LIGHTFOOT, F. W.
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
LINDLEY, D. W.
Noise generation and transmission in duct combustors
[AIAA PAPER 75-527] A75-27938
LOISEAU, H.
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479
Unsteady lift forces on a vibrating cylinder in a supercritical flow
A75-26480
LONGSTAFF, I. D.
A new J band pulsed radar altimeter
A75-28787
LOPEZ, M. L.
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
LORDI, J. A.
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926
LOSITO, V.
Critical analysis and improvement of the source-panel method
A75-28095
LUDWIG, G. R.
Theoretical and experimental studies of discrete-tone rotor-stator interaction noise
[AIAA PAPER 75-443] A75-27926
LYNWANDER, P.
Development of self-acting seals for helicopter engines
[NASA-CR-134739] N75-19243
LYTOVINOV, V. M.
An example of boundary layer flow with two instability regions
A75-28680

## M

MAESTRELLO, L.
New evidence of the mechanisms of noise generation and radiation of a subsonic jet
A75-28717
MAHESH, J. K.
Digital flight control system for tactical fighter. Volume 1: Digital flight control system analysis
[AD-A002320] N75-20348
Digital flight control systems for tactical fighters. Volume 2: Documentation of the digital control analysis software (DIGIKON)
[AD-A002327] N75-20349
MAIDEN, D. L.
Performance of an isolated two-dimensional variable-geometry wedge nozzle with translating shroud and collapsing wedge at speeds up to Mach 2.01
[NASA-TN-D-7906] N75-20247
MALKOV, S. N.
Organization of centralized maintenance of aircraft assemblies
A75-27838

MAOLI, G.
Development of air transport and environmental requirements
A75-28228
MARAZZI, R.
Survey on two calculation methods in transonic regime
A75-28096
MARINI, M.
Jet noise suppressors for turbojet engines
A75-28227
MARTINDALE, C.
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 1: Air induction system module
[AD-A002857] N75-20308
A structural weight estimation program (SWEEP) for aircraft. Volume 5: Air induction system and landing gear modules. Part 2: Landing gear module
[AD-A002858] N75-20309
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual
[AD-A002870] N75-20321
A structural weight estimation program (SWEEP) for aircraft. Volume 9: User's manual, appendix A
[AD-A002871] N75-20322
MARTLEW, D. L.
The use of Hartmann generators as sources of high intensity sound in a large absorption flow duct facility
[AIAA PAPER 75-529] A75-27939
MARUTA, H.
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode
A75-26553
MARVILLET, J. P.
The STRADA flight path tracking system
[RAE-LIB-TRANS-1813] N75-19209
MASEK, R. V.
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
MATTESON, F. H.
Analysis of in-flight disintegration accidents
N75-19197
MAY, D. P. L.
Helicopter rotor-produced modulation and aerial field distribution in the band 30 to 76 MHz
[RAE-TR-74032] N75-19217
MCCABRIA, J. L.
Program for the development of a superconducting generator. Part 1: Phase 1
[AD-A001649] N75-19546
MCCARTNEY, J. R.
Ratio of peak frequencies of jet self and shear noise spectra
A75-28400
MCCARTY, R. S.
Evaluation program on using compressor bleed air as a source of pneumatic power for fluidic circuits
[AD-A002483] N75-20676
MCCLURE, J. D.
Environmental and operating requirements for fire extinguishing systems on advanced aircraft
[AD-A001640] N75-19228
MCCONVILLE, G.
Characteristics of MLS signals and their effect on flight control systems
A75-28791
MCDONNELL, J. D.
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734
MCFARLAND, A. L.
Multi-site intermittent positive control algorithms for the discrete address beacon system
[AD-A001112/2] N75-19214
MCKINSTRY, R. G.
Software engineering of a navigation and guidance system for commercial aircraft
[AIAA PAPER 75-575] A75-26733
MCLEMORE, H. C.
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport
[NASA-TM-X-72671] N75-19226
MCTIGUE, T. V.
F-15 computational subsystem
[AIAA PAPER 75-590] A75-28470
MEHTA, U. B.
Starting vortex, separation bubbles and stall - A numerical study of laminar unsteady flow around an airfoil
A75-26212
MEIER, R. W.
Digital avionics - An overview
[AIAA PAPER 75-553] A75-26721
MELLIN, S.
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
MENICUCCI, D. F.
USAF aircraft takeoff length distances and climbout profiles
[AD-A001826] N75-19878
MERCER, G. S.
Economics: General aviation cost factors
N75-19206
MERCURIO, S. P.
Reliability life cycle of a complex electronic airborne equipment
A75-27839
MERZ, A. W.
Aircraft guidance for automatic collision avoidance
A75-27178
MEYER, R. T.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
MEYERS, R. E.
Operational use of the UH-1 H helicopters in Arctic environment
[AD-A002603] N75-19236
MEZHIROV, I. I.
Study of two hypersonic, axisymmetric, shaped nozzles with smooth contour
A75-28658
MICHEL, A. N.
Stability analysis of stochastic composite systems
A75-27919
MICHEL, R.
Experimental and theoretical analysis of three dimensional turbulent boundary layers in a curved supersonic channel
A75-26476
MILLER, C. O.
Analysis of general aviation accident records
N75-19200
MINECK, R. E.
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
MITCHELL, J. S.
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
MITTAG, C. F.
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194

