NASA SP-7037 (24)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 1

NOVEMBER 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (24)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 24

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 October 1972 in

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

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 399 reports, journal articles, and other documents originally announced in October 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

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

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

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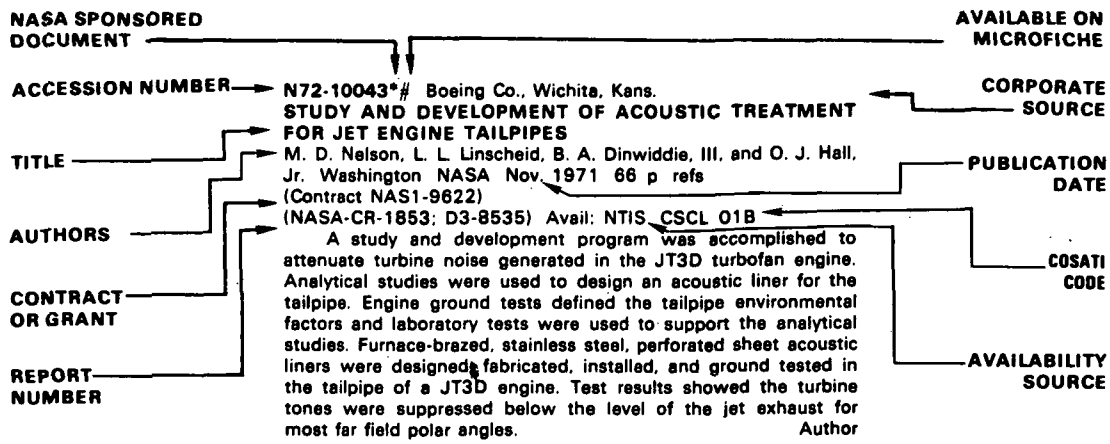

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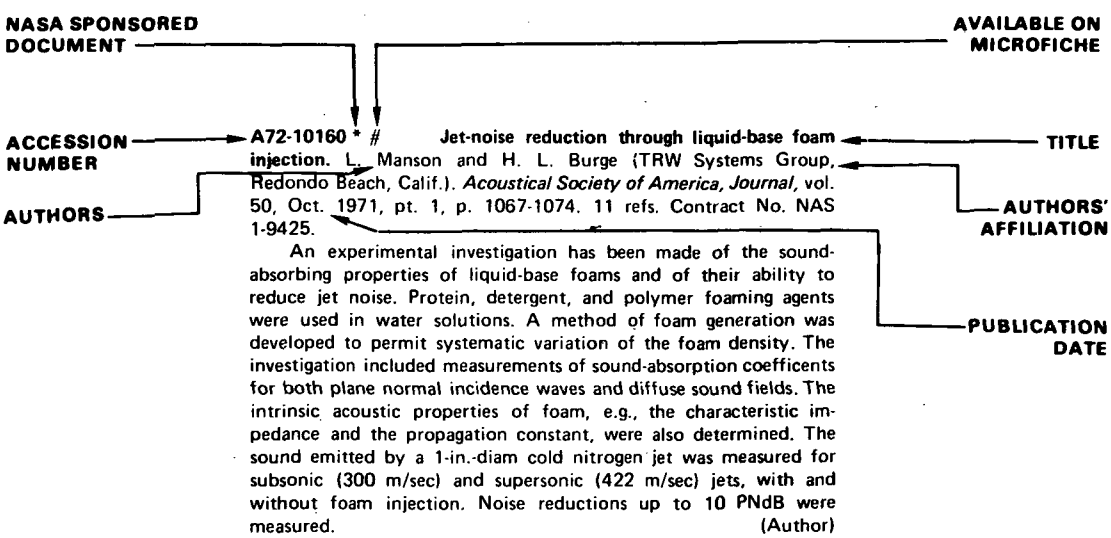

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 24) NOVEMBER 1972

IAA ENTRIES

A72-37268 **An all solid-state MIC transmit-receive module.** F. Sullivan and R. Perry (Raytheon Co., Missile Systems Div., Bedford, Mass.). In: International Microwave Symposium, Arlington Heights, Ill., May 22-24, 1972, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 227-229.

Design of a completely integrated all-solid-state CW transmit-receive module in dual breadboard form. The reason for a dual module approach stems from the interface connector requirements between the phased array aperture and feed network of the overall communications system. A dual module approach reduces the number of physical connections by a factor of two over that of a single module. Since the main objective was for utilization in airborne systems, size and weight were parameters of utmost importance. Therefore, the medium of transmission chosen was microstrip. The problem discussion deals with the difference in RF boundary conditions of a single component and of multiple components integrated into a single subsystem, and fabrication difficulties as they related to integrating several components. F.R.L.

A72-37270 **Single and dual gate GaAs FET integrated amplifiers in C band.** S. Arnold (Plessey Co., Ltd., Avionics and Communications Research Laboratory, Roke Manor, Hants., England). In: International Microwave Symposium, Arlington Heights, Ill., May 22-24, 1972, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 233, 234. Research supported by the Ministry of Defence.

This paper outlines some aspects of the device characterization, circuit design, and realization of hybrid integrated amplifiers in C band. The performance of designs at 5 GHz employing single and dual-gate GaAs FETs is presented. (Author)

A72-37275 **Interaction effects between blade rows in turbomachines.** R. Parker and J. F. Watson (Swansea, University College, Swansea, Wales). *Institution of Mechanical Engineers, Proceedings,* vol. 186, no. 21, 1972, p. 331-340. 21 refs.

Review of present knowledge on the interaction of blade rows in subsonic-axial-flow fans and compressors. Following a discussion of the wake interaction mechanism and characteristics and the non-steady lift produced by blade wakes, the potential flow interaction is examined, along with resonance effects. Special attention is given to such aspects as (1) the propagation and magnitude of disturbances, due to a blade row, under subsonic, transonic, and supersonic velocities; (2) the analysis of the complete interaction process under incompressible and compressible flow; (3) the existence and effects of acoustic resonances in cascades; and (4) the coupling of mechanical and acoustic systems. It is shown that, in spite of extensive investigations of various aspects of interaction, there is very little information available in a form applicable by a designer to the minimization of noise and vibration excitation caused by blade row interaction. M.V.E.

A72-37277 **Application of electronic data processing airport analysis in airlines operations and for manufacturers.** G. Radnoti (Seaboard World Airlines, Inc., John F. Kennedy International Airport, N.Y.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, May 1972, p. 264-268.

An analysis of the factors affecting aircraft takeoff and landing weights is presented. This analysis, made with the aid of a computer, considers all factors, including: type of aircraft; weight; temperature; wind; engines; payload; policies; limits; runway slope, conditions, and length; obstructions; and aircraft flap settings. (Author)

A72-37279 **Improved antenna systems for ILS localizers.** O. P. Hakonsen (Norges Tekniske Hogskole, Trondheim, Norway). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, May 1972, p. 273-279.

Analysis of the requirements of an ILS localizer and development of an improved localizer antenna system which, in addition to reducing the bend amplitudes and sensitivity to snow and ice, would provide a system in which the course width in the reverse direction (back beam) could be made larger than that in the forward direction. The system was based on requirements for Norwegian airports, where runways must be used at their maximum lengths. Log-periodic dipole antennas were chosen. The antenna system is not affected by snow and moderate amounts of ice, and since no antenna heating is necessary, and the required transmitter power is small, the localizer may operate for long periods on batteries only. F.R.L.

A72-37282 **Tracking of DABS-equipped aircraft.** P. J. Buxbaum (Concord Research Corp., Burlington, Mass.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, May 1972, p. 298-305. 8 refs.

Investigation of the potential value of turn-rate telemetry in the tracking of aircraft equipped with the discrete address beacon system (DABS) that is to replace the present air traffic control beacon system as the prime sensing tool for air traffic control in the 1980's. The design of DABS tracking algorithms is discussed, and the results obtained with a tracker simulation using a Kalman filter algorithm are shown to indicate that including turn-rate telemetry of moderate accuracy considerably improves tracking of DABS-equipped aircraft. It is found that steady-state improvements of the order of 10 to 1 are obtained over a broad range of flight geometries. M.V.E.

A72-37283 **Application of the Volterra series to the analysis and design of an angle track loop.** M. Landau (Hughes Aircraft Co., Culver City, Calif.) and C. T. Leondes (California, University, Los Angeles, Calif.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, May 1972, p. 306-318. 6 refs. Grant No. AF-AFOSR-72-2166.

Using Volterra series techniques, a method is developed for determining the pointing error magnitude in the performance of an angle tracking loop that is to keep an interceptor's radar antenna

pointed at a target moving in space. This tracker is characterized by a general polynomial nonlinearity, an arbitrary initial pointing error, and a bounded deterministic input. Numerical results for a tracker with a cubic nonlinearity are also given. Theoretical upper bounds and actual upper bounds on the antenna pointing error are plotted as a function of the line of sight rate obtained for various system parameters and are presented along with initial antenna pointing errors. M.V.E.

A72-37289 Applications of optimally sensitive control to systems involving time-varying uncertainties. K. C. Pedersen (Texas Instruments, Inc., Austin, Tex.) and L. R. Nardizzi (Southern Methodist University, Dallas, Tex.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-8, May 1972, p.355-363. 12 refs. NSF Grant No. GK-5608; Contract No. F44620-68-C-0023.

The implementation of control systems capable of identifying and adapting to time-varying unknown parameters has become increasingly important in air-traffic control and other applications. In the recent literature the control problem, in which both the initial state vector as well as a vector of constant plant parameters are unknown, has been treated utilizing sensitivity techniques referred to as optimally sensitive control. The concepts of optimally sensitive control as developed by Kokotovic, Perkins, Cruz, and others are extended to the problem in which the state dynamics contain a vector of stochastic inputs which can be represented as Martingale processes. The resulting optimally sensitive system is shown to be an effective and realistic adaptive controller for systems containing unknown time-varying parameters. A numerical example is presented to demonstrate the effectiveness of the resulting control system at identifying and adapting to the levels of the unknown time-varying inputs. (Author)

A72-37300 # Assembly and testing of hydraulic and pneumatic systems of flight vehicles (Montazh i ispytaniia gidravlicheskikh i pnevmaticheskikh sistem na letatel'nykh apparatakh). V. M. Sapozhnikov. Moscow, Izdatel'stvo Mashinostroenie, 1972. 273 p. 30 refs. In Russian.

Recent achievements and advances in the field of aircraft hydraulics and pneumatics are examined. The specific operating conditions, the loads acting on the system elements, and causes of malfunction are reviewed. The requirements placed on hydraulic lines and joints, methods of stress analysis, and methods of determining the influence of assembly stresses on the fatigue life of hydraulic and pneumatic lines are discussed. The assembly and control technology of lines and their elements is discussed, together with the technology of cleaning, filtering, and maintaining hydraulic and pneumatic lines. Line leakage testing methods and facilities are described. V.P.

A72-37320 # Stability of a gyro navigation system (Ob ustoichivosti odnoi giroskopicheskoi sistemy navigatsii). E. V. Nitusov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika*, vol. 27, May-June 1972, p. 113-117. 7 refs. In Russian.

Motion stability analysis for a gyro inertial navigation system with a gyro-horizon compass and two accelerometers, using a Levental system for oscillation damping. Small motions of this system described by a homogeneous system of equations with coefficients which are either constant or are continuous arbitrary functions of time are discussed specifically. V.Z.

A72-37450 # Optimization of thermal circuits of complex gas-turbine power plants (Optimizatsiia teplovykh skhem slozhnykh gazoturbinnykh ustanovok). Iu. M. Dedusenko and G. V. Dedkov. Kiev, Izdatel'stvo Naukova Dumka, 1972. 124 p. 98 refs. In Russian.

The results of a complex study of the cycle, regenerator, coolant, and limit-power parameters of gas-turbine power plants are presented. An analytical method is proposed which makes it possible to determine the optimal parameters of a gas-turbine power plant and the permissible deviations from them for the purpose of solving a number of practical design problems, and also to determine the optimal heat-engineering characteristics of heat-transfer devices in a thermal scheme together with the cycle parameters. The problem of rational distribution of the relative resistance between the regenerator and the coolants is solved. Special allowance is made for hydrodynamic losses referred to the compressor and turbine groups. On the whole, the proposed method concerns the optimization of open-loop gas-turbine power plants of both single-shaft and multi-shaft type. A.B.K.

A72-37452 # Aircraft design synthesis. J. J. Pugliese (Vought Aeronautics Co., Dallas, Tex.). *SAWE Journal*, vol. 31, Apr.-May 1972, p. 19-24.

Discussion of the flow and circulation diagrams formed by events involved in the selection of an optimum aircraft configuration, followed by outline of methods for actually carrying out the various calculations. The preliminary design flow of events can be classified as the initiation and coordination phase, the analytical phase, and the ultimate goal or objective. The analysis and optimum configuration phases are the easiest to adapt to computer operations. The weight control engineer must first determine which components will have fixed weights for the study, and which will vary as the various parameters affecting the component weight are varied. F.R.L.

A72-37453 # Fast method for aircraft rebalance. F. B. Matthias. *SAWE Journal*, vol. 31, Apr.-May 1972, p. 34.

Use of four equations to facilitate the quick and accurate determination of the appropriate distance to move the cockpit or tail to rebalance an aircraft. To shift the CG forward or aft involves insertion or removal of sections either forward or aft of the CG. F.R.L.

A72-37490 # Computational and experimental investigations regarding the operational characteristics of a three-stage axial-flow compressor with high performance per stage (Rechnerische und experimentelle Untersuchungen über das Betriebsverhalten eines dreistufigen Axialverdichters hoher Stufenleistung). L. Turanskyj. Hannover, Technische Universität, Fakultät für Maschinenwesen, Dr.-Ing. Dissertation, 1971. 188 p. 52 refs. In German.

The requirements for the computation of the operational characteristics of axial-flow compressors are examined, and questions of the design of the axial-flow compressor are considered. The calculation of the cascade structure is discussed together with an experimental investigation of the operational characteristics of the axial-flow compressor. The results of the investigations considered include the pressure-volume characteristics, the efficiency characteristics, and rotor speed data. The computational data agree with the experimental results in the range of low rotor speeds. Certain deviations at higher speeds can be explained on the basis of assumptions regarding the cascade characteristics made for the computation. G.R.

A72-37598 # The motion of a vortex filament with axial flow. D. W. Moore (Imperial College of Science and Technology, London, England) and P. G. Saffman (California Institute of Technology, Pasadena, Calif.). *Royal Society (London), Philosophical Transactions, Series A*, vol. 272, no. 1226, July 13, 1972, p. 403-429. 17 refs. Grant No. AF-AFOSR-71-2092.

Study of infinitesimal waves on a uniform vortex with axial flow. The equation for the frequency of helical waves is obtained and solved for the case of long waves which leave the internal structure almost unaltered. A method is developed to obtain results for vortices of nonuniform structure and for displacements which are not necessarily small compared with the core radius. The approach consists of balancing the Kutta-Joukowski lift force, the momentum flux due to the axial motion, and the 'tension' of the vortex lines. A general equation for the motion of a vortex filament is obtained, valid for arbitrary shape and internal structure, and in the presence of an external irrotational velocity field. When the axial flow vanishes, the method is equivalent to using the Biot-Savart law for the self-induced velocity, with a suitable cutoff. The impulse of a vortex filament is discussed, and its rate of change is given. (Author)

A72-37605 **Surface evaluation of airfoils via contouring.** F. C. Way (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). In: Engineering applications of holography; Proceedings of the Symposium, Los Angeles, Calif., February 16, 17, 1972. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 57-64. 9 refs. Research supported by the United Aircraft Corp.

A technique is described in detail which makes possible real-time contouring of test objects, such as airfoils, in a quality control situation. The technique is based on the principles of multiple source holographic contouring although holographic recording is unnecessary. Inspection is accomplished by producing a divergent field of parallel, equally spaced interference fringes by reflecting a beam off a thin beam-splitter at a given distance in front of a mirror, thus simulating two separate source locations. This field illuminates the object under test. The fringes on the surface of the object represent the loci of points on the object equally parallel to the illuminating beam. Tilt, twist, and rotation of an airfoil in respect to a reference plane, as well as contour, can be measured via this technique. (Author)

A72-37625 **Microwave holography and its applications in modern aviation.** N. H. Farhat (Pennsylvania, University, Philadelphia, Pa.). In: Engineering applications of holography; Proceedings of the Symposium, Los Angeles, Calif., February 16, 17, 1972. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 295-314. 38 refs. Contract No. DA-28-043-AMC-02411(E).

Discussion of several aspects of microwave and millimeter wave holographic imaging within the context of applications to aircraft landing aid and airport security (detection and identification of concealed weapons). Results of laboratory experiments employing millimeter waves to study the effects of sampled hologram recording, processing and image enhancement, and close-range imaging of a variety of reflecting objects including concealed weapons are presented. Prospects for real-time operation are discussed. (Author)

A72-37637 * # **Experience with low cost jet engines.** R. L. Cummings (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, National Business Aircraft Meeting, Wichita, Kan., Mar. 15-17, 1972, Paper.* 19 p.

A summary is given of the results of a NASA program for reducing the cost of turbojet and turbofan engines. The design, construction, and testing of a simple turbojet, designed for use in missiles, is described. Low cost axial stage fabrication, the design of a fan jet engine, suitable for propulsion of light aircraft, and application of such engines to provide higher flight speeds, are discussed. (Author)

A72-37645 * # **Review of jet engine emissions.** J. Grobman (NASA, Lewis Research Center, Cleveland, Ohio). *U.S. Department of Transportation, Survey Conference on Climatic Impact Assessment, Cambridge, Mass., Feb. 15, 16, 1972, Paper.* 17 p. 15 refs.

The various constituents in jet engine exhaust during typical takeoff or cruise conditions are presented in a table. The categories considered include inerts and unreacted oxygen from air, products of complete combustion of fuel, products of incomplete combustion, oxides of nitrogen formed during the heating of air, and elements or compounds derived from sulfur and trace metals present in kerosene fuel. Typical jet engine emission characteristics are discussed together with the effect of operating variables on emissions, and combustor design techniques to reduce emissions. Particular attention is given to emissions in the upper atmosphere, and to methods to reduce nitric oxide emissions. G.R.

A72-37668 # **The exergetic efficiency of a compressor (Eksergeticheskii KPD kompressora).** V. I. Evenko. *Mashinostroenie,* no. 4, 1972, p. 121-124. In Russian.

Consideration of the possibility of estimating the efficiency of compressors of various types by comparing their so-called exergetic efficiencies. It is recommended that the efficiencies of various compressors be determined on the basis of the concept of gas exergy, exergy being the maximum efficiency of an energy source under given environmental conditions. The thermodynamic quality of the conversion process can then be estimated by the exergetic efficiency (the degree of reversibility) of this process. It is shown that the exergetic efficiency of a compressor can be represented in the form of a product of two efficiencies - namely, an indicator or internal efficiency and a mechanical efficiency. A.B.K.

A72-37676 # **Toward a viable system for superior test capability.** J. Lukasiewicz (Carleton University, Ottawa, Canada). *Astronautics and Aeronautics,* vol. 10, Aug. 1972, p. 18-20. 5 refs.

There has been a consensus of aerospace experts concerning the practical worth of testing. The experts estimated that, for 75% of the aircraft programs evaluated, better use of more sophisticated test facilities would have resulted in smaller over-all development cost, superior aircraft performance, and less flight testing. Deficiencies in existing test facilities are examined together with certain impediments to the modernization of test facilities. The establishment of an integrated facility-research program is recommended. G.R.

A72-37677 * # **Advanced subsonic transport technology.** A. L. Braslow and W. J. Alford (NASA, Washington, D.C.). *Astronautics and Aeronautics,* vol. 10, Aug. 1972, p. 26-31. 15 refs.

NASA has undertaken an Advanced Transport Technology Program directed toward defining technology advances that would contribute to a superior subsonic long-haul transport aircraft for conventional takeoff and landing. The aircraft, engine industries, and airlines play substantial parts in the program. Major objectives of the studies include the making of conceptual layouts of new subsonic transport aircraft incorporating projected advances and the identification of the potential benefits and costs of the technology advances. Another goal is the definition of the ground and flight research activities required to bring the advanced technologies to a state of readiness for industry use by the late 1970s. G.R.

A72-37678 * # **Supercritical aerodynamics - Worthwhile over a range of speeds.** T. G. Ayers (NASA, Washington, D.C.). *Astronautics and Aeronautics,* vol. 10, Aug. 1972, p. 32-36. 6 refs.

Supercritical flow exists whenever a high enough forward speed causes local flow over a lifting surface or body to exceed the sonic or critical value. The principal difference between conventional subsonic aerodynamic technology and supercritical technology lies in the cross-sectional profile of lifting surfaces. The characteristics of the supercritical airfoil suggests three potential benefits from applications to civil aircraft. For aircraft designed to operate at moderate subsonic speeds the supercritical airfoil may permit the reduction of structural weight. Supercritical technology would have a second application in permitting efficient high subsonic speed cruise by delaying the transonic drag rise. Another advantage of the thick supercritical wing shows up at low speeds. G.R.

A72-37679 * # **Advanced propulsion - Cleaner and quieter.** M. A. Beheim, R. J. Antl, and J. H. Povolny (NASA, Lewis Research Center, Cleveland, Ohio). *Astronautics and Aeronautics,* vol. 10, Aug. 1972, p. 37-43.

Studies were conducted to determine the factors which are significant in advancing propulsion technology. The studies surveyed a wide distribution of variables including aircraft configuration, payload, range, and speed. System studies placed major emphasis on reducing noise and exhaust emissions while attaining good economies and performance. An engine for an advanced transport will probably superficially resemble the presently emerging generation of modern high-bypass and high-temperature turbofan engines, but would incorporate the advances in component and system technology identified by the propulsion system studies. These advances could be used to improve aircraft economics significantly with no increase in noise, or to significantly reduce noise and pollution with few or no economic penalties. G.R.

A72-37680 * # **Composites - Lighter and cheaper.** R. L. Goble (NASA, Washington, D.C.). *Astronautics and Aeronautics,* vol. 10, Aug. 1972, p. 44-49.

Composite engineering materials have two distinct parts,

including the load-bearing filaments and the matrix. Fibers can range from glass to boron and graphite. Matrix constituents include epoxies for lower temperatures and metals for higher temperatures. Composites appear as tape or combined with metal in structural shapes. The increased use of composites will reduce over-all per pound manufacturing costs. Two major deterrents to further application of composites in advanced commercial transports include a shortage of cost-effective structural design concepts and a lack of confidence in the life characteristics. A program has been outlined by NASA that will, if implemented, provide considerable in-service life experience with structural components on commercial transports. G.R.

A72-37681 * # **Active controls - Changing the rules of structural design.** R. V. Hood (NASA, Washington, D.C.). *Astronautics and Aeronautics*, vol. 10, Aug. 1972, p. 50-55.

Approaches making use of aerodynamic surfaces in combination with advanced flight computers, and electrohydraulic systems could be used to improve economics of commercial aircraft operation, smooth the passenger's ride, reduce terminal-area noise, and ease terminal-area congestion. This emerging technology is becoming known as active controls technology. Maximum benefits from active controls can come only by considering controls early in the design cycle. Active controls can save weight by reducing the structural strength necessary. Some of the technical benefits of active controls would increase return on investment and raise profits. Details of a proposed active controls research program are discussed. G.R.

A72-37745 # **Factors to be considered in airline scheduling.** C. H. Glenn (Air Canada, Montreal, Canada). *Canadian Aeronautics and Space Journal*, vol. 18, June 1972, p. 149-156.

Outline of the various external and internal factors which must be considered during the development of an airline schedule. The demand characteristics of the customer, by hour of day, day of week, and month of year, are all illustrated, and the difficulties of catering to the variation in demand are outlined. At the same time, the economic objectives of the airline must be considered, and the impact of the schedule from both the cost and the revenue point of view is illustrated. The main operating constraints, such as aircraft maintenance and flight crew requirements, noise, curfew, controlled airports, terminal area congestion, etc., all add to the complexity of developing a schedule and must be considered along with the desires of the company, the market place, and other interested parties. (Author)

A72-37746 # **Optimization of turbofan cycles.** H. I. H. Saravanamuttoo (Carleton University, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 18, June 1972, p. 157, 158. Research supported by the National Research Council.

Consideration of methods for optimizing specific fuel consumption and specific thrust, at the same time taking account of mechanical design problems in parallel with thermodynamic studies. The four thermodynamic parameters at the disposal of the designer are overall pressure ratio, turbine inlet temperature, bypass ratio, and fan pressure ratio. It is shown that increasing bypass ratio improves specific fuel consumption at the expense of a significant reduction in specific thrust. The optimum fan pressure ratio increases with turbine inlet temperature. High turbine inlet temperatures are extremely beneficial. The optimum fan pressure ratio decreases with increase of bypass ratio. F.R.L.

A72-37748 # **The Gander automated air traffic system.** B. Capel (Ministry of Transport, Ottawa, Canada). *(Canadian Aeronautics and Space Institute, Aerospace Electronics Symposium, Quebec, Canada, Mar. 13, 14, 1972.) Canadian Aeronautics and Space Journal*, vol. 18, June 1972, p. 163-166.

Outline of the arrangements at the Gander Oceanic Center, which is responsible for the strategic planning of all eastbound flights from North America to Europe. The programs which make up the Gander Automated Air Traffic System (GAATS) are divided into the categories of supervisor, message operator routines, tables for system communication and data storage, work areas, and mathematical and conversion routines. To give a general understanding of the information flow within the system, the steps taken by the system in response to an input message are described. F.R.L.

A72-37749 # **Development of the Saab-Scania Viggen.** A. Roed (Saab-Scania AB, Goteborg, Sweden). *Canadian Aeronautics and Space Journal*, vol. 18, June 1972, p. 167-175.

Discussion of the Viggen, whose development is based on Saab delta-wing knowledge and extensive experience in making transonic and supersonic fighter and attack aircraft. The Viggen was planned for several types of mission from low level supersonic attacks to high altitude interceptions, air reconnaissance, and two-seat training. Maximum speed is about Mach 2, and takeoff and landing can be accomplished within 500 m from dispersed bases. The high-speed requirements led to short span designs with high wing loadings for both drag and gust load reasons. Aspects of directional stability, external store effects, transonic pitching moment, the flight control system, handling qualities, drag considerations, the pilot's environment, the electronic system, the head-up display, armament, structural design, and maintainability are considered. F.R.L.