MIYAI, Y.
Lift coefficients on a supercavitating jet-flapped foil between rigid walls
A75-26554
MOCKAPETRIS, L. J.
Analytical comparison of hypersonic flight and wind tunnel viscous/inviscid flow fields
[NASA-CR-2489] N75-19586
MOHR, J.
What have we learned from applying digital technology to cabin/passenger multiplex systems
[AIAA PAPER 75-574] A75-26732
MORECI, A. P.
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins
A75-27073
MORFEY, C. L.
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data
[AIAA PAPER 75-477] A75-27933
MORIARTY, L.
Design and fatigue testing of integral armored servo actuator modified trunnion
[AD-A002069] N75-19235
MORIN, C. R.
Analysis of wreckage
A75-26533
MORRISON, D. K.
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278
MOSSMAN, D. C.
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
MOSUNOV, V. A.
Allowance for the elastic deformation of the wing in its own plane in the calculation of the skewsymmetric vibrations of an aircraft with a small-aspect-ratio wing
A75-28687
MOULANG, F. B.
A specialised recording system for the measurement of helicopter rotor blade performance in flight
A75-28770
MULDER, J. A.
Some aspects of performance measurements in nonsteady flight
N75-19262
MULLEY, W. G.
Instrumentation displays for future naval aircraft
[AIAA PAPER 75-599] A75-26744
MUNSER, H. J.
Evaluation of flight test of the FIAT G-91 T3 by means of the method of forced oscillations
N75-19258
MYSHENKOV, V. I.
A subsonic axisymmetric wake in a viscous gas
A75-26891

## N

NAGAMATSU, H. T.
Aeroacoustics: Fan, STOL, and boundary layer noise; sonic boom; aeroacoustic instrumentation
A75-28626
NAISH, J. M.
A conformal head-up display for the visual approach
N75-19138
NAMBA, M.
Lifting surface theory for a rotating subsonic or transonic blade row
[ARC-R/M-3740] N75-19185
NAPOLITANO, L. G.
Critical analysis and improvement of the source-panel method
A75-28095
NARBUT, V.
Antennas, a collection, issue 15
[AD-A002646] N75-19557
NARUCKI, C. W.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
NAYLOR, P. R.
Roll paper pilot
N75-19134
NECHAEV, N. P.
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity
A75-26671
NELSON, E. R.
Experimental aerodynamic characteristics for a cylindrical body of revolution with side strakes and various noses at angles of attack from 0 degrees to 58 degrees and Mach numbers from 0.6 to 2.0
[NASA-TM-X-3130] N75-19181
NELSON, R. C.
The dynamic response of aircraft encountering aircraft wake turbulence
N75-19170
NEUMAN, D. D.
SEEK BUS - A time division multiple access system
[AIAA PAPER 75-564] A75-28468
NICOLAS, J.-R.
Determination of the dynamic characteristics of a helicopter by the branch-modes method
A75-26479
NIKOLAEV, IU. A.
Adaptive digital system for aircraft control
A75-27182
NISHIO, K.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
NISS, G.
A SAAB-SCANIA developed method for obtaining stability derivatives from flight tests
N75-19260
NORTHEN, W. P.
A new J band pulsed radar altimeter
A75-28787
NOWAK, Z.
Computation of airfoil DRAG profiles
[REPT-35/1974] N75-19165
NUGENT, J.
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83
[NASA-TM-X-56030] N75-20329

## O

OBERMAYER, R. W.
A study of carburetor/induction system icing in general aviation accidents
[NASA-CR-143835] N75-19208
OBERMEIER, L.
A pilot's report concerning the VTOL YAK 191 B
A75-26900
OBLANAS, J.
Feasibility of laser systems for aircraft landing operations under low visibility conditions
[AD-A005637] N75-19198
OHATA, T.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator
[RAE-LIB-TRANS-1768] N75-19274
OSBORNE, C.
The prediction of turbulent heat transfer to wedge compression corners and cylinder-flare bodies at hypersonic speeds
[IC-AERO-73-03] N75-20264
OSDER, S. S.
Flight test of a digital guidance and control system in a DC-10 aircraft
[AIAA PAPER 75-567] A75-26726
OVERBURY, F. G.
The range of airborne processing available to the future user of the Doppler MLS
A75-28792
OVSIANNIKOV, A. M.
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier
A75-26881

## P


PACKER, K. P.
Analysis of wreckage A75-26533

PAGE, R. H.
Heat transfer in separated and reattached flows - An annotated review A75-26685

PAKHOMOVA, Z. S.
Hypersonic flow past pointed and blunt bodies with a concave generatrix A75-26896

PAO, S. P.
New evidence of the mechanisms of noise generation and radiation of a subsonic jet A75-28717

PARKER, J. A.
A study of the effects on mice of smoke and gases from controlled fires in simulated aircraft cabins A75-27073

PARKER, J. H., JR.
Program for the development of a superconducting generator. Part 1: Phase 1
[AD-A001649] N75-19546

PARLETT, L. P.
Low-speed wind-tunnel tests of a 1/10-scale model of a blended arrow advanced supersonic transport
[NASA-TM-X-72671] N75-19226

PASHINTSEV, V. T.
Qualitative analysis of a family of extremums in a problem involving optimal control of aircraft motion A75-28676

PASSERELLO, C. E.
Users manual for UCIN vehicle occupant crash study model, version 2
[AD-A001801] N75-19211

PATTERSON, R. W.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
Evaluation of active control technology for short haul aircraft
[NASA-CR-137634] N75-20344

PAULON, J.
The coexistence of two supersonic plane flows in the presence of a longitudinal pressure gradient N75-20209

PECH, Z.
Adaptive control system with reference model A75-27912

PETERS, D. A.
Flapping response characteristics of hingeless rotor blades by a generalized harmonic balance method N75-19166

PETERS, D. V.
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height A75-27526

PETRINO, A. R.
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724

PEW, R. W.
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator N75-19127

PFIZENMAIER, E.
On the instability of a sound-influenced free jet
[ESRO-TT-122] N75-20267

PHILPOT, M. G.
The role of rotor blade blockage in the propagation of fan noise interaction tones
[AIAA PAPER 75-447] A75-27927

PIERCY, J. E.
Propagation of aircraft noise near airports - Effects of hillsides, inversions and source directionality A75-27859

PIETRASS, A.
Determination of aerodynamic derivatives of the FIAT G-91 T3 aircraft from flight tests by means of manual analog model matching N75-19257
Extraction of flight mechanic derivatives from flight data by a manual analog matching technique
[ESRO-TT-118] N75-20347

PIROGOVA, S. V.
Calculation of the flow around blunted, nonsymmetric cones with large aperture angle A75-28652

PIRUMOV, U. G.
A method of calculating aerodynamic-nozzle profiles with passage through the sound barrier A75-26881

PLOKHIKH, V. P.
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182

PLUMBLEE, H. E.
Radiation of duct noise out through a jet flow
[AIAA PAPER 75-457] A75-27928

PLUMER, J. R.
Development of scratch and spall resistant windshields
[AD-A002513] N75-20300

PODSYPANINA, N. A.
A method of profiling short two-dimensional nozzles A75-26880

POLITT, W.
The aircraft accident A75-26498

PRIOLO, D.
Problem of aircraft noise in the vicinity of airports A75-28222

PUZINO, M. G.
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer A75-27052


## R


RADITZ, M.
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220

RADWAN, M. S.
Internal-combustion engine/vapour cycle combination
[OUEL-1097/74] N75-20336

RANDALL, C. C.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292

RANLET, J. D.
Multi-slot film cooling of supersonic aircraft using air as a coolant
[AD-A002673] N75-19239

RAO, C. K.
Nonlinear torsional vibrations of thin-walled beams of open section A75-26410

REDDY, N. N.
Propulsive-lift noise of an upper surface blown flap configuration
[AIAA PAPER 75-470] A75-27931

REDHEAD, H. W.
Development of an R.F. telemetry system A75-28778

REDIESS, H. A.
Status and trends in active control technology N75-20236

REDING, L.
Determination by means of hydraulic analogy of the transonic flow in a blade cascade N75-20213

REES, D. A.
Development of statistical fatigue failure characteristics of 0.125 inch 2024-T3 aluminum under simulated flight-by-flight loading
[AD-A002310] N75-20554