A72-37760 # **Prediction of the stalling of a wing section in incompressible flow (Prévision du décrochage d'un profil d'aile en écoulement incompressible).** M. V. De Paul (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(AGARD, Meeting on Fluid Dynamics of Aircraft Stalling, Lisbon, Portugal, Apr. 26-28, 1972.) ONERA, TP* no. 1088, 1972, p. 1-15. 15 refs. In French.

Development of a method, analogous to the simple, semi-empirical one proposed by Horton (ARC CP No. 1073) for the calculation of 'short bulbs', to calculate prediction of stalling. Short bulbs are detached zones initiated by a laminar detachment, and are small enough so as to bring only very local modifications to the velocity distribution in a perfect fluid. The detachment of the boundary layer takes place in the region of the leading edge of the wing sections at an angle of attack. This calculation has made it possible to define the stall process and to predict the maximum lift, at least in a certain range of Reynolds numbers. F.R.L.

A72-37761 # **Numerical study of the characteristic magnitudes of turbulence on the far sound field radiated by a subsonic jet (Etude numérique de l'influence des grandeurs caractéristiques de turbulence sur le champ sonore lointain rayonné par un jet subsonique).** J. F. de Belleval, J. Milczynski, and M. Perulli. *(Groupement des Acousticiens de Langue Française and Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace, Colloque d'Acoustique Aéronautique, 3rd, Toulouse, France, Mar. 6-8, 1972.) ONERA, TP* no. 1058, 1972. 15 p. 9 refs. In French.

Use of a numerical calculation which makes it possible to predict the sound field in cases more complicated than those generaliy developed for homogeneous turbulence. This has been accomplished in the case of inhomogeneous turbulence where the typical magnitudes vary in the turbulent space. This makes it possible to see the evolution of the sound field as a function of variation of these magnitudes and their profiles, and to find these variations as a function of acoustic objectives defined a priori. It also makes it possible, in the case where these characteristic magnitudes can be measured, to calculate the sound field which is compared to the measured field. Numerical experiments and application to various experimental results are discussed. F.R.L.

A72-37762 # **Review of some new results obtained at ONERA concerning phenomena of separation and reattachment (Aperçu de quelques résultats nouveaux obtenus à l'O.N.E.R.A. sur les phénomènes de décollement et de récollement).** P. Carriere (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Gesellschaft für angewandte Mathematik und Mechanik, Assemblée Scientifique Annuelle, Ljubljana, Yugoslavia, Apr. 4-8, 1972.) ONERA, TP* no. 1072, 1972. 38 p. 23 refs. In French.

Consideration of the phenomena involved in most of the practical problems of aerodynamics, and which frequently play a determining role. Integral and correlation methods are proposed to

solve the problems. The integral methods, stemming from the classical method of boundary layer calculation, feature in addition a coupling equation between the boundary layer and the external flow which plays an essential role here, since the evolution of pressures is determined by this interaction. The correlation methods are semi-empirical and do not describe the phenomena in detail, but are limited to establishing, from some typical experiments, the rules or criteria to make it possible for users to treat problems of practical interest. The major effort is given to the perfecting and the extension of these overall methods to the problem of the turbulent boundary layer, which is by far the most important, especially for problems of air intakes, nozzles, and afterbodies. F.R.L.

A72-37764 # A time-frequency high performance collision avoidance system. R. Gouillou (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(Institute of Navigation, Annual Meeting, 28th, West Point, N.Y., June 27-29, 1972.) ONERA, TP* no. 1091, 1972. 7 p.

Study of a collision avoidance system (CAS) complying with ARINC specifications, in order to analyze its feasibility and to provide precise elements regarding the time-frequency CAS. The ONERA-Crouzet system includes a computer, a transmitter, and a receiver. The local oscillator is a rubidium clock. Flight tests were performed with two DC-7 aircraft fully equipped with electronic devices, plus a piece of ONERA equipment which permitted comparison of the time standards of Paris, Braunschweig, Greenwich, Ottawa, and Washington, with an overall accuracy of 15 nsec. Results from McDonnell-Douglas, Bendix, and Sierra-Wilcox systems, which have been tested elsewhere, are compared. All the CASs present a velocity jitter larger than requested, and a noticeable sensitivity to multipaths. A message format is defined which respects the ARINC specifications as much as possible, including a pulse usable for 800 microsec for the velocity measurement, and permitting the automatic adjustment of the receiver sensitivity. F.R.L.

A72-37796 The perspectives and promises of the Omega system (Les perspectives et les promesses du système Oméga). P. Hugon. *(Colloque International sur l'Electronique et l'Aviation Civile, Paris, France, June 26-30, 1972.) Navigation* (Paris), vol. 20, July 1972, p. 266-282. In French.

Outline of the major characteristics of the Omega system, with summary of conclusions concerning it, principally with reference to air navigation. The system makes use of eight transmitters judiciously placed throughout the world. The airborne Omega receiver is tuned separately on three frequencies. Hyperbolic systems and systems at two distances, the infrastructure, methods of utilization, propagation models, parameters of propagation, the effects of solar flares, loss of signal, and experimental results are discussed. On high speed airliners, experimental results already achieved anticipate the use of more sophisticated receivers. F.R.L.

A72-37797 Study of the flow of air traffic and capacity of a control system (Etude de l'écoulement du trafic aérien et capacité d'un système de controle). F. Cousin. *Navigation* (Paris), vol. 20, July 1972, p. 283-290. In French.

Attempt to define and measure the capacity of the airspace, the capacity depending on rules of use of the space. It is possible to assign to each control sector a number, c, which represents the maximum number of aircraft which the controller can simultaneously take charge of, i.e., the capacity of the sector. The capacity of the control system is thus determined by the capacity of each of the sectors. The Poisson character of traffic flow is discussed. A statistical study of traffic was undertaken to test a hypothesis according to which the flow could be represented by a Poisson process. The hypothesis was found to be quite acceptable. F.R.L.

A72-37799 The SAGEM MGC 30 inertial system (Le système inertiel MGC 30 de SAGEM). J. Hardouin (Société d'Applications Générales d'Electricité et de Mécanique, Paris, France). *(Colloque International sur l'Electronique et l'Aviation Civile, Paris, France, June 26-30, 1972.) Navigation* (Paris), vol. 20, July 1972, p. 304-312. In French.

Description of an inertial platform designed to meet the recommendations of ARINC 571 and be capable of integrating itself in a surface navigation system or of operating in an autonomous way. The MGC 30 makes use of a miniature gyrocompass platform. A combination of the MGC 10 and the MGC 30 will equip the A300B European Airbus. The performance and price make it attractive for use in either in new types of aircraft, or for retrofit to existing aircraft. F.R.L.

A72-37800 Air collision prevention (L'anticollision aérienne). A. Gély (Compagnie Nationale Air France, Paris, France). *Navigation* (Paris), vol. 20, July 1972, p. 313-329. In French.

General review of the causes and prevention of air collisions. The 'rules of the road,' originally developed for maritime traffic, and adapted for air traffic, are now inadequate. However, the necessity of keeping a lookout remains, and the responsibility for this remains with the pilots. Of the factors affecting the possibility of perceiving an object, moving or not, speed is the most critical. Some typical collisions are analyzed, and airborne and ground-based anticollision devices and procedures are described and compared. F.R.L.

A72-37823 The S4MA hypersonic wind tunnel - Its use for tests of ramjet engines with supersonic combustion of hydrogen (La soufflerie hypersonique S4MA - Utilisation pour des essais de statoréacteurs à combustion supersonique d'hydrogène). C. Soulier, L. Martin, and J. Laverre (ONERA, Modane, Savoie, France). *L'Aéronautique et l'Astronautique,* no. 36, 1972, p. 25-36. In French.

Discussion of the wind tunnel, which offers the possibility of testing a full-scale combustion source in conditions of flight at Mach 6 and 28 km altitude. The S4MA was modified by suppression of the aerodynamic nozzle which was replaced by the combustion source to be studied, which is directly supplied by the reheater with hot air under pressure. A brief description of the reheater and wind tunnel is given, as well as the setup established, the methods and means of measurement put into operation, and measurement of the thrust of the combustion source, its pressures, temperatures, and outputs. The possibilities offered by the wind tunnel for tests of a complete engine, including supply of air in the Mach 6 test section, are considered. F.R.L.

A72-37824 Numerical prediction of the diffusion of exhaust products of supersonic aircraft in the stratosphere (Prévision numérique de la diffusion des produits d'échappement des avions supersoniques dans la stratosphère). R. Joatton (Société Nationale Industrielle Aérospatiale, Paris, France) and A. Douiy (Commissariat à l'Energie Atomique, Direction des Applications Militaires, Montlhéry, France). *L'Aéronautique et l'Astronautique,* no. 36, 1972, p. 37-44. In French.

Attempt to provide a numerical evaluation of pollutant concentration which could result during ten years of operation in the stratosphere of 300 Concordes, each accomplishing a daily round trip on a heavily frequented route. Attention is given to combustion products such as nitrogen oxide, carbon monoxide, and water vapor, and finely scattered solid particles small enough to float in the stratosphere. The mathematical formulation distinguished three types of situations: a single aircraft, or several aircraft in formation, with exhaust blending at a single point; several aircraft passing the same point at the same level at equal time intervals; and several aircraft which have passed the same point at the same level, but with stopovers since a determined time. The calculations were made without taking account of the effects of dissociation and dispersion of the various combustion products involved. F.R.L.

A72-37825 The VAK 191 B VTOL fighter and reconnaissance aircraft (L'avion de combat et de recofinaissance à décollage et atterrissage vertical VAK 191 B). G. Bruner (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 36, 1972, p. 45-56. In French.

Description of the VAK 191 B, built in cooperation by VFW (60 per cent) and Fiat (40 per cent), with most of the testing and

development being carried out by the former. The preliminary studies and tests are reviewed. The aircraft is equipped with a main jet engine with vector thrust, and with two vertical lifting jets which ensure a thrust/weight ratio at takeoff of 1.21. The wing area is relatively small. The fuselage, of light alloy, is semimonocoque. The tail surfaces are conventional, are fully movable, and have a deflection of plus or minus 15 deg. The stability in vertical flight is effected by bleeding compressed air behind the pressure compressor of the main engine. Speed should be Mach 0.96 at 300 m altitude. F.R.L.

A72-37873 Application of the computer to aerial design and development. P. J. Wood (GEC-Marconi Electronics, Ltd., Chelmsford, Essex, England). *Journal of Science and Technology,* vol. 39, no. 2, 1972, p. 52-60.

Categories of computer-oriented problems are discussed. It is pointed out that in any particular case the possibility of obtaining the desired information by other means, as for instance experimental measurement, must be taken into account. Examples are presented to illustrate the categories of computer-oriented application. Ground effects on vertical polar diagrams are considered together with frequency-independent aerials, pencil-beam Cassegrain aerials, double-curvature aerials, the prediction of polar diagrams from near-field measurements, aerial-array feed networks, the automation of manufacturing processes, the presentation of information, and aspects of future developments. G.R.

A72-37899 What is an FGS. C. M. Ramsey (KLM - Royal Dutch Airlines, Amstelveen, Netherlands). *Shell Aviation News,* no. 408, 1972, p. 7-9.

Discussion of the Flight Guidance System, which consists of a computer supplied from aircraft sensors with raw data such as air data (like airspeed and altitude), radio deviation, and heading. It is controlled in its mode of operation from a mode select panel or by automatic programming. Outputting signals for the command of aircraft attitude are controlled by the autopilot servos or manually by the flight director. The traditional raw data displays are used by the pilot for monitoring and programming or management. The use of dual output or identical computers makes it possible to monitor the autopilot with the flight director, and to integrate mode selectors so that the pilot can monitor without having to duplicate his selections. The role of inertial navigation systems is considered. F.R.L.

A72-37900 The Dassault Mystere 20. N. Williams (Trader Airways, Ltd., Sevenoaks, Kent, England). *Shell Aviation News,* no. 408, 1972, p. 10-15.

General discussion of the aircraft, which features high performance, smoothness, and quietness. The flying controls are fully powered and duplicated, and are smooth and powerful throughout their range. The aircraft is exceptionally good in turbulence, and feels very solid. The fuel system is basically simple and works well. Flight planning, let-down, and normal approach and landing are discussed. F.R.L.

A72-37989 # Analytic quasi-terminal control system designs (Analiticheskoe konstruirovanie sistem kvaziterminal'nogo upravleniia). A. A. Krasovskii. *Avtomatika i Telemekhanika,* Apr. 1972, p. 5-14. 9 refs. In Russian.

Analysis of a control synthesis problem with the minimization of the functional as the sum of a given phase coordinate function and an integral estimate of determined phase coordinate functions. A linear homogeneous partial differential equation is solved to obtain optimal controls and corresponding signals as components of the functional when the terminal component constitutes the boundary condition. Optimal conditions for a linear plant are given through the weight functions of the plant in a finite form, showing that even for a stationary plant these conditions are nonstationary. V.Z.

A72-38030 Pilot report - Lockheed L-1011 TriStar. R. E. Gillman. *Flug Revue/Flugwelt International,* Aug. 1972, p. 18-21. In German.

A test flight with a new TriStar is discussed. The aircraft flight characteristics tested included lateral and directional stability, longitudinal dynamics, lateral control power, high speed flight properties, and stalling. The aircraft was equipped with a number of nonstandard instruments for the flight tests. It was found that the stability of the TriStar during the flight is good. The high-speed characteristics are quite satisfactory, and the performance of the aircraft at low speed is excellent. Comments concerning possible improvements are concerned with the aileron loads, which are too light, and the nosewheel steering, which is too heavy. G.R.

A72-38031 Pulsed-jet engine of Messerschmitt-Bölkow-Blohm without valve flaps (Ventilklappenloses Pulsostrahltriebwerk von Messerschmitt-Bölkow-Blohm). W. Eick (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Flug Revue/Flugwelt International,* Aug. 1972, p. 27-31. In German.

The development of the engine is considered, giving attention to fundamental research conducted to obtain an engine for the Mach number range from 0 to 1.5. The construction of a test engine for the optical investigation of the combustion characteristics is discussed together with studies which were carried out to develop a jet propulsion system which consumes a standard fuel. Aspects of thermodynamics and reaction thermodynamics are examined along with gasdynamics, questions of acoustics and vibrations, propulsion system geometry, control techniques, and methods of measurements used. The test and measurement results show that the engine can be used for a number of civil and military applications. G.R.

A72-38032 V/STOL-weapon system VJ-101 - VJ-101C X1 and X2. IV (V/STOL-Waffensystem VJ-101 - VJ-101C X1 und X2. IV). H. Redemann. *Flug Revue/Flugwelt International,* Aug. 1972, p. 36-39. In German.

A salient feature of the VTOL concept of the aircraft type VJ-101C is the use of thrust modulation during hovering flight. This approach was only possible because of the triangular arrangement of the propulsion units. The development of two experimental aircraft is discussed, giving attention to wind tunnel tests, system investigations, the solution of problems with new control techniques, and the testing of the aircraft on the ground. The first hovering flight was conducted with the VJ-101C X1 on April 10, 1963. Horizontal flight tests of the X1 were begun on Aug. 31, 1963. The first VTOL-flight involving vertical takeoff and landing is discussed together with other test flights including a flight in which the aircraft pancaked because of control difficulties. The two prototypes are equipped with 6 RB.145 engines. Afterburners were used in the X2 model for speeds above Mach 1. G.R.

A72-38047 Fluidics - A potential technology for aircraft engine control. C. B. Kunkle and W. L. Webb (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *(American Society of Mechanical Engineers, Joint Gas Turbine-Fluids Engineering Conference, San Francisco, Calif., Mar. 26-30, 1972.) Fluidics Quarterly,* vol. 4, Apr. 1972, p. 49-58. USAF-sponsored research.

A three-year program is discussed whereunder a team of three participant companies designed, fabricated, and conducted a feasibility demonstration of a breadboard hybrid control system for aircraft engine control, that incorporated fluidic, hydromechanical and electronic technologies. This program has resulted in positive advancements of turbopropulsion systems control concepts and turbine engine implementation. The results include the findings that fluidic elements should be oriented toward sensors and/or single-function control loops. Temperature sensors, pressure ratio sensors, speed sensors, and internal compression shock position sensors appear to be the more promising applications. Digital logic elements and timing circuits are other possible applications. System applications of fluidics appear to be more compatible with ramjets and missile engines, rather than with the more complex computation requirements of advanced turbopropulsion control systems. M.V.E.

A72-38048 **Turbine engine sensors for high temperature applications.** L. L. Small (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *(American Society of Mechanical Engineers, Joint Gas Turbine-Fluids Engineering Conference, San Francisco, Calif., Mar. 26-30, 1972.) Fluidics Quarterly*, vol. 4, Apr. 1972, p. 59-67. 6 refs.

Discussion of the state of the art in turbine inlet gas temperature (TIGT) and turbine blade temperature measurement techniques. Emphasis is on work recently accomplished. Immersion and non-immersion techniques represent the two categories of TIGT measurement methods. Immersion techniques such as thermocouples, fluidics, and immersed target pyrometers have basic materials limitations. Even the most promising immersed target pyrometer technique is limited to several hundred hours life at 3000 degrees Fahrenheit. Nonimmersion techniques such as ultrasonic, electron beam, or laser TIGT sensors offer real promise for 3000 F and above TIGT measurements. For turbine blade temperature measurement applications, optical pyrometry techniques show significant promise. M.V.E.

A72-38049 **A fluidic sensor for closed loop engine acceleration control.** A. J. Wetzel, S. E. Arnett (Bendix Corp., Energy Controls Div., South Bend, Ind.), and R. High (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). *(American Society of Mechanical Engineers, Joint Gas Turbine-Fluids Engineering Conference, San Francisco, Calif., Mar. 26-30, 1972.) Fluidics Quarterly*, vol. 4, Apr. 1972, p. 68-79.

Study and evaluation of a unique engine acceleration parameter, the compressor airflow, generalized to the compressor discharge station, and analysis of the applicability of a fluidic pressure ratio sensor to measurements of the 'unique acceleration parameter.' The results of the study indicate that the use of a compressor discharge corrected airflow as an acceleration parameter offers benefits for many engines. Airflow parameter sensing is difficult and requires development to establish the proper sensing location. The pressure ratio sensor must be very accurate and have good dynamic characteristics. The fluidic pressure ratio sensor offers good promise for use in this application. M.V.E.

A72-38091 # **Effect of fuel on gas corrosion in jet engine combustion chambers (Vliianie topliva na gazovuiu korroziiu kamer sgoraniia reaktivnykh dvigatelei).** V. N. Zrelov, V. S. Kurinov, and L. V. Boiko. *Khimiia i Tekhnologiia Topliv i Masel*, vol. 17, no. 4, 1972, p. 42-44. 5 refs. In Russian.

It is found that the gas corrosion of jet engine combustion chambers is not related to the quality of presently used fuels (T-7, T-1, TC-1). This corrosion increases with the service time of the jet engine and is linked with local obstructions of wall cooling by the boundary air, due to the formation of wall scale in the primary and secondary burning zones. V.Z.

A72-38101 # **Real time flight flutter testing via Z-transform analysis technique.** P. R. Waisanen (Grumman Aerospace Corp., Calverton, N.Y.) and H. J. Perangelo (Grumman Data Systems Corp., Calverton, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-784*. 16 p. Members, $1.50; nonmembers, $2.00.

A rapid flight test flutter analysis capability has been successfully developed and implemented for the F-14 flight test program. This capability has resulted in a significant savings in flutter test time and enhanced safety of flight test visibility. Data reduction was achieved using a high speed digital computer facility and Z-transform/model matching analysis techniques to enable the rapid determination of aircraft structural resonance and damping information from complex multi-modal response data excited during fast swept frequency shaker sweeps. The discussion covers a description of the software, summary of development test results, the user interface requirements for flight test operations and actual flight test results. (Author)

A72-38102 # **The development of dynamic flight test techniques for the extraction of aircraft performance.** W. R. Simpson (U.S. Naval Air Test Center, Flight Test Div., Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-785*. 8 p. Members, $1.50; nonmembers, $2.00.

The development of dynamic performance test techniques was undertaken to reduce the total flight time required to determine aircraft performance. Dynamic test techniques differ from conventional techniques in that aircraft accelerations are measured by onboard accelerometers to determine excess thrust. Corrective procedures for using the accelerometers for this determination are reviewed. Application of dynamic performance methods to both thrust modelling and fuel flow modelling analysis techniques are discussed. Results are presented which indicate a significant savings in flight time can be achieved. Additionally, an application of dynamic techniques is made to self-contained take-off and landing data systems. (Author)

A72-38103 # **Flyover noise testing of commercial jet airplanes.** E. L. Zwieback (Douglas Aircraft Corp., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-786*. 10 p. 10 refs. Members, $1.50; nonmembers, $2.00.

The flight development and certification programs of new commercial jet transport airplanes include flyover noise testing to define public acceptability of the airplanes. Current flight test programs include preliminary, development, survey, certification, and demonstration phases. Flyover noise testing requires extensive and complex techniques and equipment. Specific field and flight data systems utilized include a noise recording array dispersed over a surveyed ground test range, recording stations for the surface weather (continuous) and the sound-path weather (periodic), a tracking facility for the precise continuous recording of the airplane space position, and aircraft instrumentation for recording time-synchronized airplane engine operating parameters. (Author)

A72-38104 # **Status of U.S. Navy stall/post-stall/spin flight testing.** J. A. Nial (U.S. Naval Air Test Center, Flight Test Div., Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-787*. 16 p. 7 refs. Members, $1.50; nonmembers, $2.00.

Discussion of the out-of-control problem and the present U.S. Navy stall/poststall/spin program designed to alleviate this problem. The basic program is characterized by a contractor demonstration of the most critical conditions followed by an independent customer evaluation of all aspects of the stall/poststall/spin characteristics and their relation to the fleet pilot and mission suitability. The evolution of the Naval Air Test Center's role in reducing fleet pilot and aircraft losses from inadvertent out-of-control maneuvers is traced from the first qualitative Navy stall/poststall evaluation in 1952 through 18 different airplanes to the well documented comprehensive stall/poststall/spin evaluation of today. Recommendations are made to improve the timing of Navy tests, to add a fleet indoctrination phase to the present program, to improve the suitability of present trainers for the spin training mission, and to establish a coordinated fleet training program. (Author)

A72-38105 # **All weather landing for a STOL system.** F. B. Pogust (Cutler-Hammer, Inc., AIL Div., Farmingdale, N.Y.) and G. J. Taylor (Ministry of Transport, Ottawa, Canada). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-788*. 8 p. Members, $1.50; nonmembers, $2.00.

It is pointed out that because of their short-haul nature STOL operations are not economically viable without an all weather capability. STOL operations are not practical with conventional

instrument landing systems due to glide angle upper limitations of approximately 3 degrees in these systems. For STOL, angles in the range from 5 to 9 degrees are required in order to overcome obstacle clearance problems created by urban development. Microwave landings systems have been developed to provide these high glide path angles. CO-SCAN is one of several of these systems considered for STOL operations. The CO-SCAN operates on a mechanical scanning beam principle with time-coded and pulsed azimuth and elevation information sequentially transmitted on a microwave carrier. G.R.

A72-38106 * # **Development of STOLAND, a versatile navigation, guidance and control system.** Q. M. Hansen, L. S. Young (NASA, Ames Research Center, Moffett Field, Calif.), W. E. Rouse, and S. S. Osder (Sperry Rand Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-789.* 13 p. Members, $1.50; nonmembers, $2.00.

STOLAND has been developed to perform navigation, guidance, control, and flight management experiments in advanced V/STOL aircraft. An integrated digital concept using modern avionics components was selected as the simplest approach to maximizing versatility and growth potential. Unique flexibility has been obtained by use of a single, general-purpose digital computer for all navigation, guidance, control, and displays computation. Modularity of the software insures easy change of experiments. The general-purpose computer is integrated with flexible pilot controls and with both electromechanical and CRT displays for maximum cockpit versatility. A complex hierarchy of control modes with safety monitors and interlocks has been provided. (Author)

A72-38107 * # **STOL ride quality criteria - Passenger acceptance.** I. D. Jacobson and A.R. Kuhlthau (Virginia, University, Charlottesville, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-790.* 5 p. 6 refs. Members, $1.50; nonmembers, $2.00. Grant No. NGR-47-005-181.

The ability to mathematically model human reaction to variables involved in transportation systems offers a very desirable tool both for the prediction of passenger acceptance of proposed systems, and for establishing acceptance criteria for the system designer. As a first step in the development of a general model for STOL systems, a mathematical formulation is presented which accepts as inputs nine variables felt to be important in flight under STOL-type conditions and presents an index of human response as the output. The variables used are three linear motions, three angular motions, pressure, temperature and noise level. The results are used to establish specifications for stability augmentation systems to improve the ride quality of existing STOL aircraft. (Author)

A72-38108 * # **Noise generated by STOL core-jet thrust reversers.** J. R. Stone and O. A. Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-791.* 10 p. 18 refs. Members, $1.50; nonmembers, $2.00.

This paper summarizes the results of an experimental investigation on the noise generated by target-type thrust reversers. The experimental data are normalized and scaled up to sizes suitable for reversing the core jets of a 45,400-kg augmentor-wing-type STOL airplane. The scaling calculatings yield perceived noise levels well above the 95-PNdB design goal for both sideline and flyover at 152.5 m. V-gutter and semicylindrical reversers were tested with a 5.24-cm-diameter circular nozzle, and a semicylindrical reverser was also tested with a 7.78-cm-diameter circular nozzle. Other test variables were the spacing between nozzle and reverser, reverser orientation, and nozzle pressure ratio. The thrust reversers, in addition to being noisier than the nozzle alone, also had a more uniform directivity. (Author)

A72-38109 * # **Forward flight effects on mixer nozzle design and noise considerations for STOL externally blown flap systems.** U. von Glahn, N. Sekas, D. Groesbeck, and R. Huff (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-792.* 9 p. 9 refs. Members, $1.50; nonmembers, $2.00.

Experimental data of the peak axial-velocity decay in a moving airstream are presented for several types of nozzles. The nozzles include a six-tube mixer nozzle of a type considered for reduction of jet-flap interaction noise for externally-blown-flap STOL aircraft. The effect of secondary flow on the core flow velocity decay of a bypass nozzle is also discussed. Tentative correlation equations are suggested for the configurations evaluated. Recommendations for minimizing forward velocity effects on velocity decay and jet-flap interaction noise are made. (Author)

A72-38110 # **A computerized system for the preliminary design of commercial airplanes.** R. E. Wallace (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-793.* 13 p. Members, $1.50; nonmembers, $2.00. Research supported by the Boeing Independent Research and Development Program.