REID, J. S.
Natural icing tests. UH-1H helicopter
[AD-A002077] N75-19194

REINER, D.
Provisional message formats for the DABS/NAS interface (revision 1)
[PAA-RD-74-63-A] N75-19216
RENSHAW, J. H.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
Evaluation of active control technology for short haul aircraft
[NASA-CR-137634] N75-20344
REYNOLDS, P. H. J.
Oceanic air route navigation with envelope match Loran-C
[AD-A003800] N75-20286
RHOTEN, R. P.
Eigenvalue/eigenvector assignment for multivariable systems
A75-26312
RIABCHENKO, V. P.
Nonlinear problem of the unsteady flow past an airfoil lattice
A75-28671
RICCIUS, R.
Flight tests with the V/STOL experimental aircraft VAK 191 B
A75-27985
RICE, E. J.
Spinning mode sound propagation in ducts with acoustic treatment
A75-27854
RICHARDS, L. G.
Ride quality evaluation. I
A75-26849
RIGNEY, J. W.
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278
ROBERT, E.
Determination by means of hydraulic analogy of the transonic flow in a blade cascade
N75-20213
ROBERTS, D. R.
Boundary-layer pressure fluctuations at high Reynolds numbers on a second free-flight test vehicle
[ARC-CP-1302] N75-19189
ROBERTS, L.
On wake vortex alleviation
N75-20231
ROBINSON, M. L.
Boundary layer effects in supersonic flow over cylinder-flare bodies
[WRE-REPT-1238(WR/D)] N75-20257
ROCKWELL, H.
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 1: Program integration
[AD-A002852] N75-20302
A strucutral weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Part 2: Data management module
[AD-A002853] N75-20303
A structural weight estimation program (SWEEP) for aircraft. Volume 2: Program integration and data management module. Appendix A: Data management module flow charts and FORTRAN lists
[AD-A002851] N75-20304
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue
[AD-A002856] N75-20307
A structural weight estimation program (SWEEP) for aircraft. Volume 8: Programmer's manual
[AD-A002869] N75-20320
ROE, W. T.
A study of carburetor/induction system icing in general aviation accidents
[NASA-CR-143835] N75-19208
ROECK, G. D.
Dynamic loads and structural criteria study
[AD-A001739] N75-19195
ROH, J.
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
ROTHAMMER, G.
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module
[AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program
[AD-A002873] N75-20324
ROY, M.
On the future of jet propulsion in subsonic transport aviation
A75-27777
ROZENSHTEIN, I. E.
Elementary method of graphic replotting of a characteristic of an uncooled turbocompressor when the intake temperature and number of revolutions are varied
A75-26672
RUBAN, A. I.
Hypersonic, viscous gas flow around a wing of small aspect ratio
A75-28653
RUBBERT, P. E.
Sideslip of wing-body combinations
[NASA-CR-114716] N75-20260
RUBINS, P. M.
PLT 27 gas turbine engine exhaust emission and noise measurements
[AD-A001728] N75-19251

## S

SALEMME, R. M.
Feasibility of adapting a thin film permeable membrane to jet transport fuel tank inerting system
[AD-A003799] N75-20295
SALOSINA, S. A.
Characteristics of pressure fluctuations in distributed suction of a turbulent boundary layer
A75-27052
SAMOILOV, G.
Helicopter flight regimes
[AD-A001220] N75-19268
SANDERSON, K. C.
A new flight test data system for NASA aeronautical flight research
A75-28774
SAZONOV, V. V.
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate
A75-28866
SCARPINO, F. A.
Digital avionics information system /DAIS/ integrated test bed development
[AIAA PAPER 75-588] A75-26739
SCHAEFFER, D. R.
Wind models for flight simulator certification of landing and approach guidance and control systems
[AD-A003801] N75-20352
SCHAEUFELE, H. U.
Determination of the parameters of a system of equations of motion from flight test data
N75-19263
SCHETZ, J. A.
Wind tunnel studies of the turbulent wake behind self propelled slender bodies
[AD-A002396] N75-20272
SCHMALL, R. A.
Unsteady viscous flow past a lifting plate
N75-19171
SCHULZ, W.
Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973
A75-27978
SCHWENDLER, R. G.
Improvements to the SADSAM computer program for aeroelasticity analysis
[NASA-CR-132617] N75-19173