A computerized preliminary design system for subsonic and transonic airplanes has been developed. This system has interrelated in computerized form the technical disciplines of aerodynamics, configuration design flight controls, propulsion, structures, and weights with a versatile computer superstructure capable of solving a wide-range of airplane synthesis problems. A diversity of airplane problems can be exercised with this engineering tool, because the libraries of technology modules, executive routines, and machine systems routines can be automatically compiled by user-oriented language into interactive, overlay-structured computer programs. (Author)

A72-38111 # **A flutter optimization program for aircraft structural design.** S. Siegel (North American Rockwell Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-795.* 12 p. 9 refs. Members, $1.50; nonmembers, $2.00.

Described herein is an optimization method for accurately and rapidly calculating, through a completely automated digital computer program, the minimum-weight spanwise distribution of structural material for an airfoil surface to provide a given required flutter speed. The computer program obtains a typical solution in one 2-minute computer run within a short enough total elapsed time from initial setup to allow interaction of flutter with other considerations in the design process. The method has been extensively applied to the B-1 and has been extremely successful in minimizing flutter weight requirements, not only by providing minimum-weight solutions, but also by providing results quickly enough so that designers could consider basic configuration changes if flutter problems exist. Some typical applications to the B-1 are illustrated. (Author)

A72-38112 * # **An integrated computer system for preliminary design of advanced aircraft.** R. E. Fulton, J. Sobieszczanski, and E. J. Landrum (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-796.* 13 p. 19 refs. Members, $1.50; nonmembers, $2.00.

A progress report is given on the first phase of a research project to develop a system of Integrated Programs for Aerospace-Vehicle Design (IPAD) which is intended to automate to the largest extent possible the preliminary and detailed design of advanced aircraft. The approach used is to build a pilot system and simultaneously to carry out two major contractual studies to define a practical IPAD system

preparatory to programing. The paper summarizes the specifications and goals of the IPAD system, the progress to date, and any conclusion reached regarding its feasibility and scope. Sample calculations obtained with the pilot system are given for aircraft preliminary designs optimized with respect to discipline parameters, such as weight or L/D, and these results are compared with designs optimized with respect to overall performance parameters, such as range or payload. (Author)

A72-38113 # **Design studies and model tests of the stowed tilt-rotor concept.** D. E. Fraga (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and J. Liiva (Boeing Co., Vertol Div., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-804*. 13 p. Members, $1.50; nonmembers, $2.00.

This paper presents the results of an Air Force-contracted study on the stowed tilt-rotor concept. The program included design studies, parametric tradeoff analyses, and wind tunnel tests. The wind tunnel tests included performance and fully dynamic scaled models. Technical data presented includes blade loads, dynamic stability, performance, rotor/wing interactions, and stability and control data. The impact of the tests on stowed-rotor aircraft design is discussed and recommendations for further technical design work are provided. (Author)

A72-38114 # **Investigation of the commonality in development of military and commercial STOL transports.** J. D. Pinson and J. P. Ryan (Dayton, University, Dayton, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-808*. 9 p. 15 refs. Members, $1.50; nonmembers, $2.00. Contract No. F33615-70-C-1019.

An investigation has been conducted to relate the commonality in development of military and commercial medium STOL transports. Military and FAA specifications, regulations, and other related documents have been reviewed. Consideration is given to such areas as aircraft configuration, structural design specifications, terminal area requirements, handling qualities, avionics, landing systems, noise, ride qualities, all-weather requirements, safety, stability and control, reliability, and maintenance and performance. Areas of commonality and/or differences are identified and discussed based on a detailed comparison of general requirements. (Author)

A72-38115 # **The DHC-7, first generation transport category STOL - Particular design challenges.** F. H. Buller and A. F. Toplis (de Havilland Aircraft of Canada, Ltd., Downsview, Ontario, Canada). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-809*. 12 p. Members, $1.50; nonmembers, $2.00.

The DHC-7, a high-wing airplane, powered by four turboprops, with a mechanical flap system, retractable gear and accommodation for about 50 passengers, is shown to possess, below its superficially conventional appearance, the distinctive characteristics of the STOL-aircraft category, whose first generation it represents. Its capabilities are shown to include those of: (1) consistent scheduled operation from 2000 foot STOL-ports; (2) a comfort level acceptable to regular travelers on trunk air lines; (3) unobtrusive operation with very low noise and no visible smoke; and (4) profitable operation over stage lengths from 50 to over 300 miles. The DHC-7 is expected to have the benefit of three additional years of design by the time it flies in 1974, and to offer a logical solution to the STOL problems of the 1970s. M.V.E.

A72-38116 * # **Flight evaluation of three-dimensional area navigation for jet transport noise abatement.** D. G. Denery, K. R. Bourquin, K. C. White, and F. J. Drinkwater, III (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-814*. 7 p. 6 refs. Members, $1.50; nonmembers, $2.00.

The NASA, working with American Airlines, has completed the first phase of research to evaluate the operational feasibility of two-segment approaches for noise abatement. For these tests, area navigation was used to establish the upper glide slope and an ILS was used to establish the lower. The flight director was modified to provide command information during the entire approach. Twenty-eight pilots representing the airlines, professional pilot associations, FAA, and NASA participated. With an ILS approach for comparison, the procedure gave a noise reduction of 18 EPNdB at the outer marker and 8 EPNdB 1.1 n. mi. from touchdown. (Author)

A72-38117 # **Noise - A triumph of ignorance.** F. W. Kolk (American Airlines, Inc., New York, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-815*. 9 p. Members, $1.50; nonmembers, $2.00.

A serious long term noise problem exists with the operation of jet transports. This situation exists because of a continued lack of technical knowledge in the appreciation of the various decision making parties, coupled with a general lack of recognition that these parties do indeed lack and have lacked facts. The history of this situation is reviewed against the background of events in the field in the past twenty years, and a broad assessment of the technological position is made, with a projection of where we are going and how this direction can be best steered for the common good. The paper concludes with a suggested strategy for a long term solution to this problem which requires coordination for all parties involved. (Author)

A72-38118 # **Airline aircraft in the airport environment.** M. E. Volz (United Air Lines, Inc., Chicago, Ill.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-813*. 6 p. Members, $1.50; nonmembers, $2.00.

This paper deals with the day-to-day operational airplane-airport relationship. It will direct itself only to on-the-ground situations and make no attempt to touch upon approach facilities, electronic installations, etc. Major emphasis will be on the impact of runway grooving on many of the problem areas in the tire-runway interface. Methodology in the measurement and dissemination of the coefficient of friction in a manner that is meaningful to the pilot in his particular airplane type will be explored. Wintertime problems in the ice and snow belt, along with suggestions for alleviating some of these problems through the use of better equipment and procedures, will be covered. The comparatively new and controversial techniques involving the use of chemicals for anti-icing and deicing of airport surfaces will be discussed. It will be apparent throughout this paper that the real world environment is not always the same as that envisioned by the design team during initial construction of a particular airplane type. (Author)

A72-38119 # **A private pilot looks at general aviation.** F. L. Pugh (IBM Corp., Federal Systems Div., Thousand Oaks, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-812*. 10 p. Members, $1.50; nonmembers, $2.00.

Feasibility of personally owned and operated aircraft is examined through a three year case history of a four-place airplane. Family and training uses covered 40,000 miles. This study reviews pilot and aircraft initial capabilities, utilization, costs, maintenance, and operational problems. Study results indicate that for viable family operations, improvements are needed in airport-home proximity, aircraft reliability, weather flying capabilities, and passenger well-being. (Author)

A72-38120 # **Airline view of STOL system requirements.** R. K. Ransone (American Airlines, Inc., New York, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9,*

1972, Paper 72-807. 9 p. Members, $1.50; nonmembers, $2.00. U.S. Department of Transportation Contract No. OS-10075.

Discussion of the alleviation requirements and possibilities for the airport congestion problem from the viewpoint of an airline. The feasibility of a STOL-based national short-haul transportation program is reviewed in terms of system requirements, economics, STOL-port sites, technical considerations, STOL-port acceptance, and safety. M.V.E.

A72-38121 * # **Automated synthesis of transonic transports.** M. D. Ardema and L. J. Williams (NASA, Ames Research Center, Advanced Concepts and Missions Div., Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-794*. 13 p. 30 refs. Members, $1.50; nonmembers, $2.00.

The development of a vehicle synthesis program, called TRANSYN, designed to perform automated preliminary design of long-haul transport aircraft is briefly described. The TRANSYN-TST program was used in a study of commercial transonic transports designed for introduction in the early 1980s. The optimum engine cycles of all the study aircraft are within the current state-of-the-art, but fan noise suppression will be required to meet the noise requirements of FAR Part 36. It was found that full use of advanced composite materials in the wing and fuselage structure is neutrally cost effective when compared with aluminum for aircraft designed to cruise in the low transonic regime (Mach 0.90 to 1.0), but that such materials are very cost effective for aircraft designed to cruise in the high transonic regime (Mach 1.0 to 1.15). Finally, increasing speed results in reduced trip times with at most very slight increases in cost in the low transonic regime, but cruise speeds in the high transonic regime result in a significant economic penalty for the conventional configurations considered in this study. (Author)

A72-38122 # **Aerodynamic design and development of the Lockheed S-3A Viking.** A. L. Byrnes, Jr. (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-746*. 13 p. Members, $1.50; nonmembers, $2.00.

Aerodynamic studies conducted in preparation of the VS(X) proposal which led to the winning Lockheed configuration are reviewed. The definition of small for a carrier based airplane, minimum weight, minimum wing area, or minimum wing span concepts was difficult. Ultimately, weight was chosen as the basic parameter even though it did not necessarily result in minimum wing area. Development of the aerodynamic configuration as dictated by operational requirements is traced, and significant aerodynamic production design problems and solutions are discussed. Some comparisons between analytical, flight simulator, and flight test determined performance and flying qualities are included. (Author)

A72-38123 # **B-52 control configured vehicles program.** G. J. Kass (Boeing Co., Wichita, Kan.) and R. P. Johannes (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-747*. 7 p. 9 refs. Members, $1.50; nonmembers, $2.00. Contract No. F33615-71-C-1926.

Discussion of the potential payoff available from application during the preliminary design phase of an aircraft of the concepts of control configured vehicles (CCV) technology that includes flutter mode control, maneuver load control, ride control, and augmented stability of an airplane having reduced static stability. The potential improvements thus obtainable are shown to be reduced gross weights, superior ride quality, reduced maneuver and gust loads, better controllability, and expanded operational usage. A flight demonstration program, using a B-52 test vehicle, that is to validate each of the CCV technology concepts is described. An airplane incorporating the CCV concepts is expected to provide a gross weight reduction of approximately 20% and to perform the same mission as a conventionally designed configuration. M.V.E.

A72-38124 # **Design for air combat.** W. B. Herbst and B. Krogull (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-749*. 11 p. Members, $1.50; nonmembers, $2.00.

A combination of air combat simulation and aircraft synthesis techniques is used to analyze problems such as missile vs. aircraft maneuverability, offensive vs. defensive capability, and the cost effectiveness of increasing energy maneuverability. Aircraft design parameter combinations ranging from 0.5 to 1.7 thrust/weight ratios, 40 to 90 lb/sq ft wing loading, and 1.2 to 2.4 maximum Mach number for fixed and rubberized engines are evaluated in combat environments. The results substantiate earlier findings such as the importance of turn performance at subsonic speeds. New insight is gained into the problem of detection and low level interception and into the behaviour of a fleet of air superiority fighters. (Author)

A72-38125 # **Area navigation and its affect on aircraft operation and systems design.** E. E. Glanz (Eastern Air Lines, Inc., La Guardia Airport, Flushing, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-754*. 3 p. Members, $1.50; nonmembers, $2.00.

Discussion of the increased pilot work load resulting from the demands of present area navigation systems, and review of some of the improvements the next decade's area navigation accuracy requirements call for. The required improvements include: program changes that can be completed in thirty seconds; information that can be used immediately or stored and called up for future use; and guidance that anticipates future trends and responds to speed changes. M.V.E.

A72-38126 # **Airborne recording and its future with the airlines.** F. D. Wise (American Airlines, Inc., Tulsa, Okla.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-752*. 10 p. Members, $1.50; nonmembers, $2.00.

A need for improved data exists primarily in three areas including engine analysis, aircraft subsystems, and aircraft operational performance studies. Automated airborne recording is one approach for obtaining the required data. A typical airborne recording system installation is shown. The system contains a Flight Data Entry Panel, a Flight Data Acquisition Unit, a Data Storage Unit, and a Digital Flight Data Recorder. New recording systems presently available are discussed together with the requirements for modular Aircraft Integrated Data Systems (AIDS), major areas of application of an automated airborne data acquisition system, the costs of airborne recording, its economic benefits, and aspects of automated testing of AIDS. G.R.

A72-38127 * # **Parametric analysis of ATT configurations.** R. H. Lange (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-757*. 10 p. 6 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10701.

This paper describes the results of a Lockheed parametric analysis of the performance, environmental factors, and economics of an advanced commercial transport envisioned for operation in the post-1985 time period. The design parameters investigated include cruise speeds from Mach 0.85 to Mach 1.0, passenger capacities from 200 to 500, ranges of 2800 to 5500 nautical miles, and noise level criteria. NASA high performance configurations and alternate configurations are operated over domestic and international route structures. Indirect and direct costs and return on investment are determined for approximately 40 candidate aircraft configurations.

The candidate configurations are input to an aircraft sizing and performance program which includes a subroutine for noise criteria. Comparisons are made between preferred configurations on the basis of maximum return on investment as a function of payload, range, and design cruise speed. (Author)

A72-38128 * # Economic impact of applying advanced technologies to transport airplanes. A. J. K. Carline. *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-758.* 12 p. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10702.

Various technologies have been studied which could have application to the design of future transport airplanes. These technologies include the use of supercritical aerodynamics, composite materials, and active control systems, together with advanced engine designs that provide lower noise and pollutant levels. The economic impact of each technology is shown for a typical fleet of 195-passenger, transcontinental commercial transports cruising at both 0.9M and 0.98M. Comparisons are made with conventional transports cruising at 0.82M. Effects of combining the technologies are discussed. An R & D program aimed at bringing the technologies to fruition is outlined. (Author)

A72-38129 * # Use of the flight simulator in the design of a STOL research aircraft. R. E. Spitzer, P. C. Rumsey (Boeing Co., Commercial Airplane Group, Seattle, Wash.), and H. C. Quigley (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-762.* 15 p. 12 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS2-6025.

Piloted simulator tests on the NASA-Ames Flight Simulator for Advanced Aircraft motion base played a major role in guiding the design of the Modified C-8A 'Buffalo' augmentor wing jet flap STOL research airplane. Design results are presented for the flight control systems, lateral-directional SAS, hydraulic systems, and engine and thrust vector controls. Emphasis is given to lateral control characteristics on STOL landing approach, engine-out control and recovery techniques in the powered-lift regime, and operational flight procedures which affected airplane design. (Author)

A72-38130 # Naval air test center participation in development of air-to-air combat simulation. W. A. Allison (U.S. Naval Air Test Center, Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-765.* 6 p. Members, $1.50; nonmembers, $2.00.

Air-to-air combat simulators are discussed from the viewpoint of a flight test activity assisting in their development. Several factors are presented with discussion on the need for accurate simulation of these factors to produce valid studies of present and proposed fighter aircraft. Topics covered include aircraft data requirements, simulation of the cockpit area, visual presentations, and pilot cues of aircraft behavior. (Author)

A72-38131 # A-X Air Force flight evaluation. G. P. Lynch, Jr. (USAF, Flight Test Center, Edwards AFB, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-770.* 4 p. Members, $1.50; nonmembers, $2.00.

Discussion of the flight test program planned for the selection of the best design between two competitive prototypes of close air support aircraft, the A-9A and A-10A, whose first flights occurred in May 1972. Following a review of the characteristics, objectives, and program background of these aircraft, their planned flight tests at Edwards AFB are detailed and discussed. M.V.E.

A72-38132 # B-1 structural mode control system. J. H. Wykes, A. S. Mori, and C. J. Borland (North American Rockwell Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-772.* 9 p. 6 refs. Members, $1.50; nonmembers, $2.00.

The principal mission of the B-1 strategic bomber will involve flying close to the terrain. Turbulence excitation at low altitudes combined with the flexibility of the aircraft can degrade handling qualities and crew efficiency due to structural motion at the crew station. These problems are alleviated by an automatic structural mode control system utilizing a set of aerodynamic vanes located near the crew station. Symmetric deflections produce vertical control forces while differential deflections produce side forces. Wind tunnel tests have revealed unique vane aerodynamic characteristics which have been considered in system optimization. System mechanization and fail-safety features are discussed. (Author)

A72-38133 # Designing aircraft structure for resistance and tolerance to battle damage. J. G. Avery, T. R. Porter, and R. W. Walter (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-773.* 8 p. 5 refs. Members, $1.50; nonmembers, $2.00.

A methodology has been developed for incorporating both damage resistance and tolerance into the structural design of aircraft. The use of this methodology results in an assessment of the survivability of the structure, including the quantitative effects of design and survivability criteria. The objective of the methodology is to determine the strength requirements of the structure at any point in time, and to compare these results with the corresponding capability of the damaged structure. Analysis and test data are presented for applying the methodology to military airplanes. (Author)

A72-38134 # Application of advanced methods to the determination of design loads of the Lockheed L-1011 TriStar. W. A. Stauffer, J. G. Lewolt, and F. M. Hoblit (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-775.* 23 p. 14 refs. Members, $1.50; nonmembers, $2.00.

A72-38135 # Structural development of the L-1011 TriStar. D. J. Mackey and H. Simons (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-776.* 17 p. Members, $1.50; nonmembers, $2.00.

Review of the philosophies and experiences which led to the selection of criteria for design, structural configuration, and materials used for the Lockheed L-1011 Tri-Star aircraft. The methods used to develop internal loads and stresses are described. Analytical techniques which were developed from prior programs and applied during the preliminary and project design phases are included. Final verification of requirements established at the onset was achieved by fatigue testing and static testing complete structural airframes. (Author)

A72-38136 # Analysis of the interaction of jets and airfoils in two dimensions. C. A. Shollenberger (McDonnell Douglas Research Laboratories, St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-777.* 9 p. 10 refs. Members, $1.50; nonmembers, $2.00. Research supported by the McDonnell Douglas Independent Research and Development Program.

A solution for the flow of a jet in the proximity of one or more airfoils is developed to approximate the aircraft wing/engine interface. The two-dimensional, inviscid, incompressible case considered is significant simplification of the real flow, but has proved useful for similar problems. The jets and airfoils are represented by appropriate

flow singularities. A general numerical formulation is developed to describe the airfoil and jet system allowing an iterative scheme to be constructed for determining the location and strength of the flow singularities. Example calculations including jet shapes and aerodynamic characteristics are presented for various configurations. (Author)

A72-38137 * # **The inclusion of rotor dynamics in controller design for helicopters.** W. E. Hall, Jr. (Systems Control, Inc., Palo Alto, Calif.) and A. E. Bryson, Jr. (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-778.* 9 p. 10 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS2-5143.

State-feedback-controllers and state-estimators (filters) are designed for the roll-pitch-horizontal motions of a helicopter near hover, using a new quadratic synthesis technique. One model (tenth order) uses a dynamic model of the rotor, whereas the other model (sixth order) assumes the rotor can be tilted instantaneously. It is shown that, for tight control, neglecting the rotor dynamics in designing the autopilot can produce unstable closed-loop response on the model that includes rotor dynamics. Two filters are designed to use only fuselage sensors and two are designed to use both fuselage and rotor sensors. It is shown that rotor states can be estimated with sufficient accuracy using only fuselage sensors so that it does not seem worthwhile to use rotor sensors. The mean square response of the vehicle to a gusty, random wind, using several different filter/state-feedback compensators, is shown to be satisfactory. (Author)

A72-38138 # **Methodology for estimating STOL aircraft high lift systems characteristics.** E. S. Levinsky and J. C. Ramsey (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-779.* 16 p. 32 refs. Members, $1.50; nonmembers, $2.00.

Description of methods and test data for evaluating the low-speed aerodynamic characteristics of three STOL concepts. For mechanical flap (MF) and internally blown flap (IBF) concepts, the method chosen is a nonlinear lifting line procedure which used two-dimensional section data (either theoretical or experimental) as the basis for predicting the aerodynamic characteristics of three-dimensional wings. Both section and finite-aspect-ratio wind-tunnel data are presented for the same MF and IBF system geometries. Two methods are used for the externally blown flap (EBF) concept. The analogy method, which assumes that the EBF acts in a manner aerodynamically similar to an IBF with the same distribution of jet momentum, requires knowledge of the jet spanwise spreading. The analogy method has been evaluated by determining its sensitivity to the extent of jet spreading and by comparing with EBF test data. The wing-in-jet EBF method is an extension of lifting surface theory to include additional fluid boundary conditions across the jet interface, and is evaluated by comparison with EBF force data obtained as part of the experimental investigation. (Author)

A72-38139 # **STOL transport stability and control derivative prediction methods and accuracy requirements.** E. C. Laudeman (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-780.* 17 p. 17 refs. Members, $1.50; nonmembers, $2.00. Contract No. F33615-71-C-1754.

Summary of the status of those aspects of a technology study which concern stability and control derivative prediction methods and accuracy requirements for STOL transport aircraft using the externally blown flap, internally blown flap, or mechanical flap/vectored thrust propulsive lift concepts. In the overall approach for evolving analytical prediction methods the basic tool is a spanload program that has the capability of handling nonlinear two-dimensional airfoil data. Effects of the powered lift systems are accounted for by super-imposing power-induced lift, drag, and pitching moments on the power-off two dimensional data used to obtain spanload solutions. Accuracy requirements for the stability and control derivatives were established by estimating, using state-of-the-art prediction methods and available test data, a complete set of aerodynamic data for a typical STOL transport. From this baseline, the individual derivatives were varied to obtain the effect of each on various flying qualities parameters. (Author)

A72-38140 # **Lift and control augmentation by spanwise blowing over trailing edge flaps and control surfaces.** C. J. Dixon (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-781.* 14 p. 13 refs. Members, $1.50; nonmembers, $2.00. Contract No. N00019-71-C-0077.

Experimental evaluation of spanwise blowing for two practical applications. Data taken from tests of spanwise blowing over trailing edge flaps on a wind tunnel model of an F-8J Navy fighter and over the rudder of a STOL aircraft are presented. These data are compared with previously published results for chordwise blowing from the knee of flaps. Both concepts exhibit nearly equal aerodynamic performance, but spanwise blowing allows considerable savings in weight, cost, and complexity. Variables tested include flap span, flap deflection, jet nozzle position, and jet momentum. These are correlated in terms of equivalent two-dimensional lift coefficients and jet momentum coefficients. A qualitative description of the flowfield mechanism of spanwise blowing is presented to offer an explanation of the concept. (Author)

A72-38141 * # **A method for increasing thrust reverser utilization on STOL aircraft.** J. W. Tatom, J. H. Dunlap, and W. A. Ledwith (Vanderbilt University, Nashville, Tenn.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-782.* 16 p. 42 refs. Members, $1.50; nonmembers, $2.00. Grant No. NGR-43-002-034.

A technique for increasing the utilization of thrust reversers on STOL aircraft is described. The technique involves asymmetric orientation of the reversed exhaust in such a manner as to avoid the problems of self-ingestion, even in the presence of a cross wind, and cross ingestion between adjacent engines. Experimental results of ingestion in a single nacelle inlet are discussed and flow visualization pictures are presented. An analytical model of ingestion is described and sample results are shown. (Author)

A72-38142 # **What should real-time testing offer.** J. W. Rymer (U.S. Naval Air Test Center, Patuxent River, Md.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-783.* 18 p. 26 refs. Members, $1.50; nonmembers, $2.00.

A current approach to real-time telemetry processing systems (RTPS) is described along with display features and limitations. Present shortcomings in telemetry processing systems are examined, and practical limits on user expectations are suggested. Differences in requirement definition are highlighted that affect manpower, quality, and turnaround. Concepts of integrated testing and specific areas for attention focus are presented. It is argued that real-time testing should offer improved turnaround by definition and should maintain or improve the quality of test results, while tending to increase the depth of testing. M.V.E.

A72-38143 # **Survivable flight control system compatibility test program.** H. L. Jeffrie and D. R. Rolston (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-761.* 8 p. Members, $1.50; nonmembers, $2.00. Contract No.

F33615-69-C-1827.

A test program was conducted to determine compatibility and operating characteristics of survivable flight control system (SFCS) components which were developed for flight testing a three-axis, fly-by-wire flight control system in an F-4 aircraft. This paper presents a description of the SFCS hardware, test bed, and the digital computer program used to provide a high fidelity simulation of the aircraft. Pilots used the SFCS simulator to evaluate handling qualities over the entire F-4 flight regime. Results obtained from this program are compared with available flight data obtained during the SFCS flight test program. (Author)

A72-38165 # **Filament winding techniques for rotor blade applications.** K. Brunsch (Messerschmitt-Bölkow-Blohm, GmbH, Munich, West Germany). *Plastics Institute, Conference on Reinforced Plastics Filament Winding, 2nd, London, England, Mar. 15, 16, 1972, Paper.* 6 p.

Composite rotor blade design criteria are described in terms of aerodynamic, dynamic, and structural requirements. Advantages over metal blades include possible airfoil section variability along the blade span, greater range of blade elastic properties, and controllable mechanical characteristics. Filament winding techniques were adapted for composite rotary wing fabrication. C- and D-section spars were wound from glass and carbon fibers for wet lay up. Fiber orientation was dictated by design requirements, and the fiber alignment after curing was good. Graphs show blade natural frequencies versus rotational speed, aerodynamic efficiency versus rotational speed, and effects of winding patterns on mechanical properties. T.M.

A72-38222 * **Generating high Reynolds-number flows.** D. A. Russell (Washington, University, Seattle, Wash.). *Instruments and Control Systems,* vol. 45, Aug. 1972, p. 57-59. 14 refs. Grant No. NGL-48-002-057.

Present test facilities are seriously limited regarding investigations involving high Reynolds numbers due to financial considerations. Quasi-steady testing facilities offer a practical immediate solution to the problem of high-Re testing. A familiar example is the blowdown wind tunnel, but even more flexibility and economy may be provided by using shock-tube devices. The Ludwieg tube is the shock-tube device most often proposed as a means of generating high-Re flows. Two-stage nozzles may be used with a Ludwieg tube. Quasi-steady facilities will be useful only if the available test time exceeds that required to establish steady flow. G.R.

A72-38227 # **Optimal selection of stability augmentation parameters for excellent pilot acceptance.** R. O. Anderson (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and R. A. Hannen (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. (A72-38226 19-10) New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 21-24. 10 refs.

The results of several recent applications of the Pitch Paper Pilot (an automated means of predicting pilot acceptance ratings) to the synthesis of flight control systems are reviewed. Early work in this area produced effective system dynamics that compare extremely well with military flying requirements. This procedure is fully automated, and includes provisions to handle control authority limits. The above procedure has also been extended to handle flexible vehicle effects. (Author)

A72-38228 # **An optimal model-following flight control system for manual control.** A. J. VanDierendonck (Honeywell, Inc., Minneapolis, Minn.), M. Wynne, and L. Kruczynski (U.S. Air Force Academy, Colorado Springs, Colo.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 25-32. Contract No. F33615-72-C-1266.

Optimal model-following quadratic control is applied to the design of the Pilot's Control Mode of the Sight Line Auto-Pilot of the AC-130 Gunship. The purpose of this controller is to improve the pilot's ability to point the aircraft's guns as instructed by the fire control computer. The model-in-the-performance-index method is used to decouple roll rate and sideslip from each other and from the pitching motion of the aircraft, while improving the dutch roll characteristics of the aircraft. In addition, integral-plus-proportional control is used to compensate for nonlinearities in the servo-actuator-control surface systems. Simulation results show remarkable improvement in the responses of the aircraft due to command inputs. Linear and nonlinear simulation results are presented. (Author)

A72-38252 * # **4-D guidance system design with application to STOL air traffic control.** H. Erzberger (NASA, Ames Research Center, Moffett Field, Calif.) and T. Pecsvaradi (U.S. Army, Washington, D.C.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 445-454. 7 refs.

A new guidance technique, referred to as 4-D guidance, is being developed to improve the operation of future STOL aircraft transportation systems. 4-D guidance refers to a technique of synthesizing a complex three-dimensional flight path from simple pilot inputs and flying the aircraft along the path according to an ATC specified time schedule. The two major elements of a 4-D guidance system are the trajectory synthesizer and the control law for flying the aircraft along the synthesized trajectory using the aircraft's autopilot and autothrottle. Inputs to the trajectory synthesizer are the three-dimensional coordinates of waypoints, the turning radius, the speed range, the acceleration limits and the arrival time at time control waypoints. First the three-dimensional trajectory is computed using circular arcs and straight lines. Then the airspeed profile, compensated for wind, is calculated to achieve the desired arrival times. The pilot is informed if the arrival times cannot be achieved. The synthesized trajectory is stored as a time sequence of reference states and controls which the aircraft is forced to track using a linear feedback law. (Author)

A72-38253 * # **Precision navigation for approach and landing operations.** S. F. Schmidt (Analytical Mechanics Associates, Inc., Jericho, N.Y.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 455-463. 6 refs. Contract No. NAS2-6099.

This paper summarizes some of the practical considerations and implementation techniques used in the development of the onboard software for an experimental navigation system. This software includes (1) a Kalman filter implementation in square-root form with gyro and accelerometer noises modeled as random forcing functions in the filter; (2) operational modes for inflight alignment, ground alignment, normal aided inertial navigation operation, and postflight analysis; (3) a sophisticated time-sharing system for obtaining a very flexible input-output capability during real-time operations; and (4) a problem formulation and scaling for complete operation in single-precision arithmetic using a 24-bit word. The paper emphasizes the procedures used in formulation, scaling, and time-sharing for the real-time Kalman filter application. Some flight results are presented to illustrate the performance of the filter during real-time operation. (Author)

A72-38254 # **Air traffic flow control - Problems and approaches.** I. G. Wolf (FAA, Washington, D.C.) and J. F. Bellantoni (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 465-477. 8 refs.

This paper first describes the major operational problems in

controlling the general flow of the nation's air traffic from a central facility, and then outlines some of the approaches that may be taken to help automate their solutions. The paper is divided into two parts. Part I describes the operational problems, giving the history, present procedural techniques and constraints, data sources, and control strategies available. Part II discusses various approaches to automating flow control such as quantifying the objectives and developing algorithms to assist the controllers. (Author)

A72-38255 * # Application of optimization techniques to near terminal area sequencing and flow control. T. A. Straeter, S. K. Park, and J. E. Hogge (NASA, Langley Research Center, Hampton, Va.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 478-487. 10 refs.

Development of an arrival air-traffic management system for a single runway. Traffic is segregated throughout most of the near terminal area according to performance characteristics. Nominal approach routes for each class of aircraft are determined by an optimization procedure. In this fashion, the nominal approach routes are dependent upon and, hence, determined by the near terminal area operating capabilities of each class of aircraft. The landing order and spacing of aircraft on the common approach path are determined so that a measure of total system deviation from the nominal landing times is minimized and safety standards are met. Delay maneuvers required to satisfy sequencing needs are then carried out in a manner dependent upon the particular class of aircraft being maneuvered. Finally, results are presented to illustrate the effects of the rate of arrivals upon a one-runway system serving three different classes of aircraft employing several different sequencing strategies and measures of total system deviation. (Author)

A72-38256 * # An investigation of vehicle dependent aspects of terminal area ATC operation. C. L. Britt, Jr., J. A. Modi, E. G. Baxa, Jr. (Research Triangle Institute, Research Triangle Park, N.C.), and T. M. Walsh (NASA, Langley Research Center, Hampton, Va.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, *Preprints of Technical Papers.* New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 488-498. 8 refs. NASA-supported research.

Description of a terminal area simulation which permits analysis and synthesis of current and advanced air traffic management system configurations including ground and airborne instrumentation and new and modified aircraft characteristics. Ground elements in the simulation include navigation aids, surveillance radars, communication links, air-route structuring, ATC procedures, airport geometries, and runway handling constraints. Airborne elements include traffic samples with individual aircraft performance and operating characteristics and aircraft navigation equipment. The simulation also contains algorithms for conflict detection, conflict resolution, sequencing and pilot-controller data links. (Author)

A72-38259 # Investigation of data rate requirements for low visibility approach with a scanning beam landing guidance system. J. D. Dillow, P. R. Stolz, and M. D. Zuckerman (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 518-524.

Data rate requirements for low visibility approach with a sample data measurement of glideslope deviation is investigated analytically. Approach performance is defined by specifying certain allowable deviations in the aircraft motion variables which are acceptable for continuation of the landing at a 100 foot decision altitude. The landing approach process is modeled by a system of linear-Gaussian-differential equations which account for aircraft dynamics, atmospheric disturbances, guidance errors and data rate. The flight control system is modeled by a state estimator and an optimal state feed-back control law. Performance as a function of data rate was computed using DC-8 and CH-53A dynamics and considering variations in the atmospheric environment, guidance errors, control authorities, control points, and on board sensors. (Author)

A72-38260 * # A generalized method for the identification of aircraft stability and control derivatives from flight test data. R. K. Mehra, D. E. Stepner, and J. S. Tyler (Systems Control, Inc., Palo Alto, Calif.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 525-534. 14 refs. Contracts No. NAS1-10700; No. N0019-69-C-0534.

This paper discusses the application of a generalized identification method for flight test data analysis. The method is based on the maximum likelihood (ML) criterion and includes output error and equation error methods as special cases. Both the linear and nonlinear models with and without process noise are considered. The flight test data from lateral maneuvers of HL-10 and M2/F3 lifting bodies are processed to determine the lateral stability and control derivatives, instrumentation accuracies and biases. A comparison is made between the results of the output error method and the generalized ML method for M2/F3 data containing gusts. It is shown that better fits to time histories are obtained by using the generalized ML method. (Author)

A72-38265 # Adaptive parameter identification applied to VTOL aircraft. H. Kaufman and D. Beaulier (Rensselaer Polytechnic Institute, Troy, N.Y.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 579-583. 5 refs. Grant No. DAAB07-69-C-0365. Project THEMIS.

An extended Kalman filter with a fictitious noise input is developed for tracking time varying parameters. An adaptation algorithm is used for adjusting the covariance of the fictitious noise according to the magnitude of the measured residuals. Application of the filter to the tracking of time varying VTOL parameters is shown to give an off line model that reproduces the process behavior much better than a model with fixed parameters. (Author)

A72-38276 # The dynamic modeling technique for obtaining closed-loop control laws for aircraft/aircraft pursuit-evasion problems. G. M. Anderson (USAF, Institute of Technology, Wright-Patterson AFB, Ohio), W. L. Othling, Jr. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio), and S. M. D. Williamson-Noble (Royal Air Force College, Cranwell, Lincs., England). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 953, 954.

A72-38277 # Optimum turns to a specified track for a supersonic aircraft. W. C. Hoffman, J. Zvara (Aerospace Systems, Inc., Burlington, Mass.), and A. E. Bryson, Jr. (Stanford University, Stanford, Calif.; Aerospace Systems, Inc., Burlington, Mass.). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 955, 956. 9 refs. Contract No. F44620-71-C-0016.

Study of the prerequisites to a digital computer program required for implementing calculations of optimum turns to a specified track for a supersonic combat aircraft. The aim of the study is to contribute to the ultimate goal of a complete real-time on-line flight path optimization capability. M.V.E.

A72-38278 # A landing approach guidance scheme for aircraft which are capable of executing steep approaches. D. H. deDoes and M. C. Lowe (USAF, Institute of Technology, Wright-Patterson

AFB, Ohio). In: Joint Automatic Control Conference, 13th, Stanford, Calif., August 16-18, 1972, Preprints of Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1972, p. 959, 960. 5 refs.

A72-38380 Silencing the sources of jet noise. D. Crighton (Imperial College of Science and Technology, London, England). *New Scientist,* vol. 55, July 27, 1972, p. 185-188.

The probably most obvious source of jet noise is associated with the mixing process which occurs when the exhaust gas emerges from the jet nozzle. The only real cure for subsonic mixing noise lies in great exhaust speed reduction. This is now possible with the advent of turbofan engines, whose very large diameter permits the mass flow and thrust to be maintained with much lower speeds. Mixing noise still dominates the field of engines with supersonic exhaust speeds. However, the mechanism involved in this case is quite different, and noise suppression devices are available to ensure that mixing noise is no longer a problem. G.R.

A72-38514 Optimal control of linear passive systems. A. A. Krasovskii. *(Avtomatika i Telemekhanika,* Jan. 1972, p. 5-14.) *Automation and Remote Control,* vol. 33, June 1972, pt. 1, p. 1-9. Translation.

Analytical synthesis of optimal controls for linear passive stationary plants whose coefficient matrices exhibit a symmetry that makes it possible to obtain very simple solutions for a number of given coefficients of the minimized functional. The prescribed part of the functional has a straightforward physical meaning. The use of one obtained solution is illustrated for an example problem involving the synthesis of a system for damping flexural vibrations of an aircraft. T.M.

A72-38554 Surface vorticity theory for axisymmetric potential flow past annular aerofoils and bodies of revolution with application to ducted propellers and cowls. R. I. Lewis (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England) and P. G. Ryan (British Ship Research Association, Wallsend, Northumberland, England). *Journal of Mechanical Engineering Science,* vol. 14, Aug. 1972, p. 280-291. 17 refs.

A72-38568 # The acoustics of axial flow machines. C. L. Morfey (Southampton, University, Southampton, England). *(British Acoustical Society, Spring Meeting, Loughborough, Leics., England, Apr. 5-7, 1972.) British Acoustical Society, Proceedings,* vol. 1, Summer 1972. 39 p. 43 refs.

Review of the applications of linear acoustic theory to subsonic turbomachinery. The various noise source mechanisms indicated by the acoustic analogy are discussed in detail. Particular attention is given to simplified models from which straightforward analytical predictions can be obtained. Comparisons between theoretical predictions and measured data are made under the three headings of: (1) effect of flow on sound radiation from known sources; (2) radiation from a blade row operating in a known nonuniform flow; and (3) relation between sound power output and steady-flow operating parameters. M.V.E.

A72-38686 Experimental results regarding drag in supersonic flow without lift in the case of flight bodies with three in front pointed bodies (Zu experimentellen Ergebnissen des Widerstands in auftriebsloser Überschallströmung von Flugkörpern mit drei vorn spitzen Rümpfen). F. Keune, H. Riedel, and H. Emunds (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für angewandte Gasdynamik, Porz-Wahn, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 20, July 1972, p. 257-261. 5 refs. In German.

A72-38687 Displacement corrections for subsonic wind tunnels and the correction applicability limits (Die Verdrängungskorrekturen in Unterschallwindkanälen und die Grenzen ihrer Anwendbarkeit). G. Schulz (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Zentralabteilung Niedergeschwindigkeits-Windkanäle, Porz-Wahn, West Germany). *(Deutsche Gesellschaft für Luft- und Raumfahrt, Sitzung, Munich, West Germany, Feb. 29, 1972.) Zeitschrift für Flugwissenschaften,* vol. 20, July 1972, p. 261-268. 6 refs. In German.

Discussion of the corrections to which wind tunnel measurements are subject because of the finite dimensions of the airflow cross section. There are several kinds of corrections, namely: (1) displacement or dynamic-pressure corrections, (2) downwash or directional corrections, and (3) pressure gradient corrections. The required correction magnitude grows rapidly with the relative size (i.e., displacement) of the model, but no information has as yet appeared in print on the displacement limit up to which the correction accuracy is adequate. Quantitative data thereon are presented for the first time, and it is shown that, when the relative size of the model grows so large as to cause excessive wind tunnel obstruction, the corrections for the various model surface locations assume differing (inhomogeneity-indicating) values. Though the applicability limit investigation is restricted to the displacement correction only, the investigation method used is, in principle, applicable to the downwash correction, too. M.V.E.

A72-38809 Analytical and numerical studies of downwash over rectangular planforms. H. C. Garner (Royal Aircraft Establishment, Farnborough, Hants., England) and G. F. Miller (Aeronautical Research Council, National Physical Laboratory, Teddington, Middx., England). *Aeronautical Quarterly,* vol. 23, Aug. 1972, p. 169-180. 11 refs.

Consideration of the distribution of downwash at the surface of rectangular planforms with prescribed subsonic aerodynamic loading. Three separate aspects of the problem are treated analytically, the results of each being tested against those derived from an accurate numerical procedure. Asymptotic expressions for large and small aspect ratio are formulated and are shown to apply over a wide range of aspect ratio. Downwash routines from certain existing lifting-surface methods are studied, and their patterns of convergence are illustrated and compared. A logarithmic singularity near the leading tip corner is identified, but it is observed that this can exist without serious detriment to the lifting-surface methods. (Author)

A72-38810 Evaluation of the downwash integral for rectangular planforms by the BAC subsonic lifting-surface method. W. Kellaway (British Aircraft Corp., Ltd., Preston, Lancs., England). *Aeronautical Quarterly,* vol. 23, Aug. 1972, p. 181-187. 10 refs.

A72-38949 Analytical prediction of vortex-ring boundaries for helicopters in steep descents. J. Wolkovitch (Mechanics Research, Inc., Los Angeles, Calif.). *American Helicopter Society, Journal,* vol. 17, July 1972, p. 13-19. 9 refs. Grant No. DAAJ02-69-C-0004.

The vortex-ring state is characterized by severe thrust fluctuations and difficulty of control. A simple method of predicting the combination of rate of descent and angle of descent at which the vortex-ring state occurs is described. Momentum theory and actuator disk concepts are employed. The flow model used consists of a slipstream with uniform flow at any cross section, surrounded by a protective tube of vorticity which separates the slipstream from the relative wind. The key assumption of the analysis is that the vortex-ring state will occur when the relative velocity of the vortex cores normal to the disk falls to zero. The parasite drag of the rotor and of other components is considered. The causes of vertical and inclined descent, and the lower boundary of the vortex-ring state are studied. The results are in good agreement with experiment. F.R.L.

A72-38950 Analytical investigation of the effects of blade flexibility, unsteady aerodynamics, and variable inflow on helicopter rotor stall characteristics. E. D. Bellinger (United Aircraft Research Laboratories, East Hartford, Conn.). *American Helicopter Society,*

Journal, vol. 17, July 1972, p. 35-44. 21 refs.

Systematical investigation of the relative importance of blade flexibility, unsteady aerodynamics, and variable inflow (with and without wake distortions) in determining predicted helicopter rotor stall characteristics. The theoretical results of this study were compared with corresponding full-scale wind tunnel results for the H-34 rotor system. Various levels of rotor stall were investigated at forward speeds of 117 and 194 knots. The classical theory (rigid blades, steady aerodynamics, and constant inflow) produced good correlation at nominally unstalled operating conditions. However, rotor lifts significantly lower than the test values were predicted at high blade angles of attack. The use of unsteady airfoil data provided the most significant improvement in correlation by allowing higher section lift coefficients to be reached due to the 'stall delay' phenomenon associated with unsteady operating conditions. (Author)

A72-38974 # **Evaluation of film forming foams for the suppression of fuel fires in aircraft hangars.** D. E. Breen (Factory Mutual Research Corp., Norwood, Mass.). *Combustion Institute, Spring Meeting, University of Washington, Seattle, Wash., Apr. 24, 25, 1972, Paper 72-16*. 45 p. 29 refs.

An evaluation of the fire suppression capability of aqueous foams containing film forming fluorosurfactants has been carried out. Tests were made by burning 900 sq ft of JP-4. The agent was discharged through 48 nozzles, 60 ft above the fire. The area per nozzle under protection was fixed at 80, 100, or 130 sq ft/head, depending on the desired pressure. The amount of air entrained by the foam solution in a given nozzle and the rate of liquid drainage from the foam were found to depend primarily on the type of head, but also on head pressure. At elevations of 60 ft, foam with an expansion ratio of about 5 appears to be less effective in suppressing 900 sq ft fires than foam with a ratio of about 2. (Author)

A72-38989 **The lightning arrestor-connector - A new concept in system electrical protection.** J. A. Cooper and L. J. Allen (Sandia Laboratories, Albuquerque, N. Mex.). In: EMC at the crossroads; International Electromagnetic Compatibility Symposium, Arlington Heights, Ill., July 18-20, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 194-199. 12 refs. AEC-supported research.

The device described provides protection against large currents exceeding 200,000 A. It is small enough to be installed in a multipin connector housing. Lightning characteristics are discussed together with dielectric-stimulated arcing. Design details for the lightning arrestor-connector are provided, taking into account the general geometry, aspects of dielectric selection, metal selection, sealing procedure, breakdown voltages, and connector pin fusing. The experimental investigation of the device included static breakdown tests, pulse breakdown tests, and high current tests. G.R.

A72-39074 **The film vaporization combustor and its physical principles. I - The vaporizer section of the combustor. II - The reaction chamber and the combustion (Die Filmverdampfungsbrennkammer und ihre physikalischen Grundlagen. I - Der verdampferteil der Brennkammer. II - Die Reaktionskammer und die Verbrennung).** F. Eisfeld (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Luftsaugende Antriebe, Braunschweig, West Germany). *Motortechnische Zeitschrift*, vol. 31, no. 2, 1970, p. 47-51; vol. 33, no. 1, 1972, p. 8-15. 32 refs. In German. (DFVLR-SONDDR-194)

Consideration of the present state of development of the film vaporization combustor and of the possibility of using it in aircraft power plant gas turbines. Two types of vaporization combustors that have already been built are described, showing their advantages over normal burners, including the possibility of rust-free operation. Problems arising in the further development of the film vaporization combustor are considered, including the problem of coupled heat and mass transfer and the occurrence of adverse flow effects. For this purpose a detailed study is made of the operation of the main components of a model film vaporization combustor - namely, the vaporizer section, the reaction chamber, and the flame tube. The flame propagation, the operation range, and the effect of exhaust gas emission are discussed on the basis of certain important chemical reactions which take place under conditions differing from those prevailing in a fuel-injection burner. A.B.K.

A72-39079 # **The impact of gradiometer techniques on the performance of inertial navigation systems.** K. R. Britting, S. J. Madden, Jr., and R. A. Hildebrant (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-850*. 10 p. 9 refs. Members, $1.50; nonmembers, $2.00. Contract No. F19628-71-C-0105.

A72-39081 # **Error analysis of hybrid aircraft inertial navigation systems.** R. A. Nash, Jr., J. A. D'Appolito, and K. J. Roy (Analytic Sciences Corp., Reading, Mass.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-848*. 11 p. 22 refs. Members, $1.50; nonmembers, $2.00. Contracts No. F29600-69-C-0004; No. F29600-69-C-0014.

Error propagation in hybrid aircraft inertial systems is described for several applications. Free-inertial systems, systems damped by classical feedback techniques, and systems integrated by Kalman filtering algorithms are all considered. Available external aids include Doppler radar, and position fixing systems such as Loran. Design guidelines for reduced state Kalman filters are presented. Total navigation system performance and error budget development are detailed for alignment and navigation modes and for cruise and high-g environments. The results are intended to provide fresh insights into aircraft inertial system behavior and to indicate a design and evaluation methodology for such systems. (Author)

A72-39082 # **Optimum aiding of inertial navigation systems using air data.** P. G. Savage and G. L. Hartmann (Honeywell, Inc., Minneapolis, Minn.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-847*. 12 p. 9 refs. Members, $1.50; nonmembers, $2.00.

A Kalman filter is configured to estimate inertial navigator errors by using the difference between inertial velocity and dead reckoned velocity (from air data and inertial azimuth) as the measurement. Error models are derived for the air data aided inertial system. Gyro drift is modeled as a composite of systematic drift, warm-up transient, and random walk. The wind is modeled as a composite of a constant mean, random walk fluctuation of the mean, and higher frequency gusts. Synthesis of the filter involves definition of the states to minimize observability problems created by identical correlation times in the wind and gyro drift model. A covariance analysis demonstrates that air data aiding of inertial systems can be a useful technique for in-air alignment/calibration (eliminating preflight warm-up requirements) and achieving high accuracy performance from moderate cost inertial systems. (Author)

A72-39083 * # **Updating inertial navigation systems with VOR/DME information.** J. C. Bobick (U.S. Navy, Center for Naval Analyses, Arlington, Va.) and A. E. Bryson, Jr. (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-846*. 12 p. 13 refs. Members, $1.50; nonmembers, $2.00. Contract No. F33615-72-C-1297; Grants No. NGR-05-020-431; No. NGL-05-020-007.

Demonstration that updating an inertial navigation system (INS) with VOR/DME information (from one or two stations) by means of a maximum-likelihood filter results in substantial improvements in navigational accuracy over that obtained by the use of a single VOR/DME (current practice). When continuously updating, the use of a high-quality INS (0.01 deg/hr gyro drift) instead of a low-quality INS (1.0 deg/hr gyro drift) does not substantially improve position

accuracy. In-flight alignment (or realignment) of an INS to an accuracy comparable to that of ground alignment can be accomplished by using two DMEs. Several reduced-order suboptimal filters were found to perform nearly optimally. (Author)

A72-39089 * # **A versatile Kalman technique for aircraft or missile state estimation and error analysis using radar tracking data.** G. T. Aldrich (Wolf Research and Development Corp., Riverdale, Md.) and W. B. Krabill (NASA, Traffic Management Programs, Wallops Island, Va.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-838.* 9 p. Members, $1.50; nonmembers, $2.00.

A72-39090 # **Advanced fighter controls flight simulator for all-systems compatibility testing.** S. Rayhawk, D. R. Rolston, and B. B. Barnes (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-837.* 11 p. Members, $1.50; nonmembers, $2.00.

A72-39091 # **A time-frequency localization system applied to acoustic certification of aircraft.** J. Besson and J. Boillot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-836.* 11 p. 11 refs. Members, $1.50; nonmembers, $2.00.

A72-39107 # **Weapon delivery system development.** R. K. Smyth (North American Rockwell Corp., Autonetics Div., Anaheim, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-896.* 8 p. Members, $1.50; nonmembers, $2.00.

This paper describes weapon delivery techniques and development trends for tactical aircraft. The paper describes the navigation systems used in conjunction with weapon delivery and the sensors and techniques used for target detection, identification, and designation. The paper also describes the guidance used from the point of target designation to the point of weapon release. The techniques for weapon release computation are described in qualitative terms. The various modes used for weapon delivery are also described in qualitative terms. The modes described include dive, toss, level and continuously computed impact point modes. Finally, the future trends in weapon delivery system mechanization are outlined. (Author)

A72-39109 # **Future trends of airborne computers.** A. F. Schmitt (Litton Systems, Inc., Woodland Hills, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-895.* 7 p. Members, $1.50; nonmembers, $2.00.

Review of the distinctive characteristics of airborne computers (ABC), discussion of their contemporary design features and trends, and forecast of the potentialities of future ABC generations. Design trends in circuits, logics, memories, and computer organization patterns are shown to point at the development of smaller, computationally more powerful ABC systems encompassing multi-organ structures and making possible cost-efficient multiprocessor computer systems with memory hierarchy. M.V.E.

A72-39117 # **Redundancy management for fly-by-wire systems.** E. A. Bumby (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-884.* 6 p. Members, $1.50; nonmembers, $2.00.

Various analog circuit techniques employed in the redundancy management of a quadruple-redundant system are discussed. The redundancy management is separated into two categories, signal selection (voting), and failure detection and isolation (monitoring). The circuits employed in several types of voter/monitor techniques are discussed with respect to their failure response characteristics and their mode of voting. The voters are separated into averaging and discrete signal selection categories. The monitoring function is discussed with respect to failure detection threshold and failure transient response time. A brief discussion of redundancy management programs for triple-redundant digital computer systems employing voter/monitor techniques similar to the analog circuits is presented. (Author)

A72-39118 # **Fly by wire technology.** J. Emfinger and J. Flannigan (Sperry Rand Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-882.* 7 p. Members, $1.50; nonmembers, $2.00.