SCOTT, G. A.
New horizons in air traffic control
[AIAA PAPER 75-569] A75-26728
SEBRING, J. R.
The U.S. Candidate Microwave Landing System - A new generation of avionics/ground equipment
[AIAA PAPER 75-607] A75-28472
SEMENENKO, V. N.
Cavitating flow past a vibrating thin-section wing profile
A75-26895
SEMRAU, W. R.
Investigation of aircraft combustor noise
[AD-A001737] N75-19250
SERAFINI, T. T.
Processable high temperature resistant polymer matrix materials
[NASA-TM-X-71682] N75-19367
SHAMES, O.
Flight test evaluation of SECANT VECAS collision avoidance system
[AD-A002281] N75-19220
SHAMRIKOV, B. M.
Adaptive digital system for aircraft control
A75-27182
SHEARER, J. R.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
SHERIDAN, P. R.
Computer simulation of maintenance for multi-mission RPV's
[AD-A003351] N75-20253
SHEYNIN, V. M.
Problems of designing passenger aircraft
[NASA-TT-F-808] N75-19223
SHIFRIN, E. G.
A method of profiling short two-dimensional nozzles
A75-26880
SHIMOKAWA, T.
Relation between scatter of fatigue life and S-N curve in aircraft structural aluminium alloy 2024-T4
[NAL-TR-360] N75-19414
SHKADOV, L. M.
Mechanics of optimum three-dimensional motion of aircraft in the atmosphere
[NASA-TT-F-777] N75-19182
SIEGEL, S.
A structural weight estimation program (SWEEP) for aircraft. Volume 10: Flutter optimation stand-alone program
[AD-A002872] N75-20323
SIGNORELLI, R. A.
Metal matrix composites for aircraft propulsion systems
[NASA-TM-X-71685] N75-19245
SIMCOX, C. D.
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936
SIMPSON, L. P.
Visual Augmentation System (VAS) laboratory demonstration and test results
[AD-A003323] N75-20332
SMITH, H. J.
A flight test investigation of the rolling moments induced on a T-37B airplane in the wake of a B-747 airplane
[NASA-TM-X-56031] N75-20221
SMITH, P. R.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1
[NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2
[NASA-CR-137526] N75-20292
SMITH, S. H.
Fatigue-crack growth behavior of C-5A wing control points
[AD-A002553] N75-20299
SMITH, W. B.
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
SNACKENBURG, S. J.
Dynamic loads and structural criteria study
[AD-A001739] N75-19195
SOKOLOV, K. B.
Interaction between a sonic boom N-wave and an obstacle near corner points
A75-28665
SOPIN, L.
Antennas, a collection, issue 15
[AD-A002646] N75-19557
SORENSEN, J. A.
Aircraft guidance for automatic collision avoidance
A75-27178
SPEE, B. M.
Technical evaluation report on Fluid Dynamics Panel Symposium on V/STOL Aerodynamics
[AGARD-AR-78] N75-19585
SPREUER, K. R.
Dynamic loads and structural criteria study
[AD-A001739] N75-19195
SPRINGER, R. J.
Environmental and operating requirements for fire extinguishing systems on advanced aircraft
[AD-A001640] N75-19228
SRINATHKUMAR, S.
Eigenvalue/eigenvector assignment for multivariable systems
A75-26312
STEELE, M. A.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
STEPHENSON, D.
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
STEPHENSON, D. W.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
STEVEN, G. P.
Shear lag analysis of thick skin aircraft structures
[ATN-7404] N75-19225
STEVENS, R. C. K.
An investigation of the noise from a scale model of an engine exhaust system
[AIAA PAPER 75-459] A75-27929
STEWARTSON, K.
A non-uniqueness of the hypersonic boundary layer
A75-26195

STIMPSON, E. W.
Manufacturer's overview N75-19207
STOKIC, D.
A concept of flight dynamics control A75-27180
STONE, J. R.
Noise of model target type thrust reversers for engine-over-the-wing applications A75-27853
Paper pilot ponders supersonic transports N75-19135
STRAENG, G.
Characteristics of the AJ 37 aircraft: Comparison of the results of wind tunnel and flight tests N75-19261
SUDDERTH, R. W.
Development of longitudinal handling qualities criteria for large advanced supersonic aircraft [NASA-CR-137635] N75-20345
SUGIYAMA, N.
Real-time simulation of jet engines with a digital computer(1), fabrication and characteristics of the simulator [RAE-LIB-TRANS-1768] N75-19274
SUN, P. B.
Flight path control and performance analysis, phases 1 and 2. Integrated display, phase 3 [AD-A002014] N75-19269
SYBERG, J..
Low speed and angle of attack effects on sonic and near-sonic inlets [NASA-CR-134778] N75-19184
SYCHEV, V. V.
Hypersonic, viscous gas flow around a wing of small aspect ratio A75-28653
SZALAI, K. J.
Status and trends in active control technology N75-20236
SZECHENYI, E.
Unsteady lift forces on a vibrating cylinder in a supercritical flow A75-26480