The requirements and equipment characteristics of a production electronic primary flight control system are predicted based upon current state-of-the art trends. Current Air Force (680J) and NASA (F-8) fly-by-wire programs are described with particular attention given to the requirements placed on these programs which heavily influenced equipment physical characteristics. Typical production equipment characteristics are then developed based upon a postulated set of requirements, which eliminate constraints associated with a flight test program. (Author)

A72-39119 # **Synthesis and analysis of a fly-by-wire flight control system for an F-4 aircraft.** R. L. Kisslinger and G. J. Vetsch (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-880.* 13 p. Members, $1.50; nonmembers, $2.00. Contract No. F33615-69-C-1827.

The control laws for use in a fly-by-wire (FBW) flight control system to be flight tested in an F-4 aircraft have been developed. The synthesis of the FBW system required defining the control laws on a single channel basis to achieve the desired handling qualities. Frequency response, root locus, and transient response techniques were used as appropriate. The linear and nonlinear mathematical models used to establish the system design, including the flexible airframe models used to define structural coupling, are described. The results of the analyses and simulations used to help define the system are presented. (Author)

A72-39127 # **Practical integration of direct lift control into an automatic carrier landing system.** R. L. Fortenbaugh (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-873.* 11 p. 8 refs. Members, $1.50; nonmembers, $2.00. Navy-sponsored research.

The design philosophy and state-of-the-art mechanization for the ACLS (Automatic Carrier Landing System) are reviewed. Advantages of DLC (Direct Lift Control) are discussed to establish its integration potential for the F-14A ACLS. Design constraints imposed by the advanced stage of F-14A development at initiation of the DLC/ACLS integration feasibility study are presented. A moving base carrier landing simulation was developed to provide for pilot evaluation and statistical comparison of two 'optimized' systems: a Baseline (no DLC) ACLS and a DLC-integrated ACLS. Simulation results established the superiority of the DLC-aided system in tightly controlling the approach flight path and significantly reducing touchdown dispersions. (Author)

A72-39128 # **Problems and solutions related to the design of a control augmentation system for a longitudinally unstable supersonic transport.** L. R. Tomlinson (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-871.* 11 p. Members, $1.50; nonmembers, $2.00.

Discussion of the unusual design problems encountered in the

course of a program attempting to achieve an SST design economically competitive with the large subsonic transports by way of a control configured vehicle design relying on stability augmentation to meet handling qualities and safety requirements at correspondingly large gains in structural weight curbing, and in enhancement of aerodynamic efficiency and range/payload capability. It is shown that, even though control system design solutions are available for all of these problems, the design becomes more complex and program management problems greatly increase because of the greater interaction required among all the design disciplines. At termination of the SST program, solutions had been developed for all the problems, but the resulting control system was complex. M.V.E.

A72-39129 # Maneuver load control and relaxed static stability applied to a contemporary fighter aircraft. D. C. Anderson, R. L. Berger, and J. R. Hess, Jr. (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-870.* 13 p. Members, $1.50; nonmembers, $2.00. Contract No. F33615-71-C-1234.

Analytical investigation of the possibility to improve the maneuvering performance of fighter aircraft through application of such aircraft design concepts as those of maneuver load control (MLC) and relaxed static stability (RSS). The analysis results show that significant performance benefits can be realized through judicious application of these design concepts. Relaxing static stability and using combinations of horizontal canards and high-lift control surfaces lead to improvements in such characteristics as specific excess power and lift-limited load factor, while the use of optimal control techniques in determining the control system compensating network parameters can ensure the desired system performance and stability. These control characteristics are achievable with conventional control implementation means such as the fly-by-wire control system. The MLC and RSS design concepts are shown to be compatible and mutually complementary. M.V.E.

A72-39130 # B-52 controls configured vehicle system design. G. O. Thompson and J. I. Arnold (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-869.* 7 p. Members, $1.50; nonmembers, $2.00. Contract No. F33615-71-C-1926.

System analysis and synthesis results are presented on the B-52 Controls Configured Vehicle (CCV) program. System synthesis criteria and airplane implementation approach are presented for Flutter Mode Control (FMC), Maneuver Load Control (MLC), and Augmented Stability (AS) CCV system concepts. The FMC system employs dual flaperons and dual aileron surfaces to suppress a 2.4 hertz symmetric wing flutter problem. MLC employs flaperons, ailerons, and elevators to reduce wing bending moments in maneuvers. AS uses pitch rate feedback to the elevator and pilot command prefilters to stabilize a neutrally stable longitudinal condition and meet MIL-F-8785B flying qualities. (Author)

A72-39204 # Distortion and residual stresses in welded aluminum structures. K. Masubuchi (MIT, Cambridge, Mass.) and C. Taniguchi (São Paulo, Universidade, São Paulo, Brazil). In: Inter-american Conference on Materials Technology, 3rd, Rio de Janeiro, Brazil, August 14-17, 1972, Proceedings. Mexico City, Centro Regional de Ayuda Técnica, 1972, p. 357, 359-363. 24 refs.

The present state of the art of residual stress and distortion analysis in welded aluminum structures is summarized in the light of referenced literature of recent data. Out-of-plane distortion is considered in fillet-welded aluminum panels similar to those of typical ship or aircraft structural components consisting of a flat plate with longitudinal and/or transverse stiffeners fillet-welded to it. Analytical means are presented for estimating the possible out-of-plane distortion that will occur in a structure to be built on the basis of the thickness of the plate, the span of the panel, and the welding procedure used. M.V.E.

A72-39333 The evolution of head-up displays. J. H. Smith (Smiths Industries, Ltd., Cheltenham, Glos., England). *Interavia,* vol. 27, Aug. 1972, p. 858-860.

Electronic Head-Up Display (HUD) systems for military applications have now been under development in the United Kingdom for about 16 years. HUD systems are now specified as an essential part of the avionics system of virtually all modern strike aircraft. The prime justification for the installation of a HUD system is to enable the best possible accuracy and flexibility of weapon delivery to be obtained. In addition, a HUD system is also valuable for the convenient presentation of normal primary flight information. The development of a digital waveform generator (WFG) represented a major advance for HUD systems. The system components of the HUD are described, giving attention to the pilot's control panel, the pilot's display unit, the WFG, and the unit which provides the necessary high voltage to the final anode of the CRT in the main display unit. G.R.

A72-39351 Failsafe hydraulic actuator flight control for jet aircraft. A. Horstin (Bendix Corp., Electrodynamics Div., North Hollywood, Calif.). *Hydraulics and Pneumatics,* vol. 25, Aug. 1972, p. 69-71.

A modern flight control actuator system is a package of hydraulic and mechanical components which operates a flight control surface in response to manual inputs from the pilot or electrical commands from the autopilot. Two fully active hydraulic systems and a back-up system power the main actuator. Aspects of autopilot control are discussed together with the manual control process. Design and operation details are provided regarding the actuators, valves, indicators, feedback transducers, the lock-out mechanism, and the linkage arrangement. G.R.

A72-39448 # Prospects for the development of technically usable fiber-reinforced high-temperature materials (Aussichten für die Entwicklung technisch nutzbarer faserverstärkter Hochtemperaturwerkstoffe). G. Elssner (Max-Planck-Institut für Metallforschung, Stuttgart, West Germany). In: Composite materials; Meeting, 1st, Konstanz, West Germany, October 22, 23, 1970, Technical Reports. Oberursel, West Germany, Deutsche Gesellschaft für Metallkunde, 1971, p. 241-266. 30 refs. In German.

A72-39557 Some results in combustion generated noise. W. C. Strahle (Georgia Institute of Technology, Atlanta, Ga.). *Journal of Sound and Vibration,* vol. 23, July 8, 1972, p. 113-125. 11 refs.

This paper contains some analytical results aimed toward understanding of prior experimental results in noise generated by the turbulent combustion process. It is proven that regardless of the turbulence structure the far field sound pressure is directly proportional to the first Eulerian time derivative of the chemical reaction rate integrated over the reacting volume. The characteristics of the correlation function for this reaction rate time derivative are investigated through elementary reasoning for several simple premixed turbulent flame models. Scaling rules for the sound power output are obtained and compared with experiment. The directional characteristics of the radiated sound are investigated. (Author)

A72-39586 # Dynamic strength of tangentially wound toothed blade roots (Dinamicheskaia prochnost' zubchikovykh khvostov lopatok s tangentsial'noi zavodkoi). G. I. Bogoradovskii, D. M. Bavel'skii, and N. Z. Suponitskii. *Energomashinostroenie,* vol. 18, Apr. 1972, p. 4-6. In Russian.

Determination of the stress state of a tangentially wound toothed blade root during resonance vibrations of the blade under asymmetrical cycle conditions. On the basis of an experimental study of the stress state of the root joint on an electromagnetic vibration stand findings are obtained which make it possible to estimate the level of nominal alternating stresses arising in the teeth of the blade root. An estimate is made of the bearing capacity of the teeth on the basis of vibration stand fatigue tests, and a condition is given under which the teeth will always be stronger than the blade stem. A.B.K.

A72-39588 # Effect of the slope and curvature of meridional current lines on the long-blade twist in axial turbomachines (Vliianie naklona i krivizny meridiannykh linii toka na zakrutku dlinnykh lopatok osevykh turbomashin). Ia. A. Sirotkin. *Energomashinostroenie*, vol. 18, Apr. 1972, p. 16-19. In Russian.

A72-39589 # Calculation of the tightness of threshold joints of gas turbine engine rotor bearings (Raschet na plotnost' rez'bovykh soedinenii opor rotorov GTD). V. B. Zhukov. *Energomashinostroenie*, vol. 18, Apr. 1972, p. 25-27. 6 refs. In Russian.

Calculation of the effect of various factors on the tightness of pretightened threaded joints of radial bearings of gas turbine engine rotors. It is shown how the internal forces arising in the joints of tightened bearings due to the action of an external axial load, centrifugal forces, and temperature forces can be determined. It is found that the problem reduces to the calculation of the rigidity and strength of slotted, ordinary, and corrugated annular springs. A.B.K.

A72-39597 # *Flow separation at the edges of some types of* tail sections used in supersonic aircraft and in rocket technology (Separatia curentului la bordurile unor tipuri de ampenaje utilizate in aviatia supersonica si in tehnica rachetelor). S. Staicu (Bucuresti, Institutul Politehnic Georghe Gheorghiu-Dej, Bucharest, Rumania). *Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Buletinul*, vol. 34, Mar.-Apr. 1972, p. 59-76. 10 refs. In Rumanian.

Consideration of a supersonic flow around certain tail sections of thin cruciform shape, taking into account flow separation at subsonic leading edges. In the case of a cruciform wing the flow separates from the leading edges in the form of tubes consisting of concentrated nuclei and edge vortex surfaces. It is shown that by approaching the problem indirectly (the delta wing case) the pressure distribution and aerodynamic characteristics for certain types of tail section used in supersonic aircraft and rocket technology can be determined. A.B.K.

A72-39598 # Experimental studies of helicopter aerodynamics (Eksperimental'nye issledovaniia po aerodinamike vertoleta). V. F. Antropov, G. B. Burakov, A. S. D'iachenko, V. R. Lipatov, A. K. Martynov, P. M. Novoselov, and A. V. Stepanov. Moscow, Izdatel'stvo Mashinostroenie, 1972. 239 p. 5 refs. In Russian.

Methods, techniques, and results of model and full-scale studies of helicopter rotors are described. Methods of experimentally determining the angular displacements of the rotor blade root and the elastic strains of the blades in various cross sections are presented, as well as methods of determining aerodynamic forces from pressure measurements on the blade surface, with the aid of a special strain gauge balance element, from measurements of time-averaged lost momenta, and methods of determining the instantaneous values of the inductive velocities in the space in which the rotor spins. Methods of studying the vortex system of the rotor on the basis of velocity pulsations in the wake behind the vortex are considered, as well as methods of calculating the natural frequencies and damping coefficients of the blade vibrations, and methods of calculating simple and crossed rotational derivatives of aerodynamic forces from the angular pitch and roll velocity. A.B.K.

A72-39630 # Effect of ground wind shear on aircraft trailing vortices. D. C. Burnham (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). *AIAA Journal*, vol. 10, Aug. 1972, p. 1114, 1115.

In order to understand the observed asymmetry in vortex height, a self-consistent two-dimensional calculation was made of the vortex motion for a simple model in which all the vorticity of the ground shear layer is concentrated into a series of evenly spaced line vortices at a particular altitude. The model gives a reasonable description of winds at distances larger than the vortex spacing. The phenomenon described pertains to relatively low cross winds. F.R.L.

A72-39631 # Three-dimensional structure and equivalence rule of transonic flows. H. K. Cheng and M. Hafez (Southern California, University, Los Angeles, Calif.). *AIAA Journal*, vol. 10, Aug. 1972, p. 1115-1117. 14 refs. Contract No. N00016-67-A-0269-0021.

The basic structure of three-dimensional transonic flows around configurations having finite (nonvanishing) leading-edge sweep angles is considered. Basic to the study are the parameters characterizing the leading-edge angle of the planform, the configuration thickness ratio, and a degree of asymmetry associated with the lift or the side force. The inner flow region, three domains of the nonlinear outer region, and governing equations of the region are studied. F.R.L.

A72-39740 Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Seminar sponsored by the Flight Safety Foundation. Arlington, Va., Flight Safety Foundation, Inc., 1972. 92 p. $6.00.

The future of business aviation is first examined, NASA safety research is then outlined, and 1971 corporate accident statistics are analyzed. The head-up display is evaluated from the pilot's point of view, nonprecision approaches are reexamined, and a model corporate pilot physical program is described. Attention is given to altitude awareness and cockpit discipline, safety in commuter airline operation, visual simulation, the future of R-NAV in corporate operations, and some aspects of aircraft accident investigation.

Individual items are abstracted in this issue. F.R.L.

A72-39741 # Getting ready today for tomorrow. E. T. Peabody (General Motors Corp., Detroit, Mich.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 1-7.

The future of business aviation is examined, with reference to duties of pilots, their training, and aspects of reliability. It is suggested that trained engineering personnel look at the factors affecting reliability. Furthermore, the aircraft must be suitably chosen. The importance of crew scheduling is emphasized. A chief pilot must learn the language of his company, be budget-conscious, and be engineering- and sales-conscious. F.R.L.

A72-39742 # NASA safety research. J. Lederer (Flight Safety Foundation, Inc., Arlington, Va.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 8-12.

Review of several of the NASA R & D projects that affect safety, among which fire research is very prominent. Noncombustible and fire-resistant materials approved by NASA for use in space operations in a 100% oxygen environment are discussed. Another development now in the research stage is a system for detecting a fire long before conventional temperature probes would provide a warning. An outgassing technique is used. Methods of dealing with lightning and static are considered. Attention is given to problems of steep approaches, wakes, fog, and visibility. F.R.L.

A72-39743 # 1971 corporate accident statistics. C. A. McKinnon (Flight Safety Foundation, Inc., Arlington, Va.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 13-17.

Preliminary data are given which provide information on corporate/executive aviation performance, indicating areas where greater emphasis must be placed if the record is to be improved. Improved altitude awareness procedures and installation of vertical flight references, such as glide slope and VASI (visual approach slope indicator) should help. It is also urgent to improve instrument approach procedures to permit straight-in approach to runways suitable for corporate jet landings. F.R.L.

A72-39744 # **Head Up Display - A pilot's evaluation.** R. L. Therrien. In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 18-27. 11 refs.

The McDonnell-Douglas Head-Up Display (HUD) was informally evaluated in a Fan-Jet Falcon. The system was placed in an operational environment and flown in various weather conditions. The HUD system consists of a cathode ray tube projection device mounted over the pilot's head, a combiner glass mounted on the glare shield in front of the pilot, and a deflection unit and a display computer unit. The behavior of the HUD in taxiing, take-off, climb, cruise, descent, and approach are described. In general, when the HUD is further refined, it should be an important development that will materially reduce the hazards inherent in the low-visibility and landing phases of flight. F.R.L.

A72-39745 # **Another look at non-precision approaches.** E. B. Perry (Flight Safety Foundation, Inc., Arlington, Va.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 28-36.

The nonprecision approach, which provides no vertical information to the pilot, who must arrive at a position in space from which he can see the runway and safely complete the approach with only his altimeter and vision to assist him, is discussed. Various possible altimetry errors that have resulted in aircraft accidents under adverse weather conditions are considered. Crew coordination is vital during a nonprecision approach. Equipment of each facility used by corporate jets with distance measuring equipment (DME) is advocated so that continuous fix information is available. In addition, each runway should be equipped with a visual approach slope indicator for guidance after the runway environment becomes visible. F.R.L.

A72-39747 # **Altitude awareness and cockpit discipline.** M. E. Volz (United Air Lines, Inc., Chicago, Ill.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 45-50.

Altimeter development from the single-hand, single-revolution type, to sensitive altimeters, and to instruments available in various combinations of counters, drums, and pointers is reviewed, and the characteristics of the various types are discussed. Many radar altitude displays use the tape system, which is easily set, easily read, and exhibits reliability factor equal to that of circular displays. New altitude-alert systems provide aural as well as visual warning of altitude. However, in order to benefit from advanced systems of altimetry, self-discipline on the part of the pilots is essential. This includes not only effective monitoring of the instruments, but calling out the altitudes passed through on descent. F.R.L.

A72-39748 # **Safety in commuter airline operation.** C. A. McKinnon (Flight Safety Foundation, Inc., Arlington, Va.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 51-57.

Following a brief review of the history of so-called 'third-level carriers,' factors that affect their safety are examined. Although regulated by the CAB, commuter airlines are not all equal, and must be considered on an individual basis. Regulations allow their pilots to fly more hours than is the case with trunk and regional carriers. In general, the level of competence and experience of first pilots of commuter airlines is far above minimum requirements. Some commuter lines lack the experience and/or the funds to operate above the mere regulatory requirements. F.R.L

A72-39750 # **The future of R-NAV in corporate operations.** L. Boyd (Tennessee Eastman Co., Tenn.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 64-76.

It is suggested that area navigation (R-NAV) can be a better way of expediting the movement of large amounts of air traffic by reducing the corridor effect of the present airway route pattern. Various systems now in use or projected, such as inertial navigation systems, and R-NAV based on VOR/DME inputs are described and evaluated. Better use of R-NAV equipment and R-NAV routes can generally be made when the approach and enroute air traffic controllers are familiar with its capabilities. An R-NAV approach is a good tool for noise abatement as it is relatively easy to maintain a 3-deg glideslope by descending 300 ft/n mi remaining to go. F.R.L.

A72-39751 # **What the corporate pilot should know about aircraft accident investigation.** E. V. Nelmes (U.S. Department of Transportation, Washington, D.C.). In: Annual Corporate Aircraft Safety Seminar, 17th, Washington, D.C., April 17, 18, 1972, Proceedings. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 77-84.

The corporate pilot needs extensive knowledge of aircraft accident investigation procedures in order actively to be able to assist the Investigator-in-Charge. The pilot can provide expertise to one or more of the groups involved, e.g., operators, manufacturers, air traffic control, human factors, witnesses, etc. Three examples of accidents where in-depth investigations were carried out are cited. The essential purpose of the investigations is to determine what happened rather than to assess blame. F.R.L.

A72-39768 **Avionics packaging and the new demands.** H. W. Markstein. *Electronic Packaging and Production,* vol. 12, Aug. 1972, p. 52, 54-56, 58.

Review of some of the weight-saving, vibration-proofing, and heat-dissipating techniques used in avionics packaging. The electronic multiplexing packaging system proposed for the B-1 bomber is shown to make possible weight savings corresponding to the elimination of 33 miles of wire. To ruggedize the design and provide heat transfer, this system involves an assembly of two circuit boards attached back to back on supporting rails. Rack-mounted and 'egg-crate' packaging techniques are also discussed. M.V.E.

A72-39801 # **Influence of the structural format on the range of critical rotational speeds of rotors in aircraft engines (O wplywie formy konstrukcyjnej na zakresy krytycznych predkosci obrotowych wirnikow silnikow lotniczych).** S. Szczecinski. *Technika Lotnicza i Astronautyczna,* vol. 27, July 1972, p. 9-13. 12 refs. In Polish.

A72-39802 # **Vibrational shot peening as a method of increasing the fatigue strength of critical aircraft elements (Wibracyjne kulowanie jako metoda zwiekszenia wytrzymalosci zmeczeniowej odpowiedzialnych czesci lotniczych).** J. Jonczyk. *Technika Lotnicza i Astronautyczna,* vol. 27, July 1972, p. 17-19. 5 refs. In Polish.

A72-39803 # **Aircraft noise as a problem for contemporary civil aviation (Halas lotniczy problemem wspolczesnego lotnictwa cywilnego).** H. Ostromecki (International Civil Aviation Organization, Montreal, Canada). *Technika Lotnicza i Astronautyczna,* vol. 27, July 1972, p. 20-22. In Polish.

The reduction of objectionable aircraft noise levels and the enforcement of noise standards are discussed from the viewpoint of problems encountered in measurement and definition of noise. Acoustic pressure levels, sound intensity levels, and noise annoyance measures are explained on the basis of fundamental concepts in acoustics. Noise units and norms employed in civil aviation are described. T.M.

A72-39818 **Can Concorde make a profit.** P. G. Masefield. *Flight International,* vol. 102, Aug. 10, 1972, p. 214-216.

Cost comparisons are made between the Concorde, the 707, and

the 747. Because of its speed and relatively small size, Concorde offers relatively low costs per aircraft mile, but relatively high costs per seat mile. The operating costs of Concorde are likely to be such that it will be able to make profits in competition with subsonic transports at existing fares on medium to long sectors. F.R.L.

A72-39819 Quiet propulsion. M. J. T. Smith (Rolls-Royce, Ltd., Derby, England). *Flight International*, vol. 102, Aug. 17, 1972, p. 241-246.

Quieter engines than those at present in use are essential if V/STOL and reduced takeoff and landing (RTOL) forms of aircraft operation are to become a reality in the vicinity of populated areas. Turbomachinery sources are responsible for the majority of the noise output. Some particulars of the Rolls-Royce RB.211 engine, installed in the Lockheed TriStar, the quietest of certificated aircraft, are given. A notable feature of new engines is the use of acoustically absorbent liners which make it possible to attack noise sources within the engine itself. Fan, turbine, and tailpipe noise, and the noise of the jet itself are examined. F.R.L.

A72-39846 Aerodynamics at NPL, 1917-1970. R. C. Pankhurst. *Nature*, vol. 238, Aug. 18, 1972, p. 375-380. 22 refs.

Aerodynamics studies conducted by the National Physical Laboratory Aerodynamics Division during this period are discussed in a decade-by-decade progress review. Some details are given on swept wings, 'peaky' aerofoils, industrial aerodynamics tests, and the development of shock tubes and wind tunnels. V.Z.

A72-39902 # Optimization of the wing parameters of a glider hovercraft (Optimizatsiia parametrov kryla planera-paritelia). R. N. Akhmadulin. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 5-13. In Russian.

A method is proposed for calculating the parameters of a glider wing of prescribed span for which the induced drag coefficient is minimum both in corkscrew flight in thermal upcurrents and during transition from one upcurrent to another. It is assumed that the upcurrent is symmetric, that slip is absent, that the axes of the corkscrew and the upcurrent are vertical and coincide, and that the flight is steady in each case. The nonuniformity of the upcurrent's velocity field is taken into account. V.P.

A72-39903 # Optimization of discontinuous systems with random parameters (Ob optimizatsii razryvnykh sistem so sluchainymi parametrami). V. N. Kurshev. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 14-22. In Russian.

Theoretical analysis of the optimization of a sequence of controlled plants whose behavior is described by a system of partial differential equations with random parameters. The results are applied to the optimization of the pneumohydraulic system of a liquid-fuel jet engine in terms of minimum fuel pressure fluctuations at the combustion chamber inlet. V.Z.

A72-39904 # Uniformly exact solution of the problem of the flow past a slender profile (O ravnomerno tochnom reshenii zadachi obtekaniia tonkogo profilia). N. M. Monakhov. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 23-29. In Russian.

A72-39907 # Application of the finite element method to torsional flutter analysis on an analog computer (Primenenie metoda konechnykh elementov dlia issledovaniia izgibno-krutil'nogo flattera na analogovoi vychislitel'noi mashine). V. P. Kandidov and S. A. Khristochevskii. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 43-50. 12 refs. In Russian.

A72-39913 # Optimal arrangement of conical nozzles in a segment of a partial supersonic turbine stage (Ob optimal'nom raspolozhenii konicheskikh sopel v segmente partsial'noi sverkhzvukovoi turbinnoi stupeni). A. G. Kurzon, Iu. I. Mitiushkin, E. I. Iusupov, and B. G. Sokolov. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 87-94. 9 refs. In Russian.

A72-39916 # Aircraft engine lifetime and turbine blade reliability (Resurs aviatsionnykh dvigatelei i nadezhnost' lopatok turbiny). G. P. Pimenova. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 109-114. In Russian.

Reliability tests were carried out on ZhS6KP-alloy turbine blades of gas turbine jet engines of a less advanced and a more advanced type, after 300 to 9000 hr in operation. The surface and core blade-material microhardness and microstructure were examined for damage and the blades were tested for high temperature strength. Some structural changes were observed in blade core microstructures of the more advanced engine type after high-temperature operations of up to 9000 hr. V.Z.

A72-39922 # Steady combustion limits in afterburner gas turbine engine chambers (K voprosu o predelakh ustoichivogo goreniia v forsazhnykh kamerakh sgoraniia GTD). E. L. Solokhin and V. A. Mironenko. *Aviatsionnaia Tekhnika*, vol. 15, no. 1, 1972, p. 135-141. 5 refs. In Russian.

A semiempirical theory of steady combustion limits proposed by Mironenko (1966) for combustion chambers with a flame stabilizer is extended to chambers with afterburners. Expressions are given to determine the steady combustion range characteristics for the latter. Tables are compiled and diagrams are plotted to facilitate the selection of needed steady combustion conditions. V.Z.

A72-39930 Materials for the operation of supersonic aircraft (Betriebsstoffe für Überschallflugzeuge). R. Erlmeier and E. Jantzen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugtreib- und Schmierstoffe, Munich, West Germany). *DFVLR-Nachrichten*, Aug. 1972, p. 287-290. In German.

Aerodynamic heating effects at velocities in the range with Mach numbers from 2 to 3 raise the fuel temperatures in the tanks of the aircraft to temperatures from 85 to 120 C after three hours of supersonic flight. Conventional fuels of the type Jet-A can be used for commercial supersonic aircraft at velocities with Mach numbers up to 2.7. Thermally stable fuels with special characteristics are used for military aircraft with speeds involving Mach numbers greater than 2. The requirements for fuels, lubricating oils, and hydraulic fluids for aircraft operating in the supersonic range are discussed together with questions of economics and product availability. G.R.

A72-39931 New computation of the supersonic boom (Neue Berechnung des Überschallknalls). Y. C. Sun (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für theoretische Gasdynamik, Aachen, West Germany). *DFVLR-Nachrichten*, Aug. 1972, p. 290, 291. In German.

Pressure variations caused by conventional supersonic aircraft in the aircraft environment are examined. The disturbances pass an observer on the ground with the velocity of the aircraft. Present methods of calculation of the boom are based on a theory developed by Whitham (1952). Certain features of the theory involving the substitution of a wing by a body with rotational symmetry are critically examined. It could be shown with the aid of a computer that such a substitution in the calculation of the boom is generally not permissible. G.R.

A72-39934 Test of direct lift control in the ease of the experimental aircraft DFVLR-HFB 320 (Erprobung der direkten Auftriebssteuerung beim Versuchsflugzeug DFVLR-HFB 320). D. Hanke (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugmechanik, Braunschweig, West Germany). *DFVLR-Nachrichten*, Aug. 1972, p. 297-300. In German.

Direct lift control (DLC) is a control aid in the center of gravity of the aircraft which without great moment changes can produce almost instantaneously positive or negative lift. A number of approaches can be used for producing the lift, including trailing edge

flaps, spoilers, or air jets. Differences in a course change undertaken by conventional control and by DLC at the approach are discussed together with a flap control system, and a number of simulation results concerning various DLC concepts. G.R.

A72-40051 # Advanced technology applications to present and future transport aircraft. R. E. Black and D. G. Murphy (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-759.* 22 p. Members, $1.50; nonmembers, $2.00.

The need for continuing advances in aircraft technology is discussed in a context of cost and low-noise requirements. The costs of applying recent technology advances for noise reduction in the first jet aircraft generation are analyzed. Further technology advances are shown to be necessary to offset the effects of inflation, low-noise requirements and congestion, and to meet the design challenges of future large aircraft. The topics also include aircraft types of the future transport market, the size and range of future subsonic passenger transports, and the ticket surcharge and time/cost saving of the first generation of supersonic transport aircraft. V.Z.

A72-40052 # Use of fixed and moving base flight simulators for the aerodynamic design and development of the S-3A airplane. C. F. Anderson and B. T. Averett (Lockheed-California Co., Burbank, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-764.* 14 p. Members, $1.50; nonmembers, $2.00.

Simulation tests carried out during the design, development and early flight test phases of the S-3A aircraft are reviewed, covering the evaluation of the flight performance and flight control and automatic control system of the aircraft. A brief description of the simulation facilities and equipment of LTV and Lockheed Company is given. The subjects include a spoiler modification for improved roll control, modified ailerons, heading control and turn coordinator, longitudinal control system, approach power compensator, and pilot training procedures with potentially hazardous flight tests. V.Z.

A72-40053 # Development of an inflatable fabric structure for the early stabilization of the B-1 crew escape capsule. B. A. Johnson and G. L. Faurote (Goodyear Aerospace Corp., Akron, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-801.* 8 p. Members, $1.50; nonmembers, $2.00. Contract No. F33657-70-C-0800.

An inflatable fabric stabilization system is being developed by Goodyear Aerospace Corporation to provide early stabilization of the B-1 crew module during the brief period between module separation and deployment of the drogue parachute. The fabric structure will be inflated within 50 milliseconds by inflation gases approaching 1500 F, can withstand aerodynamic surface loadings up to 24.6 psi, and can contain integral pressures up to 275 psia. These structures, fabricated from a newly developed fiber having a tensile strength of 400,000 psi, permit higher load-carrying capability coupled with smaller stowage volumes and lower system weights than equivalent metal structures. (Author)

A72-40054 * # Analyses and tests confirm design of proprotor aircraft. H. K. Edenborough, T. M. Gaffey (Bell Helicopter Co., Fort Worth, Tex.), and J. A. Weiberg (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-803.* 14 p. Members, $1.50; nonmembers, $2.00.

Discussion of the design features of a 300-knot tilt-proprotor VTOL aircraft having proprotors 25 ft in diameter, an empty weight of 7390 pounds, a maximum VTOL gross weight of 12,400 pounds, and a design dive speed of 300 knots. Proprotor stability analysis covering aeroelastic stability characteristics and flight mode stability characteristics is included. An evaluation of the proprotor design is made on the basis of aerodynamic and aeroelastic model tests and full-scale performance tests. The test results and other obtained research data suggest the readiness of this aircraft design for construction and flight tests. V.Z.

A72-40055 # STOL performance criteria for military transport aircraft. F. J. Davenport, D. J. Selvig, A. E. Rengstorff (Boeing Co., Seattle, Wash.), and G. S. Oates (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-806.* 10 p. 6 refs. Members, $1.50; nonmembers, $2.00. Contracts No. F33615-71-C-1757; No. F33615-71-C-1880.

New ground rules for determining short takeoff and landing field length performance are proposed. They are needed because current rules give no credit for powered lift and the next generation of tactical transports will depend on powered lift to achieve short field lengths. They cover both 'normal' operation and 'assault' operation, in which the possibility of engine failure is disregarded. Military and commercial STOL criteria are compared and discussed from both the designer's and the pilot's point of view. The effects of STOL rules on design characteristics of aircraft using several different powered lift concepts, but having equivalent field length capability, are analyzed and discussed. (Author)

A72-40056 * # Advanced technology transport configuration. B. Williams (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-756.* 14 p. 6 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10703.

Consideration of the compromises involved in advanced transport aircraft designs for Mach numbers approaching 1.0, to develop an environmentally acceptable and economically viable commercial transport. The impact of configuration constraints on a baseline aircraft is discussed, and details are given on the development of the aircraft from a wind tunnel model. The subjects covered also include the configuration cycle, aerodynamic and configuration concepts, full-scale aircraft characteristics, and an alternate aircraft configuration. V.Z.

A72-40057 # Microwave landing system effect on the flight guidance and control system. J. L. Foster (Collins Radio Co., Cedar Rapids, Iowa). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test, and Operations Meeting, 4th, Los Angeles, Calif., Aug. 7-9, 1972, Paper 72-755.* 22 p. 5 refs. Members, $1.50; nonmembers, $2.00.

The microwave landing system (MLS) is described as a replacement for the existing instrument landing system (ILS). The new system offers wide angle azimuth and elevation coverage and precision range information that will appreciably affect navigation, guidance, and control in the terminal area. Discussed are operational benefits to be obtained from the MLS, such as curved path guidance, and some of the design problems and challenges that must be tackled before the system can be used to its full capacity. Impact of the MLS on automatic flight control is described with emphasis on Category III landings. Pilot interface impact is also covered. (Author)

A72-40059 * # Flight-test experience in digital control of a remotely piloted vehicle. J. W. Edwards (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-883.* 16 p. Members, $1.50; nonmembers, $2.00.

The development of a remotely piloted vehicle system consisting of a remote pilot cockpit and a ground-based digital computer coupled to the aircraft through telemetry data links is described. The

feedback control laws are implemented in a FORTRAN program. Flight-test experience involving high feedback gain limits for attitude and attitude rate feedback variables, filtering of sampled data, and system operation during intermittent telemetry data link loss is discussed. Comparisons of closed-loop flight tests with analytical calculations, and pilot comments on system operation are included. (Author)

A72-40060 * # **Design and flight experience with a digital fly-by-wire control system using Apollo guidance system hardware on an F-8 aircraft.** D. A. Deets and K. J. Szalai (NASA, Flight Research Center, Systems Analysis Branch, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-881.* 13 p. Members, $1.50; nonmembers, $2.00.

This paper discusses the design and initial flight tests of the first digital fly-by-wire system to be flown in an aircraft. The system, which used components from the Apollo guidance system, was installed in an F-8 aircraft. A lunar module guidance computer is the central element in the three-axis, single-channel, multimode, digital, primary control system. An electrohydraulic triplex system providing unaugmented control of the F-8 aircraft is the only backup to the digital system. Emphasis is placed on the digital system in its role as a control augmentor, a logic processor, and a failure detector. A sampled-data design synthesis example is included to demonstrate the role of various analytical and simulation methods. The use of a digital system to implement conventional control laws was shown to be practical for flight. Logic functions coded as an integral part of the control laws were found to be advantageous. Verification of software required an extensive effort, but confidence in the software was achieved. Initial flight results showed highly successful system operation, although quantization of pilot's stick and trim were areas of minor concern from the piloting standpoint. (Author)

A72-40062 # **Unique features of the B-1 flight control systems.** J. E. Campbell (North American Rockwell Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Stanford, Calif., Aug. 14-16, 1972, Paper 72-872.* 10 p. Members, $1.50; nonmembers, $2.00.

Discussion of the flight control systems designed to enhance the safety, the mission success capability, and the survivability and vulnerability characteristics of the B-1 long range strategic bomber. The design features covered include mechanical controls with redundant augmentation for the roll, pitch and yaw axes, rotary actuators, stick disconnects, dual mechanical linkage, and feel elements. A detailed description is also given for the electrical spoiler control and fail-operational trim controls of the craft. V.Z.

A72-40067 # **Visualization study of flow near the trailing edge of an oscillating airfoil.** H. Ohashi (Tokyo, University, Tokyo, Japan) and N. Ishikawa (Toyota Motor Co., Ltd., Japan). *Japan Society of Mechanical Engineers, Journal,* vol. 15, July 1972, p. 840-847.

STAR ENTRIES

N72-27994*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN PROGRAM FOR CALCULATING TOTAL EFFICIENCY - SPECIFIC SPEED CHARACTERISTICS OF CENTRIFUGAL COMPRESSORS
Michael R. Galvas Washington Jul. 1972 45 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland, Ohio
(NASA-TM-X-2594; E-6884) Avail: NTIS HC $3.00 CSCL 12D

A computer program for predicting design point specific speed - efficiency characteristics of centrifugal compressors is presented with instructions for its use. The method permits rapid selection of compressor geometry that yields maximum total efficiency for a particular application. A numerical example is included to demonstrate the selection procedure. Author

N72-27995*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND TUNNEL INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF SCALE MODELS OF THREE RECTANGULAR SHAPED CARGO CONTAINERS
Georgene H. Laub and Hifu M. Kodani Jul. 1972 93 p Sponsored in part by AAMRDL
(NASA-TM-X-62169) Avail: NTIS HC $6.75 CSCL 01A

Wind tunnel tests were conducted on scale models of three rectangular shaped cargo containers to determine the aerodynamic characteristics of these typical externally-suspended helicopter cargo configurations. Tests were made over a large range of pitch and yaw attitudes at a nominal Reynolds number per unit length of 1.8 x one million. The aerodynamic data obtained from the tests are presented. Author

N72-27998*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LOW SPEED AERODYNAMIC CHARACTERISTICS OF A LARGE SCALE MODEL WITH A THIN, HIGHLY SWEPT, 2.67 ASPECT RATIO WING HAVING A CRANKED LEADING EDGE
Demo J. Giulianetti and Ralph L. Maki Washington Aug. 1972 44 p refs
(NASA-TN-D-6919; A-3893) Avail: NTIS HC $3.00 CSCL 01A

The low speed aerodynamic characteristics of a large-scale model intended to represent advanced fixed-wing fighters have been investigated in the Ames 40 by 80 foot wind tunnel. The model possessed positive static longitudinal stability to nearly 28 deg angle of attack, the maximum tested, both with and without leading-edge flaps deflected. Lateral control with differentially deflected ailerons and a right wing spoiler simultaneously deployed as combined controls was only slightly greater than that with the differentially deflected ailerons deployed as a separate control without the spoiler. Measured lift and drag were in close agreement with that predicted by theory to about 14 deg angle of attack, including the prediction of lift due to 30 deg of trailing edge flap deflection. Estimated takeoff performance of an aircraft 4/3 the scale of the test model showed takeoff distances of less than 2000 ft. Author

N72-27999*# Rochester Applied Science Associates, Inc., N.Y.
BLADE FREQUENCY PROGRAM FOR NONUNIFORM HELICOPTER ROTORS, WITH AUTOMATED FREQUENCY SEARCH Informal Final Report
S. Gene Sadler [1972] 135 p refs
(Contract NAS1-11216)
(NASA-CR-112071; RASA-72-01) Avail: NTIS HC $8.75 CSCL 01B

A computer program for determining the natural frequencies and normal modes of a lumped parameter model of a rotating, twisted beam, with nonuniform mass and elastic properties was developed. The program is used to solve the conditions existing in a helicopter rotor where the outboard end of the rotor has zero forces and moments. Three frequency search methods have been implemented. Including an automatic search technique, which allows the program to find up to the fifteen lowest natural frequencies without the necessity for input estimates of these frequencies. Author

N72-28000*# Techtran Corp., Glen Burnie, Md.
DYNAMIC TESTING OF HELICOPTER COMPONENTS
H. Schumacher Washington NASA May 1972 29 p Transl. into ENGLISH from Helicopter Fatigue Testing, Proc. of the DGLR Symp. on Helicopters and Propellers Stuttgart, DGLR, Dec. 1970 p 97-123 Conf. held in Immenstaad, West Ger., 24 Jun. 1969
(Contract NASw-2037)
(NASA-TT-F-14282) Avail: NTIS HC $3.50 CSCL 01B

The importance of dynamic component testing for the development of helicopters is presented. Using the development of the BO 105 as an example, the test planning and execution used demonstrate the multiplicity and range of the test purposes. Various tests are presented in a series of figures for clarification. Author

N72-28001*# Techtran Corp., Glen Burnie, Md.
STRUCTURAL STABILITY CONSIDERATIONS IN THE ROTOR SYSTEM OF THE HOT GAS JET HELICOPTER DO 132
L. Brenner Washington NASA Jun. 1972 23 p refs Transl. into ENGLISH from Helicopter Fatigue Testing, Proc. of the DGLR Symp. on Helicopters and Propellers Stuttgart, DGLR, Dec. 1970 p 77-96, 177 Conf. held in Immenstaad, West Ger., 24 Jun. 1969
(Contract NASw-2037)
(NASA-TT-F-14281) Avail: NTIS HC $3.25 CSCL 01B

The rotor system of a hot gas-jet helicopter is examined from the standpoint of resistance to vibration and stress on the structured system of the blades. The following subjects are discussed: (1) technical structural data of the helicopter, (2) construction of the rotor system, (3) principles of measurement for the structural stability of the rotor system, and (4) the operating test plan for the test blade. Engineering drawings of the helicopter systems and stress diagrams resulting from the tests are included. Author

N72-28002*# Hughes Tool Co., Culver City, Calif. Aircraft Div.
A PERFORMANCE APPLICATION STUDY OF A JET-FLAP HELICOPTER ROTOR
R. J. Sullivan, Sally LaForge, and Barry W. Holchin Washington NASA May 1972 96 p refs
(Contract NAS1-10365)
(NASA-CR-112030) Avail: NTIS HC $7.00 CSCL 01B

A performance study was made of the application of a jet-flap to a reaction-drive rotor for a heavy-lift helicopter mission and for a high-speed-helicopter maneuverability (200 knots, 2g) mission. The results of the study are as follows: As a result of the increase in maximum airfoil lift coefficient achieved by the jet-flap, rotor solidity is reduced with the jet-flap to approximately 59% of a nonjet-flap rotor. As a result of the saving in rotor solidity, and hence in rotor weight, the jet-flap configuration had a 21% higher productivity than a nonjet-flap configuration. Of the three propulsion systems studied utilizing a jet-flap (hot cycle, warm cycle, cold cycle) the hot cycle gave the largest increase in productivity. The 200 knot 2g mission is performed best with a warm cycle propulsion system. The jet-flap permits designing for a rotor blade loading coefficient C sub T/sigma = .170 at 2g without encountering blade stall. The jet-flap rotor permits a 200 knot 2g maneuver without suffering the penalty of an unreasonable rotor solidity that would be required by a nonjet-flap rotor.

Author

N72-28003*# Lockheed-Georgia Co., Marietta. Advanced Transport Technology.

STUDY OF THE APPLICATION OF ADVANCED TECHNOLOGIES TO LONG-RANGE TRANSPORT AIRCRAFT. VOLUME 2: RESEARCH AND DEVELOPMENT REQUIREMENTS Final Technical Report

R. H. Lange, R. F. Sturgeon, W. E. Adams, E. S. Bradley, J. F. Cahill, R. R. Eudaily, J. P. Hancock, and J. W. Moore [1972] 70 p refs

(Contract NAS1-10701)

(NASA-CR-112089) Avail: NTIS HC $5.50 CSCL 01B

Investigations were conducted to evaluate the relative benefits attainable through the exploitation of advanced technologies and to identify future research and development efforts required to permit the application of selected technologies to transport aircraft entering commercial operation in 1985. Results show that technology advances, particularly in the areas of composite materials, supercritical aerodynamics, and active control systems, will permit the development of long-range, high-payload commercial transports operating at high-subsonic speeds with direct operating costs lower than those of current aircraft. These advanced transports also achieve lower noise levels and lower engine pollutant emissions than current transports. Research and development efforts, including analytical investigations, laboratory test programs, and flight test programs, are required in essentially all technology areas to achieve the potential technology benefits. Author

N72-28004# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

ON A PYROTECHNIC-BALLISTICAL DEPLOYMENT AID FOR PARACHUTES

R. Oliva 1972 40 p refs In GERMAN; ENGLISH summary

(DLR-Mitt-72-07) Avail: NTIS HC $4.00; DFVLR Porz-Wahn: 12.50 DM

The construction and function of a pyrotechnic-ballistical device for parachute deployment are described. Instructions for installation are provided. It is stated that tests have shown a reduction in filling time of approximately 40 percent. Author

N72-28005# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.

AIRCRAFT NOISE STANDARDS AND REGULATIONS

Joseph K. Power Apr. 1971 73 p refs Presented at Tenn. Univ. Space Inst., 15-20 Mar. 1971 and at Tech. Univ. of Aachen, West Germany, 29 Mar. - 3 Apr. 1971

(FAA-RD-71-24) Avail: NTIS HC $5.75

Public laws and Federal Air Regulations concerning aircraft noise are examined. Noise exposure forecasts and various systems for rating aircraft noise world-wide are presented. Noise certification and aircraft retrofit regulations are discussed. Aircraft operational procedures to reduce noise are described. Author

N72-28006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AIRCRAFT TIRE BEHAVIOR DURING HIGH-SPEED OPERATIONS IN SOIL

Tafford J. W. Leland and Eunice G. Smith Washington Aug. 1972 62 p refs

(NASA-TN-D-6813; L-7641) Avail: NTIS HC $3.00 CSCL 01B

An investigation to determine aircraft tire behavior and operating problems in soil of different characteristics was conducted at the Langley landing-loads track with a 29 x 110.0-10, 8-ply-rating, type 3 tire. Four clay test beds of different moisture content and one sand test bed were used to explore the effects on axle drag loads developed during operation at different tire inflation pressures in free rolling, locked-wheel braking, and yawed (cornering) modes, all at forward speeds up to 95 knots. The test results indicated a complicated drag-load--velocity relationship, with a peak in the drag-load curve occurring near 40 knots for most test conditions. The magnitude of this peak was found to vary with tire inflation pressure and soil character and, in certain cases, might prove large enough to make take-off hazardous. Author

N72-28007*# Boeing Co., Seattle, Wash. Commercial Airplane Group.

DESIGN INTEGRATION AND NOISE STUDIES FOR JET STOL AIRCRAFT. VOLUME 1: PROGRAM SUMMARY Final Report

V. O. OKeefe and G. S. Kelley May 1972 56 p Original contains color illustrations

(Contract NAS2-6344)

(NASA-CR-114471; D6-40552-1-Vol-1) Avail: NTIS HC $5.00 CSCL 01B

This program was undertaken to develop, through analysis, design, experimental static testing, wind tunnel testing, and design integration studies, an augmentor wing jet flap configuration for a jet STOL transport aircraft having maximum propulsion and aerodynamic performance with minimum noise generation. The program had three basic elements: (1) static testing of a scale wing section to demonstrate augmentor performance and noise characteristics; (2) two-dimensional wind tunnel testing to determine flight speed effects on performance; and (3) system design and evaluation which integrated the augmentor information obtained into a complete system and ensured that the design was compatible with the requirements for a large STOL transport having a 500-ft sideline noise of 95 PNdB or less. This objective has been achieved: Author

N72-28008*# Scientific Translation Service, Santa Barbara, Calif.

IN A MODERN PLANE

V. S. Frolov Washington NASA Jul. 1972 43 p Transl. into ENGLISH of the book "V Sovremennom Samolete" Moscow, Znaniye Press, 1971

(Contract NASw-2035)

(NASA-TT-F-14351) Avail: NTIS HC $4.25 CSCL 01C

The problems encountered by pilots of jet aircraft under various conditions of flight are discussed. The application of engineering psychology to solve difficulties encountered in jet aircraft flight is discussed. The devices available in the scientific organizations are described. Information is included on the biomechanics of the human organisms. The predicted configuration of cockpits of the future is analyzed. Author

N72-28009*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WIND TUNNEL INVESTIGATION OF A LARGE SCALE 35 DEG SWEPT WING JET TRANSPORT MODEL WITH AN EXTERNAL BLOWING TRIPLE SLOTTED FLAP

Kiyoshi Aoyagi, Leo P. Hall, and Michael D. Falarski Washington Jul. 1972 75 p refs Sponsored in part by AARDL

(NASA-TM-X-2600; A-3753) Avail: NTIS HC $3.00 CSCL 01B

An investigation was conducted to determine the aerodynamic characteristics of a large-scale subsonic jet transport model with an externally jet-augmented flap system that would augment lift and provide direct-lift control. The model had a 35 deg swept wing of aspect ratio 7.82 and two side-by-side engines mounted on a single pylon under each wing close to the fuselage. The lift of the flap system was augmented by jet engine exhaust impingement on the triple-slotted flap surfaces. The rearmost flap provided direct lift control. Results were obtained for several combinations of flap deflections at gross thrust coefficients from 0 to 2.0. Three-component longitudinal data are presented with four engines operating. Limited longitudinal and lateral data are presented for asymmetric and symmetric thrust conditions with three engines operating. For the same overall flap deflection, lift coefficient and maximum lift coefficient were improved 13 and 7 percent compared to coefficients obtained with a double-slotted flap configuration. A maximum lift coefficient of 6.3 was obtained at a gross thrust coefficient of 2.0. At the same flap deflection lateral and directional trim moment requirements with an engine inoperative were reduced 55 and 33 percent, respectively, compared to those with the engines located farther outboard on the wing. Trim moment requirements in pitch were also reduced significantly. However, pitching-moment instability occurred and increased with gross thrust coefficient. Author

N72-28010*# Hydrospace Research Corp., San Diego, Calif.

NOISE MEASUREMENTS OBTAINED DURING VISUAL APPROACH MONITOR EVALUATION IN 747 AIRCRAFT

Carole S. Tanner and Ray E. Glass May 1972 27 p refs (Contract NAS2-6490)

(NASA-CR-114478; HRC-TR-S-213) Avail: NTIS HC $3.50 CSCL 01B

The results are reported of acoustic measurements made on the 747 aircraft during visual approach monitor evaluation approaches. This display is designed to improve approach and landing precision under visual flight rule conditions. The purpose of the acoustic portion of the test was to measure, evaluate, and identify the noise levels during various types of aircraft approaches. Six noise measurement sites were positioned on the centerline of the approach ground track. The six noise measurement stations on the approach ground track were positioned between approximately 1 and 6 nautical miles from runway threshold. The 1-nautical mile point was chosen as the beginning of the ground track because it is specified as the approach measurement point in the FAA noise certification requirements. The 6-nautical mile point was chosen for its proximity to the point where the approach is initiated. Author

N72-28011*# Techtran Corp., Glen Burnie, Md.

FLIGHT PECULIARITIES OF AIRCRAFT IN THE ATMOSPHERES OF PLANETS

G. M. Moskalenko Washington NASA Aug. 1972 16 p refs Transl. into ENGLISH of "O Nekotorykh Osobennostyakh Poleta Letatelnykh App. v Atmosfere Planet" Rept. PR-84 Inst. for Space Res., Acad. Sci. USSR, Moscow, 1971 22 p (Contract NASw-2037)

(NASA-TT-F-14344; PR-84) Avail: NTIS HC $3.00 CSCL 01B

Certain questions of flight dynamics of aircraft in the atmospheres of planets are considered. The equations of dynamics of an aerostatic aircraft and their solutions for cases of motion with and without lift and drag are included. It is shown that in certain cases there is a trajectory-parametric analogy between aerostatic and aerospace vehicles. Author

N72-28012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF A LARGE-SCALE LIFT-ENGINE FIGHTER MODEL WITH EXTERNAL SWIVELING LIFT-ENGINES

Jerry P. Barrack and Jerry V. Kirk Jul. 1972 101 p refs

(NASA-TM-X-62167) Avail: NTIS HC $7.25 CSCL 01B

The aerodynamic characteristics of a six-engine (four lift, two lift-cruise) lift-engine model obtained in the Ames 40- by 80-foot wind tunnel are presented. The model was an approximate one-half scale representation of a lift-engine VTOL fighter aircraft with a variable-sweep wing. The four lift-engines were housed in the aft fuselage with the inlets located above the wing. Longitudinal and lateral-directional force and moment data are presented for a range of exhaust gas momentum ratios (thrust coefficients). Wind tunnel forward speed was varied from 0 to 140 knots corresponding to a maximum Reynolds number of 6.7 million. The data are presented without analysis. Author

N72-28013# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

ENVIRONMENTAL STUDIES: AVIATION NOISE EVALUATIONS AND PROJECTIONS, SAN FRANCISCO BAY REGION

Aug. 1971 139 p refs Sponsored by HUD

Avail: NTIS HC $9.00

An analysis of noise problems created by aircraft operations at airport in the San Francisco, California area is presented. The objectives of the analysis are to: (1) recommend analytic procedures for evaluating the impact of noise from aircraft sources in the region, (2) apply analytic procedures to describe the aircraft noise at commercial airfields and military air bases, (3) study the noise environment generated by operations in transition air spaces, and (4) provide technical information and consultation in establishing noise impact criteria and in evaluating the effect of the noise from aircraft operations on the liveability of the region. Author

N72-28014# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Behavioural Sciences Div.