## T

TAKANASHI, S.
An exact solution for transonic potential flow past aerofoil sections [NAL-TR-383] N75-19176
TALABI, S. O.
Analysis of thick turbulent jet flowing round: A circular cylinder N75-19168
TANAKA, H.
Effect of interference between moving blade rows on cascade flutter. I - Experiment on compressor cascade in flexure mode A75-26553
TANNER, R. B.
Evaluation of tactual displays for flight control N75-19132
TAYLOR, M. J.
The development of a serial P.C.M. instrumentation system A75-28797
TEJANI, S.
A structural weight estimation program (SWEEP) for aircraft. Volume 4: Material properties, structure temperature, flutter and fatigue [AD-A002856] N75-20307
TELENIN, G. F.
Development of acoustic disturbances in supersonic annular jets A75-26234
TEMPLEMAN, J. E.
Flight-critical digital control system evaluation [AIAA PAPER 75-566] A75-26725
TERADA, H.
On fatigue crack arresting by a stop-hole in 2024-T3 aluminum alloy sheet specimens [NAL-TR-359] N75-19413
TERIAEV, E. D.
Adaptive digital system for aircraft control A75-27182
TESSARZIK, J. M.
Tests of laser metal removal for future flexible rotor balancing in engines [SAE PAPER 750170] A75-26591
TESTER, B. J.
Developments in jet noise modeling - Theoretical predictions and comparisons with measured data [AIAA PAPER 75-477] A75-27933
THOMPSON, D. S.
Metallurgical factors affecting high strength aluminum alloy production A75-28529
THORPE, A. C.
Flight simulation of a Wessex helicopter: A validation exercise [ARC-CP-1299] N75-20298
TIBBETTS, J. G.
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 1 [NASA-CR-137525] N75-20291
Evaluation of advanced lift concepts and fuel conservative short-haul aircraft, volume 2 [NASA-CR-137526] N75-20292
TIKHOMIROV, B. A.
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity A75-26671
TILL, R. D.
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft [NASA-CR-132614] N75-19271
TOKAREV, V. P.
Fatigue strength of D16T Duralumin at normal and elevated temperatures as a function of the cycling rate A75-28866
TOMSHIN, V. K.
Dynamics of the motion of a body with allowance for the unsteady state of the flow about it [NASA-TT-F-16133] N75-19179
TOPUNOV, A. M.
Development and experimental evaluation of a numerical method for solving the inverse axisymmetric problem in an axial turbine stage with given velocity A75-26671
TOWNE, D. M.
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer [AD-A002705] N75-19278
TRIGGS, T. J.
Evaluation of tactual displays for flight control N75-19132

## V

VAN HOLTEN, T.
The computation of aerodynamic loads on helicopter blades in forward flight, using the method of the acceleration potential A75-26700
VANDEVENNE, H. F.
Provisional message formats for the DABS/NAS interface (revision 1) [FAA-RD-74-63-A] N75-19216
VENGHAUS, H. H.
Study of transonic flow over various bodies N75-19169
VIEZEE, W.
Feasibility of laser systems for aircraft landing operations under low visibility conditions [AD-A005637] N75-19198
VILLEMAIN, H. F.
Investigation of 14.5mm API self-sealing/crashworthy fuel tank material [AD-A001752] N75-19249
VISHNEVETSKII, S. L.
Hypersonic flow past pointed and blunt bodies with a concave generatrix A75-26896
VONGLAHN, U.
Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding [NASA-TM-X-71681] N75-19246

VONMEIER, U.
Manual evaluation of special flying maneuvers for the determination of flight-mechanical coefficients and derivatives from flight tests
N75-19255
VOROBEV, N. F.
Supersonic flow past intersecting surfaces
A75-26882
VUKOBRATOVIC, M.
A concept of flight dynamics control
A75-27180