THE EFFECTIVENESS OF TWO TYPES OF INSULATION IN THE CHSS-2 HELICOPTER

S. E. Forshaw and R. A. Stong Mar. 1972 15 p refs

(DCIEM-839) Avail: NTIS HC $3.00

Narrow-band, octave-band, and overall sound pressure levels were measured in two CHSS-2 helicopters, one with an older thin acoustic treatment and one with a new thick treatment. The noise levels at the sonar operator's position are not reduced significantly when an acoustic bulkhead and door treated with the thin sound absorbed are installed across station 155. The noise levels at this location are reduced by 8 to 15 db in the octave bands between 500 and 4000 Hz, however, when the bulkhead and door are treated with the thick absorber. Provided crew members wear properly fitted flight helmets, the noise in the CHSS-2 helicopter does not constitute a potential long-term hazard to the hearing of the crew. However, its pure tone components undoubtedly reduce the detection efficiency of sonar operations. Author

N72-28015*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECT OF STABILIZATION ON VTOL AIRCRAFT IN HOVERING FLIGHT

Richard K. Greif, Emmett B. Fry, Ronald M. Gerdes, and Terrence D. Gossett Washington Aug. 1972 24 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.

(NASA-TN-D-6900; A-4015) Avail: NTIS HC $3.00 CSCL 01B

A motion simulator study was conducted to determine the effects of roll and pitch stabilization on the handling qualities and control power requirements of VTOL aircraft during hover and

short-distance maneuvering flight. Three levels of stabilization complexity were compared: (1) no stabilization, (2) rate stabilization, and (3) attitude stabilization. Control sensitivities and stabilization gains were optimized prior to comparison. Results are presented to show how the optimum systems were determined and how they compared with each other at different levels of control power. Comparisons were made both in calm air and in the presence of roll disturbances. Results indicate the attitude-stabilized system provides the best handling qualities for the least amount of control power. Author

N72-28016# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT, US CIVIL AVIATION, ISSUE NO. 4, 1970 ACCIDENTS
21 Dec. 1971 512 p
(NTSB-BA-72-1) Avail: NTIS HC $27.75

Selected aircraft accident reports, in brief format, occurring in U.S. civil aviation operations during calendar year 1970 are presented. The 900 general aviation accidents contained in this publication represent a random selection. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author

N72-28017*# Boeing Co., Renton, Wash. Commercial Airplane Div.
PREDICTED FLIGHT CHARACTERISTICS OF THE AUGMENTOR WING JET STOL RESEARCH AIRCRAFT
R. E. Spitzer Jul. 1972 180 p refs
(Contract NAS2-6025)
(NASA-CR-114463; D6-40381) Avail: NTIS HC $11.00 CSCL 01B

An existing deHavilland C-8A airplane has been modified into an augmentor wing flight test vehicle. Research objectives are to verify the augmentor flap concept and to produce data for STOL airworthiness criteria. The Modified C-8A provides the means for jet-STOL flight research down to a 60 knot approach speed. The airplane has a high thrust-to-weight ratio, high-lift flap system, vectored thrust, powerful flight controls, and lateral-directional stability augmentation system. Normal performance and handling qualities are expected to be satisfactory. Analysis and piloted simulator results indicate that stability and control characteristics in conventional flight are rated satisfactory. Handling qualities in the STOL regime are also generally satisfactory, although pilot workload is high about the longitudinal axis. Author

N72-28018*# Washington Univ., St. Louis, Mo. Dept. of Mechanical and Aerospace Engineering.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 6-A: EFFECTS OF BLADE TORSION, OF BLADE FLAP BENDING FLEXIBILITY AND OF ROTOR SUPPORT FLEXIBILITY ON ROTOR STABILITY AND RANDOM RESPONSE
Kurt H. Hohenemser and S. K. Yin Jun. 1972 134 p refs
(Contract NAS2-4151)
(NASA-CR-114480) Avail: NTIS HC $8.75 CSCL 01B

The effects of lifting rotor blade torsion, blade flap bending flexibility and rotor support flexibility on rotor stability and random response are described. The subjects discussed are: (1) blade representation and method of analysis, (2) random gust response statistics for coupled torsion-flapping rotor blade vibrations, (3) flap bending corrections to the rigid blade analysis of lifting rotors, and (4) effects of rotor support flexibility. The response of linear periodically time varying systems to random excitation is examined. Author

N72-28019*# Washington Univ., St. Louis, Mo. Dept. of Mechanical and Aerospace Engineering.
CONCEPTS FOR A THEORETICAL AND EXPERIMENTAL STUDY OF LIFTING ROTOR RANDOM LOADS AND VIBRATIONS. PHASE 6-B: EXPERIMENTS WITH PROGRESSING/REGRESSING FORCED ROTOR FLAPPING MODES
Kurt H. Hohenemser and S. T. Crews Jun. 1972 72 p refs
(Contract NAS2-4151)
(NASA-CR-114481) Avail: NTIS HC $5.75 CSCL 01B

A two bladed 16-inch hingeless rotor model was built and tested outside and inside a 24 by 24 inch wind tunnel test section at collective pitch settings up to 5 deg and rotor advance ratios up to .4. The rotor model has a simple eccentric mechanism to provide progressing or regressing cyclic pitch excitation. The flapping responses were compared to analytically determined responses which included flap-bending elasticity but excluded rotor wake effects. Substantial systematic deviations of the measured responses from the computed responses were found, which were interpreted as the effects of interaction of the blades with a rotating asymmetrical wake. Author

N72-28020*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION STUDY OF THE LIFT ROLL COUPLING PROBLEM FOR HOVERING VTOL AIRCRAFT
Robert A. Jacobsen and Richard K. Greif Washington Aug. 1972 18 p refs
(NASA-TN-D-6906; A-3172) Avail: NTIS HC $3.00 CSCL 01B

The effects of lift-roll coupling on the handling qualities of hovering VTOL aircraft using differential thrust for roll control were assessed in a piloted simulation study in the Ames six-degrees-of-freedom motion simulator. The configuration tested has three vertical thrust sources, one on the roll axis and two laterally displaced from the roll axis, with a thrust distribution of 25%/50%/25%. The outboard thrust sources were modulated to provide roll control whereas all three provided height control. Maximum thrust-to-weight ratio was varied together with a coupling parameter that combined roll-inertia, weight, and engine location. Results showed that handling qualities are affected not only by the occurrence of lift-roll coupling (dependent on both variables) but also by the severity of the coupling (dependent on the coupling parameter alone). However, the advantages of differential thrust for control can be retained with careful design. Author

N72-28021# Texas A&M Univ., College Station. Dept. of Industrial Engineering.
RELIABILITY/MAINTAINABILITY TRADE-OFF PROCEDURE FOR THE MAIN ROTOR BLADE OF A HEAVY LIFT HELICOPTER M.S. Thesis
Royace H. Prather 1971 42 p refs Sponsored in part by Army
(AD-739582) Avail: NTIS CSCL 01/3

The paper develops a quantitative procedure for trading off reliability and maintainability parameters on the main rotor blade of a heavy lift helicopter. The procedure through the use of the probability tree makes possible the calculation of estimated operational availability and life cycle cost of the main rotor blade at the organizational level (Aviation Company) within the Department of Army. The predicted life cycle costs of the blade presented in the procedure is given on a cost per organizational unit per month basis in order that the blade cost can be used as an input to the fleet life cycle cost of the heavy lift helicopter. Author (GRA)

N72-28022# Boeing Co., Philadelphia, Pa. Vertol Div.
CH-47A B AND C SERIES HELICOPTER ROTOR BLADE FAILURE AND SCRAP RATE DATA ANALYSIS Final Report

R. L. Hunt Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Nov. 1971 120 p refs
(Contract DAAJ02-71-C-0014; DA Proj. 1F1-62205-A-1119)
(AD-739568; D210-10340-1; USAAMRDL-TR-71-58) Avail: NTIS CSCL 01/3

The report provides the results of an analysis of failure data derived from depot inspection, overhaul/rework, and scrappage reports on 5,488 rotor blades of the CH-47 series tandem rotor helicopters. Two types of rotor blades were analyzed for blade mean-time-between-removals, mean-time-to-removals, mean-time-between-unscheduled-removals and mean-time-between-scrappage. Locations on these blades for the major discrepancies were determined. Blade teardown experience was determined. A cost comparison of blade acquisition costs versus the average cost of repair/rework was provided. Author (GRA)

N72-28023# Dynamic Science, Phoenix, Ariz.
EVALUATION OF THE UH-1D/H HELICOPTER CRASH-WORTHY FUEL SYSTEM IN A CRASH ENVIRONMENT Final Report
Richard L. Cook and Donald E. Goebel Nov. 1971 182 p
(Contract DAAJ02-69-C-0030; DA Proj. 1F1-62203-A-529)
(AD-739567; Rept-1520-71-15; USAAMRDL-TR-71-47) Avail: NTIS CSCL 01/2

The primary objective of the program was to obtain empirical data to evaluate the effectiveness of the UH-1D/H helicopter crash-resistant fuel system when subjected to a severe but survivable crash environment. These data would reveal any specific weaknesses which still remain in the system that would cause a serious fire hazard. Since the performance of the various system components is the key to the effectiveness of the system, the evaluation of these components was the secondary objective of the program. GRA

N72-28024# Rensselaer Polytechnic Inst., Troy, N.Y. Systems Engineering Div.
ADAPTIVE PARAMETER IDENTIFICATION
Howard Kaufman and Daniel Beaulier 1971 22 p refs
(Contract DAAB07-69-C-0365)
(AD-739694) Avail: NTIS CSCL 12/1

An extended Kalman filter with a fictitious noise input is developed for tracking time varying parameters. An adaptation algorithm is used for adjusting the covariance of the fictitious noise according to the magnitude of the measured residuals. Application of the filter to the tracking of time varying VTOL parameters is shown to give an off line model that reproduces the process behavior much better than a model with fixed parameters. Author (GRA)

N72-28027*# North Carolina State Univ., Raleigh.
A FAST ACTING ELECTRICAL SERVO FOR THE ACTUATION OF FULL SPAN, FOWLER-TYPE WING FLAPS IN DLC APPLICATIONS: A DETAIL DESIGN STUDY
Frederick O. Smetana, Rafael J. Montoya, and Ronald K. Carden Washington NASA Jul. 1972 88 p
(Grant NGR-34-002-086)
(NASA-CR-2059) Avail: NTIS HC $3.00 CSCL 09E

The philosophy and detail design of an electro-mechanical actuator for Fowler-type wing flaps which have a response time constant of 0.025 seconds are described. A conventional electrical servomotor with a power rating twice the maximum power delivered to the load is employed along with adaptive, gain-scheduled feedback and various logic circuits, including one to remove electrical excitation from the motor during extended periods when no motion of the flap is desired. Author

N72-28028*# AiResearch Mfg. Co., Los Angeles, Calif.
STUDY OF AIRCRAFT ELECTRICAL POWER SYSTEMS Final Technical Report
Jun. 1972 487 p refs
(Contract NAS3-14367)
(NASA-CR-120939; AiR-72-8414) Avail: NTIS HC $24.35 CSCL 09E

The formulation of a philosophy for devising a reliable, efficient, lightweight, and cost effective electrical power system for advanced, large transport aircraft in the 1980 to 1985 time period is discussed. The determination and recommendataion for improvements in subsystems and components are also considered. All aspects of the aircraft electrical power system including generation, conversion, distribution, and utilization equipment were considered. Significant research and technology problem areas associated with the development of future power systems are identified. The design categories involved are: (1) safety-reliability, (2) power type, voltage, frequency, quality, and efficiency, (3) power control, and (4) selection of utilization equipment. Author

N72-28132# Metaalinstituut TNO, Delft (Netherlands).
EXAMINATION OF CORRODED RUDDER HUB DOKKUM CLASS [ONDERZOEK GESCHEURDE ROERKONING DOKKUM-KLASSE]
T. P. R. Regenboog 8 Feb. 1972 13 p In DUTCH
(M72/07/18-REG/HT) Avail: NTIS HC $3.00

Microstructural analysis on a piece of rudder hub flange showed that corrosion developed during the forging process. It is believed that deterioriation followed a combination of overheating and too much deformation. Corrosion of flange surfaces from two used rudder hubs was attributed to poorly adhesive paint. Transl. by G.G.

N72-28171# Pennsylvania State Univ., University Park.
ATC COMMUNICATIONS: THE REAL BOTTLENECK
Matthew Rosenshine FAA Apr. 1971 11 p refs Prepared for distribution at FAA's 1971 Planning Rev. Conf.
Avail: NTIS HC $3.00

Mathematical models, utilizing Markov and queueing processes, are developed for controlling aircraft in a terminal area control sector. The models cover the effects of communications constraints on controls, number of aircraft involved in control area, and controller's ability to control all aircraft in his sector. The effects of continuous voice communication and methods for modifying the system in busy air terminal areas are discussed. E.H.W.

N72-28175# Royal Aircraft Establishment, Farnborough (England).
DAMIEN 3 PCM RECORDING SYSTEM AND PROGRAMMING FOR FLIGHT TESTS
Jun. 1972 32 p Transl. into ENGLISH from SFIM (France), Jul. 1971, Oct. 1971
(RAE-Lib-Trans-1638; BR-29648) Avail: NTIS HC $3.75

The use of DAMIEN 3, a numerical recording unit, in flight tests is discussed. The system is composed of a PCM commutator. Particular attention is given to those features of the unit that relate to the ARINC 573 (flight data acquisition unit). System control, program box, and test equipment are also examined. E.H.W.

N72-28177# Federal Aviation Administration, Washington, D.C. Communications Branch.
TEST AND EVALUATION OF ARTCC AIR/GROUND CHANNELS AT LONG RANGE RADAR SITES
James Coyle Jan. 1972 12 p
Avail: NTIS HC $3.00

Techniques for collocating VHF and UHF communication transceivers at long range radar sites are investigated. The system, to be used as a redundant backup communication

system, consists of controller position equipment, fast tuning multichannel transceivers, and a processor control device which connects the controller to the correct remote transceiver. Initial tests with the equipment were successful. E.H.W.

N72-28207# Naval Research Lab., Washington, D.C.
SIMULATION OF AADC SIMPLEX AND MULTIPROCESSOR OPERATION Interim Report
William R. Smith 29 Feb. 1972 118 p
(WF15241601)
(AD-739738; NRL-7356) Avail: NTIS CSCL 09/2

Simulation of a proposed Naval Advanced Avionic Digital Computer (AADC) has been underway to arrive at architectures which efficiently meet the needs of expected program workloads. Models of avionic program workloads have been derived from various sources and used to drive these simulations . These models consist of sets of nearly independent program modules which effect periodic, known demands on system resources. Simplex and multiprocessor configurations of the AADC have been modeled, and certain features of proposed AADC executive operation have been incorporated into these models. Guided by previous simulation work, both nonpaged and paged operating systems with multiprogrammed memories have been simulated.
Author (GRA)

N72-28229# Radio Technical Commission for Aeronautics, Washington, D.C.
MINIMUM PERFORMANCE STANDARDS: AIRBORNE ATC TRANSPONDER EQUIPMENT $
17 Mar. 1972 57 p Supersedes DO-112
(DO-150; RTCA-SC-115; ICG-11; DO-112) Avail: NTIS; RTCA Secretariat, Suite 655, 1717 H Street N. W. Washington, D. C. 20006: HC $6.00

Minimum performance standards for airborne ATC transponder equipment for use in the ATC radar beacon system are defined. Compliance with these standards by manufacturers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function under all conditions normally encountered in routine aeronautical operations. Author

N72-28258# Smith (Wilbur) and Associates, San Francisco, Calif.
AIRPORT ACCESS
Jun. 1970 150 p refs Sponsored in part by HUD Prepared for Bay Area Study of Aviation Requirements and the Assoc. of Bay Area Govt.
Avail: NTIS HC $9.50

The significant findings regarding the San Francisco, California airport ground travel studies are presented. The methodology developed to test and evaluate the inter-relationships of ground transportation facilities with airport location, size, and service levels is described. The primary objective of the access portion of the study is to measure the ability of existing and planned ground and air transportation systems to serve passenger, cargo, mail, employee, vendor and rental car, airport access, and parking demands through 1985. Author

N72-28262# General Electric Co., Daytona Beach, Fla.
STUDY TO DEFINE THE INTERFACE AND OPTIONS FOR THE ADVANCED SIMULATION IN UNDERGRADUATE PILOT TRAINING VISUAL SIMULATOR Final Technical Report, Dec. 1970 - May 1971
Joseph A. Juhlin Sep. 1971 152 p refs
(Contract F33615-71-C-1211; AF Proj. 686F)
(AD-739585; Rept-71DBF017(E); AFHRL-TR-71-47) Avail: NTIS CSCL 01/3

In a study to define the interface and options for the ASUPT visual simulator, four major areas were investigated. These specific areas are: CRT electronics definition, CRT electrical characteristics, Display multiplexing, and Edge smoothing.
Author (GRA)

N72-28265# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNALF CROWS LANDING, CALIFORNIA
H. Tomita and L. J. Woloszynski Feb. 1972 56 p ref
(AD-739316; NCEL-TN-1219) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the USNALF Crows Landing, California are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual portland cement concrete pavement facilities.
Author (GRA)

N72-28266# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USMCAS YUMA, ARIZONA
H. Tomita and L. J. Woloszynski Feb. 1972 16 p ref
(AD-739317; NCEL-TN-1218) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the USMCAS Yuma, Arizona are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-28267# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USMCAS (H) SANTA ANA AND USMCAS (HOLF) MILE SQUARE, CALIFORNIA
H. Tomita and J. A. Garcia Jan. 1972 84 p refs
(AD-738828; NCEL-TN-1215) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the U. S. Marine Corps Air Station (Helicopter), Santa Ana and U. S. Marine Corps Air Station (Helicopter Outlying Landing Field), Mile Square, California are presented. The surveys established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Author (GRA)

N72-28268# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNALF SAN CLEMENTE ISLAND, CALIFORNIA
H. Tomita and L. J. Woloszynski Jan. 1972 39 p ref
(AD-738827; NCEL-TN-1214) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the U. S. Naval Auxiliary Landing Field, San Clemente Island, California are presented. The survey established statistically-based indicators of the condition of the individual portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-28269# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNOLF SAN NICOLAS ISLAND, CALIFORNIA

H. Tomita and R. B. Brownie Dec. 1971 53 p ref
(AD-738824; NCEL-TN-1208) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the U.S. Naval Outlying Field, San Nicolas Island, California are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-28270# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNALF MONTEREY, CALIFORNIA
H. Tomita and L. J. Woloszynski Jan. 1972 88 p
(AD-739314; NCEL-TN-1217) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the USNALF Monterey, California are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-28271# Franklin Inst., Philadelphia, Pa.
SNOW STABILIZATION TECHNIQUES FOR HELICOPTER LANDINGS Final Report
Francis W. Cooke and William H. Collins Sep. 1971 56 p refs
(Contract DAAD05-70-C-0389)
(AD-738561; FIRL-C2885-06; LWL-CR-05C71) Avail: NTIS CSCL 01/5

The report describes the result of a feasibility study to investigate surface stabilization of snow by chemical treatment to eliminate reduced visibility created by helicopter down wash on landing and take-off. Of the candidate methods evaluated, sintering of the snow by methanol appeared promising. GRA

N72-28272# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept. (SI)
DESIGN OPTIMIZATION AND PERFORMANCE PREDICTION OF A SHOREBASED AIRCRAFT RECOVERY SYSTEM BY MATHEMATICAL MODEL COMPUTER SIMULATION. PROPOSED SYSTEM NO. 1, CAPSTAN CABLE SYSTEM
Robert T. Barron 24 Mar. 1972 72 p refs
(AD-740098; NAEC-ENG-7740) Avail: NTIS CSCL 01/5

The design and performance predictions of the first of several proposed high cycle expeditionary shorebased aircraft recovery systems are presented. The system was obtained by means of mathematical model computer simulation. This system consists of a steel wire rope purchase cable, a stationary low inertia cable storage system, and a constant radius multi-wrap capstan attached to an energy absorber. The results show that this system is capable of satisying design requirements. Author

N72-28273# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept. (SI)
PROCEDURE FOR CERTIFICATION TESTS OF TYPE C MARK 13 MOD 1 CATAPULTS, FLUSH DECK NOSE GEAR LAUNCH EQUIPMENT, BRIDLE ARRESTERS, AND JET BLAST DEFLECTORS ON USS NIMITZ, CVAN-68
W. Riedel Mar. 1972 96 p refs
(AD-738445; NAEC-ENG-7430) Avail: NTIS CSCL 01/5

The report contains the procedure for shipboard tests of Type C13 Mod 1 catapults and all associated launcher equipment on USS Nimitz CVAN-68. Included are safety precautions, visual checks, static proof loads, hydrostatic tests, signal system tests, functional tests, wet accumulator charging and blowdown tests, establishment of water level, instrumentation requirements and deadload calibration. Author (GRA)

N72-28274# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
EVALUATION OF MO-MAT 158 AS LIGHT-DUTY LANDING MAT Final Report, Jan. - May 1970
Carroll J. Smith Feb. 1972 78 p refs
(DA Proj. 1G6-64717-DH-01)
(AD-738137; AEWES-Misc-Paper-S-72-5) Avail: NTIS CSCL 01/5

The investigation was conducted to evaluate MO-MAT, a reinforced plastic material molded into a waffle-like configuration, for use as light-duty landing mat. Tests were conducted on four special panels of MO-MAT 158 connected by nut plates with bolts placed in predrilled holes. The traffic tests were conducted using C-130 aircraft loading on three prepared subgrades of different strengths. Results of this investigation indicated that MO-MAT 158 will sustain 96, 184, and 500 actual coverages of traffic when placed on subgrades with rated CBR's of 4.0, 6.5, and 10, respectively. Author (GRA)

N72-28277# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
EXPLORATORY MEASUREMENTS OF THE FLOW IN THE WING-TIP VORTICES OF A LOCKHEED HERCULES
E. D. Poppleton Dec. 1971 29 p refs Sponsored by Dept. of Civil Aviation Original contains color illustrations
(ATN-7104) Avail: NTIS HC $3.50

The flow in a trailing vortex was visualized by means of smoke from a ground-based generator, and some measurements were made of the velocity perturbation at a fixed point as the vortex was convected past the anemometer. The accuracy of the measurements was not high, but they were consistent with values calculated from Owen's formula. There was some evidence that the slipstream from the propellers was affecting the flow in the core of the vortex. Author

N72-28280# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Freiburg (West Germany). Inst. fuer Angewandte Mathematik und Mechanik.
STEADY LAMINAR HYPERSONIC BOUNDARY LAYERS PAST AN AXISYMMETRIC HYPERBOLOID AT THERMO-CHEMICAL EQUILIBRIUM
Dieter Straub, Willi Schoenauer, Alfred Schaber, Sui Lin, and Ernst Adams 1972 106 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-16) Avail: NTIS HC $7.50; DFVLR Porz-Wahn: 25.50 DM

For laminar hypersonic flow, the hydrodynamic equations of balance are discussed for multicomponent mixtures of chemically reacting ideal gases. The pertinent differential equations are derived for stationary boundary layer flows past catalytic surfaces of planar or axisymmetric bodies. For the calculation of the constitutive properties of dissociated air, a model with the five components N2, O2, NO, N, and O is employed. By use of simple analytic relations, the pertinent reaction data, the necessary thermal properties, and the transport coefficients are determined with sufficient accuracy for this model. The boundary layer equations are solved numerically for selected conditions of flight of an axisymmetric hyperboloid under the assumption of thermochemical equilibrium. Author

N72-28287*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSTALLATION CAUSED FLOW DISTORTION AND ITS EFFECT ON NOISE FROM A FAN DESIGNED FOR TURBOFAN ENGINES
Frederick P. Povinelli and James H. Dittmar 1972 21 p refs Proposed for presentation at 7th Aerodyn. Testing Conf., Palo Alto, Calif., 13-15 Sep. 1972; sponsored by AIAA
(NASA-TM-X-68105; E-7043) Avail: NTIS HC $3.25 CSCL 20D

A ground test stand was used to obtain acoustic data on a full scale prototype fan designed for quiet subsonic aircraft engines. The fan was installed in three different ways in the test stand. In two of the installations the fan was driven by a shaft in the inlet; in the third installation the fan was driven from the rear. These three installations, and the structures associated with them, resulted in various amounts of inlet flow distortion to the fan. The rear drive installation had less inlet flow distortion than the two front drive installations. Some measurements of inlet flow distortion were made and used in a blade passage noise generation theory to predict the effects of distortion on noise. Good agreement was obtained when the predicted and measured power level differences between the front drive and rear drive installations were compared. Author

N72-28304 National Lending Library for Science and Technology, Boston Spa (England).
FINE STRUCTURE OF THE MIDDLE AND HIGH STRATOSPHERE. DETECTION OF CLEAR AIR TURBULENCE. APPLICATION TO FLIGHTS ENVISAGED FROM SUPERSONIC TRANSPORT AIRCRAFT
G. D. Barbe et al [1972] 19 p refs Transl. into ENGLISH from the publ. "French/American Meteorological Societies Joint Meeting" Paris, 1971
(NLL-M-22438-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Wind and fine scale temperature soundings were carried out under a variety of experimental conditions. Clear air turbulence measurements observations were made using Canberra and Concorde aircraft. The results are presented in the form of curves giving the distributions as a function of altitude, height, wind speed, and temperature. K.P.D.