## W

WADDOUPS, M. E.
Characterization of advanced composite materials for structural design
A75-27695
WAGAMATSU, H. T.
Aeroacoustics: Jet and combustion noise; duct acoustics
A75-28629
WAGNER, H.
The range of validity in the case of two old investigations. I - The origin of lift. II - Collision and gliding processes on the liquid surface
A75-27990
WALKER, M. J.
Application of a new slip-ringless propeller blade measurement system
A75-28771
WASSON, N. P.
A theoretical method for calculating the aerodynamic characteristics or arbitrary ejector-jet-flapped wing: Theoretical analysis
[AD-A002319] N75-20271
WEAND, A. E., JR.
Vibration and temperature survey production AH-1G helicopter
[AD-A002063] N75-19231
WEBB, E. G., JR.
Harowe altitude warning system evaluation
[AD-A002583] N75-19241
WEBB, L. D.
Exploratory wind tunnel tests of a shock-swallowing air data sensor at a Mach number of approximately 1.83
[NASA-TM-X-56030] N75-20329
WEBBER, F.
Impact of turbine modulation on variable-cycle engine performance. Phase 1 and 2: Design fabrication and rig test, part 1
[AD-A002543] N75-20337
Impact of turbine modulation on variable-cycle engine performance. Phase 3: Engine modification and sea level test, part 2
[AD-A002544] N75-20338
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3A
[AD-A002545] N75-20339
Impact of turbine modulation on variable-cycle engine performance. Phase 4: Additional hardware design and fabrication, engine modification, and altitude test, part 3B
[AD-A002546] N75-20340
WEBER, J.
Notes on the approximate solution of lifting-surface theory used in the RAE standard method
[ARC-R/M-3752] N75-19188
WEENER, E. F.
Effects of visual flight display dynamics on altitude tracking performance in a flight simulator
N75-19127
WEINGARTEN, N. C.
A study for active control research and validation using the Total In-Flight Simulator (TIFS) aircraft
[NASA-CR-132614] N75-19271
WEMPE, T. E.
A study on aircraft map display location and orientation
N75-19128
WENZEL, L. M.
An experimental investigation of compressor stall using an on-line distortion indicator and signal conditioner
[NASA-TM-X-3182] N75-20248
WHARF, J. H.
The performance in illuminances up to 80,000 lux of a light emitting diode display having a 3 mm character height
A75-27526
WHITE, F. C.
Digital avionics from the viewpoint of ATA
[AIAA PAPER 75-551] A75-28466
WHITE, J. A.
OH-58A propulsion system vibration investigation
[AD-A002672] N75-20341
WHITLOW, J. B., JR.
Comparison of parametric duct-burning turbofan and non-afterburning turbojet engines in a Mach 2.7 transport
[NASA-TM-X-71679] N75-19247
WICKENS, R. H.
The aerodynamic characteristics and trailing vortex wake of propeller V/STOL configurations
A75-28522
WILCKENS, V.
Improvements in pilot/aircraft-integration by advanced contact analog displays
N75-19141
WILCOCK, T.
Flight simulation of a Wessex helicopter: A validation exercise
[ARC-CP-1299] N75-20298
WILDERMUTH, P.
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module
[AD-A002854] N75-20305
A structural weight estimation program (SWEEP) for aircraft. Volume 3: Airloads estimation module. Appendix A: Module flow charts and FORTRAN lists. Appendix B: Sample output
[AD-A002855] N75-20306
A structural weight estimation program (SWEEP) for aircraft. Volume 11: Flexible airloads stand-alone program
[AD-A002873] N75-20324
WILDEY, C. G.
Wide bandwidth optical telemetry link for ground testing of equipment in high EMI environments
A75-28781
WILEY, D. R.
Low speed and angle of attack effects on sonic and near-sonic inlets
[NASA-CR-134778] N75-19184
WILLIAMS, L. A.
Field evaluation of model 2 of the computer-based, individual trainer for the radar intercept officer
[AD-A002705] N75-19278
WILLICH, W.
Design of the DAIS control and display core element
[AIAA PAPER 75-600] A75-26745
WILSON, J. C.
Wind tunnel investigation of helicopter rotor wake effects on three helicopter fuselage models
[NASA-TM-X-3185-SUPPL] N75-20294
WILSON, S. G.
An experimental TDMA network for airborne warning and control systems interoperability demonstrations
[AIAA PAPER 75-563] A75-26724
WINTER, F. J., JR.
Integrated avionics - Controls and displays for helicopter IFR operation
A75-28786
WOOD, K.
Design and fatigue testing of integral armored servo actuator modified trunnion
[AD-A002069] N75-19235
WRIGHT, C. P.
Supersonic jet noise suppression with multitube nozzle/ejectors
[AIAA PAPER 75-501] A75-27936

## Y

YOPP, W. B.
Digital flight control systems - Considerations in implementation and acceptance
[AIAA PAPER 75-577] A75-26734

YOUNGBLOOD, L. J., JR.
Application of digital systems to Army avionics
[AIAA PAPER 75-587] A75-26738
YU, Y. H.
Aerodynamic design of a rotor blade for minimum noise radiation
N75-19221

## Z

ZACHER, H.
The 'definition' of the motorsegler
[DFVLR-SONDDR-424] A75-27596
ZAMYATIN, Y.
Antennas, a collection, issue 15
[AD-A002646] N75-19557
ZDRAVKOVICH, M. M.
The disappearance of the wake shock behind a cylinder in a supersonic flow at high Reynolds number
A75-26414
ZELENEVITZ, J.
Influence of sound upon separated flow over wings
A75-27495
ZEMLIANSKII, B. A.
Calculation of heat transfer at the lines of flow of a three-dimensional boundary layer in a nonuniform external flow
A75-26894
ZOBEA, C.
On the calculation of non-linear aerodynamic characteristics and the near vortex wake
[AD-A002161] N75-19193
ZORUMSKI, W. E.
Unified analysis of ducted turbomachinery noise
A75-27861

# CONTRACT NUMBER INDEX



## Typical Contract Number Index Listing


Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the *IAA* accession numbers appearing first. The accession number denotes the number by which the citation is identified in either the *IAA* or *STAR* section.


AF PROJ. 921C
N75-19210
AF PROJ. 1366
N75-19239
AF PROJ. 1467
N75-19237
AF PROJ. 1987
N75-20348
N75-20349
AF PROJ. 3066
N75-20337
N75-20338
N75-20339
AF PROJ. 3145
N75-19546
AF PROJ. 7351
N75-20554
AF PROJ. 8224
N75-20342
AF PROJ. 9769
N75-19234
AF PROJ. 9781
N75-19193
AF-AFOSR-2145-71
N75-19193
AF-AFOSR-2492-73
N75-19234
ARPA ORDER 2310
N75-19278
AT/2037/057 N75-20264
CNR-73,00339,07
A75-28095
DA PROJ. 1F1-62208-AH-90
N75-19195
N75-19236
DA PROJ. 1F2-62205-AH-88
N75-19235
DA PROJ. 1G1-62204-AA-71
N75-19251
DA PROJ. 1G1-72207-AA-110
N75-19250
DA PROJ. 1G2-62207-AH-89
N75-20341
DA PROJ. 1728005
N75-20300
DAAB07-72-C-0161
N75-19269
DAAB07-73-C-0337
N75-19219
DAAJ01-71-C-0840
N75-20332
DAAJ02-73-C-0014
N75-19236
DAAJ02-73-C-0017
N75-20341
DAAJ02-73-C-0068
N75-19251
DAAJ02-73-C-0088
N75-19250
DAAJ02-73-C-0099
N75-19249
DAAJ02-74-C-0013
N75-19235
DAAJ02-74-C-0018
N75-19195
DOT-FA70WA-2448
N75-19214
DOT-FA70WAI-173
N75-20330
DOT-FA72WA-2893
A75-27936
DOT-FA72WA-2934
N75-20352
DOT-FA72WA-3080
N75-19212
N75-19213
DOT-FA72WA-3101
N75-20273
DOT-FA72WA-3134
N75-20295
DOT-FA72WAI-261
N75-19216
DOT-FA73WA-3214
N75-19198
DOT-FA74NA-1027
N75-20353
DOT-FA74WA-3388
N75-20286
DOT-FH-11-7570
N75-19136
DOT-OS-20094 A75-27937
DOT-TSC-535 A75-27178
DOT-05-40056 A75-27938
ERI PROJ. 1146-S
N75-19172
FAA PROJ. 034-241-012
N75-19216
F19628-73-C-0002
N75-19216
F33614-72-C-1801
A75-26591
F33615-71-C-1591
N75-19546
F33615-71-C-1625
N75-20337
N75-20338
N75-20339
N75-20340
F33615-71-C-1805
A75-28529
F33615-71-C-1922
N75-20301
N75-20302
N75-20303
N75-20304
N75-20305
N75-20306
N75-20307
N75-20308
N75-20309
N75-20310
N75-20311
N75-20312
N75-20313
N75-20314
N75-20315
N75-20316
N75-20317
N75-20318
N75-20319
N75-20320
N75-20321
N75-20322
N75-20323
N75-20324
F33615-72-C-1058
N75-20348
N75-20349
F33615-72-C-1202
A75-28529
F33615-72-C-2003
N75-20554
F33615-73-C-2032
A75-27933
F33615-73-C-2046
A75-27926
F33615-73-C-2071
N75-19228
F33615-73-C-3086
N75-19237
F33615-73-C-3127
N75-20271
F33615-73-C-3132
N75-19239
F33657-73-C-0281
N75-20299
N75-20548
N75-20777
F44520-68-C-0018
A75-26685
F44620-69-C-0022
A75-26212
NASW-2481 N75-19179
N75-19223
NASW-2482 N75-19182
NASW-2483 N75-20290
NAS1-11728 N75-19586
NAS1-12017 N75-19173
NAS1-12018 N75-19224
NAS1-12451 N75-19183
NAS1-13267 A75-26733
NAS1-13329 N75-19271
NAS2-5006 N75-20260
NAS2-6652 N75-19137
N75-19140
NAS2-6995 N75-20291
N75-20292
N75-20344
NAS2-7966 N75-20345
NAS3-14420 A75-26591
NAS3-16823 N75-19243
NAS3-18035 N75-19184
NAS4-2191 N75-19208
NAS9-12330 N75-19178
NGR-05-020-526
A75-28348
A75-28349
NGR-47-005-181
A75-26849
NR PROJ. 122-303
N75-19211
NR PROJ. 213-114
N75-20331
NRC A-2003 A75-28400
NSF GK-33739 A75-27919
NSF GK-42133 A75-27495
NSG-2007 A75-28348
A75-28349
NSG-2040 N75-19172
N00014-67-A-0226-0005
N75-20343
N00014-72-A-0027-0002
N75-19211
N00014-72-A-0136-0004
N75-20272
N00014-73-C-0031
N75-19132
N00014-73-C-0291
N75-20331
N61339-73-C-0065
N75-19278
N62269-73-C-0476
N75-20676
PROJ. FEDD N75-19226
PROJECT THEMIS
A75-26212
SRI PROJ. 2831
N75-19198
505-04 N75-20256
505-04-11-01 N75-20247
505-05 N75-20248
505-06-23 N75-20329
505-06-81 N75-19181
505-10-21 N75-20350
514-52-01 N75-20221
743-04-12-02 N75-19226
743-05-01-01-00
N75-20260
760-67-05 N75-20293
501024 N75-19180

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This bibliography lists 368 reports, articles, and other documents introduced into the NASA scientific and technical information system in June 1975.

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