N72-28425# Utah State Univ., Logan. Electro-Dynamics Labs.
AIRCRAFTBORNE INSTRUMENTATION FOR AIRGLOW SURVEY Final Report, 15 Nov. 1970 - 14 Dec. 1971
Allan J. Steed and Ralph H. Haycock 14 Dec. 1971 19 p
(Contract F19628-71-C-0081; AF Proj. 5710)
(AD-739196; AFCRL-71-0594) Avail: NTIS CSCL 04/1

The Electro- Dynamics Laboratories of Utah State University has modified the AFCRL trainable-instrumentation mount originally fabriated by Cook Electric Company so that it can be used as a tracking platform for two Type- III interferometers and one radiometer. The modification basically involved the addition of vibration isolation mounts and an enclosure with temperature control for the entire system which will be mounted in a KC-135 aircraft 3120. A dual-channel radiometer was designed and fabricated to fit in the remaining available mount space after the two interferometers had been installed. In connection with the radiometer design, an existing AFCRL radiometer originally built by GCA was evaluated to determine its usefulness in making airglow measurements. In addition to the Cook mount modifications, a manually trainable mount was fabricated to incorporate one interferometer, one radiometer and a 16-mm camera. Also, an NIR radiometer was modified to be used for hand-operated tracking and the rapid-scan spectrometer was updated to increase its sensitivity and reduce its noise level.
Author (GRA)

N72-28429# Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.
STUDY OF AIRBORNE TWO-WAVELENGTH RADIOMETER SYSTEM FOR TOTAL HEAT-FLOW MEASUREMENTS Final Report, 29 Jun. 1968 - 9 Nov. 1971
E. D. McAlister and Theodore D. Foster Nov. 1971 6 p refs
(Contract N62306-68-C-0258)
(AD-740092) Avail: NTIS CSCL 08/10

A two-wavelength radiometer system has been developed for measurement of the total heat flow through the sea surface from a low flying aircraft. The heat transfer in the top millimeter of the ocean was investigated theoretically and in the laboratory. This work provided a sound basis for the two-wavelength radiometric method of measuring total heat flow from the sea surface. GRA

N72-28437* National Aeronautics and Space Administration, Washington, D.C.
CLEAR AIR TURBULENCE DETECTOR Patent
George G. Haroules, Wilfred E. Brown, III, Harold I. Ewen, Arthur E. Lilley, and Ralph D. Kodis, inventors (to NASA) Issued 23 May 1972 10 p Filed 19 Nov. 1969
(NASA-Case-ERC-10081; US-Patent-3,665,467; US-Patent-Appl-SN-877990; US-Patent-Class-343-100ME; US-Patent-Class-73-355; US-Patent-Class-325-363; US-Patent-Class-343-112D) Avail: US Patent Office CSCL 14B

An apparatus for warning the pilot of an aircraft of a region of clear air turbulence is described. A multi-channel radiometric sensor mounted on the aircraft detects both the ambient temperature of the air and any temperature anomaly that is present along the forward flight path. In those cases where temperature anomalies are associated with the presence of a clear air turbulence region, the invention provides means for remotely sensing these temperature anomalies through the application of a radiometric technique. By the detection of difference temperatures between a minimum of two channels, the invention provides a means for indicating the existence of a temperature anomaly indicative of clear air turbulence region. The distance between the clear air turbulence region and the aircraft is determined by utilization of at least two observing frequencies which have known absorption coefficients of different values. Official Gazette of the U.S. Patent Office

N72-28445# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.
AN AIRBORNE EIGHT CHANNEL STEP-SCAN RADIOMETER
H.-J. Bolle and K. Th. Kriebel Bundesministerium fuer Bildung und Wiss. Apr. 1972 25 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Bildung und Wiss.
(BMBW-FB-W-72-13) Avail: NTIS HC $3.25; ZLDI Munich: 5.10 DM

An airborne spectral radiometer is described, which measures the radiances in eight channels simultaneously. The spectral bands are defined by exchangeable interference filters. Seven channels lie inbetween 0.4 and 3 microns, while one channel is designed for the thermal infrared near 11 micron. A programmed scanning mirror allows side-looking measurements in 10 degree steps. The FOV is 6 degrees, which gives an equivalent horizontal resolution from low flying aircrafts as specified for the ERTS satellites. The instrument is used for investigations of radiation fluxes in the atmosphere, radiation characteristics of clouds, and test for remote sensing techniques. Author

N72-28471# Communications Research Centre, Ottawa (Ontario).
MICROWAVE RADIOMETRY FOR SURVEILLANCE FROM SPACECRAFT AND AIRCRAFT
A. W. Adey Jan. 1972 30 p refs
Avail: NTIS HC $3.50

The status of current airborne and satellite remote-sensing programs based on microwave radiometers is reviewed. Details of instrumentation capabilities and limitations are provided. Research areas and problems where these devices appear to have application are discussed. Author

N72-28479# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
EVALUATION OF THE KEARFOTT GYROSCOPE, TYPE GYROFLEX, MOD. 2: RESULTS OBTAINED WITH THE GYROSCOPE NO. 3441 [EVALUATION DU GYROSCOPE KEARFOTT TYPE GYROFLEX MOD 2 RESULTATS OBTENUS SUR L'APPAREIL NO. 3441]
26 Apr. 1971 122 p In FRENCH
(Contract DTEN-71/179)
(LRBA-E-209-NT-1/SIE) Avail: NTIS HC $8.25

Tests performed from May 1971 to February 1972 on the Kearfott gyroflex gyroscope model 2, serial number 3441, are reported. Although this gyroscope was designed for use onboard aircraft, a full evaluation of its performance was carried out to ascertain its possible use for other purposes such as marine or missiles. A technological description of the universal joint is presented. On the whole the gyroscope performs better than required by the contract. ESRO

N72-28504*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN ANALYSIS FOR A NUTATING PLATE DRIVE 4
Stuart H. Loewenthal and Dennis P. Townsend 1972 13 p Prosposed for presentation at Mech. Conf. and Intern. Symp. on Gearing and transmissions, San Francisco, 8-12 Oct. 1972; sponsored by ASME and AM. Gear MFR. Assoc.
(NASA-TM-X-68117; E-7050) Avail: NTIS HC $3.00 CSCL 13I

A simplified design analysis was conducted on a nutating plate type drive system for a 2500 horsepower helicopter main rotor gear box. A drive system that split the output torque evenly between two nutating plates for the purpose of reducing the load on each nutating plate was analyzed. Needle bearings were used on the nutating plate pins. The results of the analysis indicate that the required load capacity of the pin bearings and the speed of the nutating plate bearings were beyond the state-of-the-art capacity of rolling-element bearings. The analysis further indicates that the nutating plate drive is less efficient, and results in a higher weight per horsepower than a conventional planetary helicopter transmission with similar design specifications. Author

N72-28505*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARATIVE LUBRICATION STUDIES OF OH-58A TAIL ROTOR DRIVE SHAFT BEARINGS
Marshall W. Dietrich, Richard J. Parker, and Erwin V. Zaretsky Jul. 1972 34 p refs
(NASA-TM-X-68118; E-7054) Avail: NTIS HC $3.75 CSCL 11H

Comparative lubrication tests were run with OH-58A helicopter tail rotor drive shaft bearings. The tests were run in an outdoor environment with ambient temperatures ranging from 10 to 75 F. Dust was periodically applied to the bearings to simulate field conditions. The cause of bearing failure was associated with dust penetration. Rotor shaft failure was found to be caused by the shaft rotating in the standard rubber collar due to seizure of the bearings. Bearings with a positive rubbing seal having a MIL-G-81322 grease produced lives greater than with bearings having labyrinth seals and a mineral oil paste lubricant. An elongated collar prevented failure of the rotor shaft during bearing seizure. In a limited test, installation of tail boom shrouds over the bearings which excluded dust and water resulted in bearing lives in excess of 1800 hours or 1200 hours greater than the current 600 hours TBO, regardless of the lubricant-bearing combination used. Author

N72-28518# Pratt and Whitney Aircraft, East Hartford, Conn.
ADVANCED SEAL TECHNOLOGY Final Report, 30 Apr. - 30 Nov. 1971
Frederic H. Mahler Wright-Patterson AFB, Ohio AFAPL Feb. 1972 175 p refs
(Contract F33615-71-C-1534; AF Proj. 3066)
(AD-739922; PWA-4372; AFAPL-TR-72-8) Avail: NTIS CSCL 11/1

The limitations of present aircraft gas turbine engine dynamic seal technology were reviewed and the effect of gas path seal losses on four representative current and advanced transport and fighter aircraft engine cycles was established. Four key seal locations were identified: high-pressure compressor blade tip seal; cantilevered compressor stator tip seal; high-pressure turbine blade tip seal; and turbine interstage seal. An evaluation of a variety of seal concepts and preliminary designs yielded four candidate seal concepts for operation in environments up to 1500 F compressor discharge temperature, 3200 F turbine inlet temperature, 600 psi maximum pressure and rotor speeds consistent with advanced engine cycles. Final design layouts were prepared for the two most promising of these seals: a free-floating composite/abradable compressor blade tip seal and a high-pressure turbine blade tip seal using integrally cost extensions of the second-stage vane platform as first-and second-stage blade tip rubstrips. Finally, recommendations for experimental evaluation of the two final seal designs were developed. Author (GRA)

N72-28519# Battelle Memorial Inst., Columbus, Ohio.
THE 30000 rpm VANE PUMP DEMONSTRATION Final Report, 16 Dec. 1968 - 30 Nov. 1971
David L. Thomas, J. Philip Dechow, Robert K. Catterson, Harry T. Johnson, Robert K. Mitchell, and John P. Wilcox Wright-Patterson AFB, Ohio AFAPL Mar. 1972 160 p refs
(Contract F33615-69-C-1302; AF Proj. 3145)
(AD-739936; AFAPL-TR-72-9) Avail: NTIS CSCL 13/11

The purpose of this project was to demonstrate the capability of new vane-pump concepts to meet future aircraft requirements. The specific objective was the development of a pressure-compensated hydraulic pump that would deliver 45 gpm at 4000 psi while operating at 30,000 rpm with MIL-H-5606B hydraulic fluid. The concepts were the product of a previous Air Force program and included a pivoting-tip vane for hydrodynamic load support and a two-lobed deformable cam ring for variable displacement. In critical experiments, pivoting-tip vanes were operated satisfactorily at the rated conditions of temperature, speed, and pressure. A pump with solid cam rings was operated a total of 27.6 hours at 30,000 rpm and 0.4 hours at 3300-psi discharge pressure. The pump with deformable cam rings was operated a total of 62 hours including 9.4 hours at 25,000 rpm, 10.6 hours at 30,000 rpm, and 1 hour at 3000-psi discharge pressure. A pressure compensator with inherent temporary droop was conceived, and laboratory development was started. Continued development is recommended to correct deformable-cam-ring deficiencies to enable determination of pump efficiency and durability. Author (GRA)

N72-28545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIAL AND STRUCTURAL STUDIES OF METAL AND POLYMER MATRIX COMPOSITES
Robert A. Signorelli, Tito T. Serafini, and Robert H. Johns 1972 23 p refs Proposed for presentation at Symp. on Impact of Composite Mater. on Aerospace Vehicles and Propulsion Systems, Toulouse, 20-22 Sep. 1972; Sponsored by the Advisory Group for Aerospace Res. and Develop.
(NASA-TM-X-68101; E-7020) Avail: NTIS HC $3.25 CSCL 11F

The application of fiber composites to aeronautical and space vehicle systems indicates the following: It appears quite probable that resin/fiber composites can be developed for service at 315 C for several thousand hours and at 370 C for a few hundred hours. The retention of resin/fiber strength at these high temperatures can be achieved by modifying the polymer molecular structure or by developing new processing techniques,

or both. Carbon monofilament with attractive strength values has been produced and fabrication studies to reinforce aluminum with such monofilaments have been initiated. Refractory wire-superalloy composites have demonstrated sufficiently high strength and impact values to suggest that they have potential for application to turbine blades at temperatures to 1200 C and above. Author

N72-28610 National Lending Library for Science and Technology, Boston Spa (England).
THE FOG REGIME OVER THE INTERNATIONAL AIRPORT AT SOFIA AND AN ATTEMPT AT THE FORECASTING OF FOG THERE
N. Godev and G. Korcev [1971] 8 p ref Transl. into ENGLISH from Hidromet. Sluz., Hidr. Met. (Bulgaria), v. 20, no. 3, 1971 p 19-28
(NLL-M-22087-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The climatic fog regime over the Sofia plain, and a method based on multifactor discriminant analysis for forecasting radiation fogs, those resulting from radiative cooling of the air, are described. During the period from 1963 to 1968, 266 fogs were observed over the airport, 127 being identified as radiation fogs. Most fogs were reported for November through February, with a well-marked maximum in November. The relations of general fogs and radiation fogs to temperature, time of day, relative humidity, and wind speed are also described. It is concluded that fog is difficult to predict but that multifactor discriminant analysis can solve a number of important problems connected with radiation fog formation. N.E.N.

N72-28659# Boeing Co., Wichita, Kans.
ADDITIONAL RESEARCH OF LOW ALTITUDE TURBULENCE DATA Final Technical Report, Jul. - Sep. 1971
Joe D. Gault Wright-Patterson AFB, Ohio AFFDL Sep. 1971 51 p refs
(Contract F33615-71-C-1836; AF Proj. ADP-682E)
(AD-739875; AFFDL-TR-71-150) Avail: NTIS CSCL 04/2

The report presents procedures, analysis methods and results pertaining to a more detailed study of several data samples recorded during the Low Altitude Atmospheric Turbulence Program (LO-LOCAT, Phase III). Wind spectra corrected for airplane motion effects and gust velocity calculated using filtered input parameters substantiated the original results obtained during LO-LOCAT, Phase III. Author (GRA)

N72-28661 National Lending Library for Science and Technology, Boston Spa (England).
HORIZONTAL RUNWAY VISUAL RANGE
M. Ja. Racimor [1970] 11 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauchn.-Issled. Tsentr. SSSR (Leningrad), v. 70, 1970 p 9-18 No diagrams etc.; to be used in conjunction with original book
(NLL-M-22355-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A method for identifying the horizontal visual range on the runway considered in connection with the takeoff and landing of aircraft is discussed. The international symbol for this visibility is runway visual range (RVR). The RVR is the maximum distance in the direction of takeoff and landing of aircraft at which the runway, runway lights, special lights, or markers marking the strip can be seen from the cockpit of an aircraft on the center line of the runway. Thus the RVR should correspond to the visibility used by the pilot. Author

N72-28662*# Litchford Systems, Northport, N.Y.
BROADCAST CONTROL OF AIR TRAFFIC
George B. Litchford Apr. 1972 162 p refs
(Contract NASw-2247)
(NASA-CR-127452) Avail: NTIS HC $10.25 CSCL 17G

The development of a system of broadcast control for improved flight safety and air traffic control is discussed. The system provides a balance of equality between improved cockpit guidance and control capability and ground control in order to provide the pilot with a greater degree of participation. The manner in which the system is operated and the equipment required for safe operation are examined. Author

N72-28667# Radio Technical Commission for Aeronautics, Washington, D.C. Special Committee 116-E.
MINIMUM OPERATIONAL CHARACTERISTICS FOR VERTICAL GUIDANCE EQUIPMENT USED IN AIRBORNE VOLUMETRIC NAVIGATION SYSTEMS
17 Mar. 1972 76 p refs
(DO-152) Avail: NTIS HC $6.00; RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D. C. 20006 $6.00

The concepts, philosophy, and development of minimum operational characteristics for airborne navigation systems are discussed. Emphasis is placed on the minimum operational characteristics for vertical guidance equipment used in volumetric navigation systems. The specifications for the equipment and the development of international standards are examined. An error analysis of various systems is included. P.N.F.

N72-28670# McDonnell-Douglas Co., St. Louis, Mo.
MICRO-CAS: A COLLISION AVOIDANCE SYSTEM FOR THE GENERAL AVIATION FLEET
Ronald M. Schutz 1971 15 p refs Presented at FAA 1971 Planning Rev. Conf., 26-29 Apr. 1971
Avail: NTIS HC $3.00

The trend of aircraft midair collisions clearly indicates the urgent need for a collision avoidance system (CAS). MICRO-CAS has been developed to provide collision avoidance to a large segment of the general aviation fleet. General aviation aircraft performance profiles were developed and used to determine protection levels attainable by various threat criteria. The degree of compatibility with the commercial carrier CAS was determined for each system synthesized. Range and altitude difference threat criteria were selected for MICRO-CAS and the system hardware requirements defined. Production cost estimates lead to the conclusion that MICRO-CAS, compatible with the commercial carriers' CAS, can be provided at a cost attractive to large numbers of general aviation aircraft owners. Author

N72-28671# Speas (R. Dixon) Associates, Manhasset, N.Y.
ANALYSIS OF DESIRABILITY OF ACHIEVING A FULLY COOPERATIVE AIR TRAFFIC CONTROL SYSTEM
Martin A. Warskow and Alex Kuprijanow Apr. 1971 36 p refs Presented at FAA 1971 Planning Rev. Conf.
Avail: NTIS HC $4.00

The development of an Intermittent Positive Control (IPC) system for air traffic control is discussed. With all aircraft equipped to conform to IPC, a cooperative traffic system results. The problems associated with achieving a cooperative system were studied. The investigation was concerned with the time required to achieve a cooperative system, the costs involved, and the possibilities of government cost-sharing for the required airborne equipment. P.N.F.

N72-28672# McDonnell-Douglas Co., St. Louis, Mo.
APPLICATION OF THE TIME/FREQUENCY COLLISION AVOIDANCE SYSTEM AS AN AID FOR LANDING AND GROUND OBSTACLE AVOIDANCE
Anatole Browde and F. D. Watson 1971 15 p
Avail: NTIS HC $3.00

The analysis and design effort that produced the threat evaluation and escape maneuver logic of the collision avoidance

system (CAS) for the air-to-air situation has produced two new applications in the field of air safety: for the avoidance of ground obstacles, and for the provision of a minimum altitude protection zone around airports. It is determined that the airborne CAS, with only minor adaptations, can provide this additional protection. Installation of a CAS compatible time/frequency ground beacon on or near the obstacle or at an airport automatically provides inputs to the airborne CAS for threat evaluation and clear escape maneuver commands. As an option, this beacon can also be used for aircraft resynchronization. The addition of these functions in no way compromises the normal air-to-air CAS protection. The aircraft threat status relative to all CAS-equipped aircraft and relative to ground beacons is evaluated once every three seconds as before. Author

N72-28673# National Bureau of Standards, Washington, D.C. Signal Lighting Group.
DEVELOPMENT, TESTING, AND EVALUATION OF VISUAL LANDING AIDS Consolidated Progress Report, 1 Jan. - 31 Mar. 1972
1 May 1972 15 p refs Prepared for Naval Air Systems Command. Ship Installations Div. and Meteorol. Div. and for FAA
(NBS Proj. 2211509; NBS Proj. 2211510; NBS Proj. 2211511; NBS Proj. 2211514; NBS Proj. 2211680; NBS Proj. 2211681) (NBS-10-837) Avail: NTIS HC $3.00

The development of visual aids for aircraft landing at airfields and on aircraft carriers is discussed. Instruments which have been produced for determining the proper operation of the systems are described. The specifications for the equipment and the arrangement of the lighting systems are reported. The importance of the systems for safe aircraft operations is emphasized. P.N.F.

N72-28675# National Center for Atmospheric Research, Boulder, Colo.
THE MEASUREMENT OF AIR VELOCITY AND TEMPERATURE USING THE NCAR BUFFALO AIRCRAFT MEASURING SYSTEM
D. H. Lenschow Jun. 1972 44 p refs Sponsored by NSF
(NCAR-TN/EDD-74) Avail: NTIS HC $4.25

The methods used to measure air velocity and temperature from an aircraft and their application to the measuring system on the NCAR Buffalo aircraft are described. The main components of this system are: (1) an inertial navigation system that provides measurements of airplane acceleration, velocity, position, and angles of attitude; (2) an air sensing probe that provides measurements of angles of attack and sideslip, pitot-static pressure, and temperature; and (3) a second pitot-static tube that provides measurements of both static pressure and pitot-static pressure; this pitot tube is free to align itself parallel to the airstream. The equations used to calculate the air velocity components from the inertial system and air sensing probe measurements are derived, use and limitations of the inertial navigation platform are discussed, methods used to calculate true airspeed and static temperature are presented, and errors in measurement and their effect on the calculated atmospheric variables are discussed. Author

N72-28677# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).
THE SIGNIFICANCE OF THE ELLIPSOIDAL FORM OF THE EARTH IN AIR NAVIGATION Ph.D. Thesis - Stuttgart Univ. [DIE BERUECKSICHTIGUNG DER ELLIPSOIDGESTALT DER ERDE IN DER FLUGNAVIGATION]
Lothar J. Kieffer 1971 120 p refs In GERMAN
(Ser-C/Diss-166) Avail: NTIS HC $8.00

Formulas are derived for evaluating the usual measurements in air navigation, which account for the ellipsoid flattening of the earth and inaccurate use of flight altitude. Formulas are given for calculation of geographic coordinates from grid coordinates that enable non-iterative evaluation. A presumably new approximative solution is given for calculating the distance between two distant points, as in Omega navigation. In addition formulas are derived enabling ellipsoidal magnitude to be modified for spherical calculation of geodetic lines. Flight over the ellipsoid of constant altitude using a gyrocompass is investigated. Inertial navigation exact formulas are derived for Doppler, and Tacan, which account for earth flattening and flight altitude. ESRO

N72-28678# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF MEASURING SYSTEM REQUIREMENTS FOR LOW VISIBILITY LANDING Final Report, May 1970 - Sep. 1971
Lee Gregor Hofmann, Warren F. Clement, Dunstan Graham, Richard E. Blodgett, and Kishor V. Shah Wright-Patterson AFB, Ohio AFFDL Dec. 1971 67 p refs
(Contract F33615-70-C-1621; AF Proj. 404L)
(AD-739932; STI-TR-198-1; AFFDL-TR-71-151) Avail: NTIS CSCL 01/5

Two methods for determining measuring system requirements for instrument low visibility landing are described. These methods have been applied for analysis of two automatic landing systems using microwave scanning beam landing guidance. Results obtained from these analyses are presented and discussed in detail. Author (GRA)

N72-28784*# Scientific Translation Service, Santa Barbara, Calif.
APPLICATION OF AN EJECTOR TO THE SOLUTION OF THE DESIGN PROBLEM OF PROPULSION SYSTEMS OF HIGH-SPEED VTOL AIRCRAFT
Ch. Storkebaum and L. V. Bonin Washington NASA Jun. 1972 23 p Transl. into ENGLISH of DFL, Brunswick Paper 64-573 from Proc. of the 4th Congr. of the Intern. Council of the *Aeron. Sci. Washington, D. C., Spartan Books, Inc.*, 1965 p 555-573 Conf. held in Paris, 24-28 Aug. 1964
(Contract NASw-2035)
(NASA-TT-F-14305) Avail: NTIS HC $3.25 CSCL 21E

The structural design of an ejector is discussed which uses part of the exhaust power to increase the mass throughput required for thrust production, by suction of additional air from the atmosphere. The advantages associated with the use of the ejector concept are described. Author

N72-28786*# Pratt and Whitney Aircraft, East Hartford, Conn.
STUDIES FOR DETERMINING THE OPTIMUM PROPULSION SYSTEM CHARACTERISTICS FOR USE IN A LONG RANGE TRANSPORT AIRCRAFT
Gerald L. Brines Jul. 1972 39 p
(Contract NAS3-15550)
(NASA-CR-120950; PWA-4449) Avail: NTIS HC $4.00 CSCL 21E

A comprehensive evaluation of propulsion systems for the next generation of near-sonic long range transport aircraft indicates that socially responsive noise and emission goals can be achieved within the probable limits of acceptable airplane performance and economics. Technology advances needed in the 1975-1985 time period to support the development of these propulsion systems are identified and discussed. The single most significant result is the low noise, high performance potential of a low tip speed, spaced, two-stage fan. Author

N72-28793*# General Electric Co., Cincinnati, Ohio.
HIGHLY LOADED MULTI-STAGE FAN DRIVE TURBINE: LEANED STATOR CONFIGURATION DESIGN
D. C. Evans and G. W. Wolfmeyer Washington NASA Jul. 1972 36 p refs

(Contract NAS3-14304)
(NASA-CR-2096; R71AEG309) Avail: NTIS HC $3.00 CSCL 21E

The results of the high lift blade configuration design study are reported. The three-stage constant-inside-diameter turbine utilizes a ten degree tangentially leaned stator in stage three. All other bladerows use plain blades. Analysis of the leaned stator is discussed, and detailed design data are summarized. Steady-state stresses are discussed, and the results of the mechanical design analysis are presented. Author

N72-28794*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRBREATHING ENGINES FOR SPACE SHUTTLE
Arthur J. Glassman, Warner L. Stewart, and Stanley M. Nosek 1972 27 p ref Proposed for presentation at Natl. Aerospace Eng. and Manuf. Meeting, San Diego, Calif., 2-5 Oct. 1972; Sponsored by the Soc. of Automotive Engr.
(NASA-TM-X-68098; E-7018) Avail: NTIS HC $3.50 CSCL 21A

The requirements imposed on the airbreathing engines by the shuttle mission and some results from engine design studies are discussed. In particular, some of the engine system weight study results are presented, potential problem areas and required engine modifications are identified, and testing requirements for a development and qualification program are discussed. The engines of interest for the shuttle are engines that are currently being developed for other applicatons. The potential problems, engine modifications, and testing requirements result primarily from the new environments associated with launch, space residence, and reentry. Author

N72-28795*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEW TECHNOLOGY IN TURBINE AERODYNAMICS
Arthur J. Glassman and Thomas P. Moffitt 1972 34 p refs Proposed for presentation at Turbomachinery Symp., College Station, Texas, 24-26 Oct. 1972
(NASA-TM-X-68115; E-7059) Avail: NTIS HC $3.75 CSCL 21E

A cursory review is presented of some of the recent work that has been done in turbine aerodynamic research at NASA-Lewis Research Center. Topics discussed include the aerodynamic effect of turbine coolant, high work-factor (ratio of stage work to square of blade speed) turbines, and computer methods for turbine design and performance prediction. An extensive bibliography is included. Experimental cooled-turbine aerodynamics programs using two-dimensional cascades, full annular cascades, and cold rotating turbine stage tests are discussed with some typical results presented. Analytically predicted results for cooled blade performance are compared to experimental results. The problems and some of the current programs associated with the use of very high work factors for fan-drive turbines of high-bypass-ratio engines are discussed. Turbines currently being investigated make use of advanced blading concepts designed to maintain high efficiency under conditions of high aerodynamic loading. Computer programs have been developed for turbine design-point performance, off-design performance, supersonic blade profile design, and the calculation of channel velocities for subsonic and transonic flow fields. The use of these programs for the design and analysis of axial and radial turbines is discussed. Author

N72-28796*# Pratt and Whitney Aircraft, West Palm Beach, Fla.
SINGLE-STAGE EXPERIMENTAL EVALUATION OF TANDEM-AIRFOIL ROTOR AND STATOR BLADING FOR COMPRESSORS. PART 3: DATA AND PERFORMANCE FOR STAGE C
J. A. Brent and D. Clemmons Aug. 1972 127 p refs
(Contrac. NAS3-11158)
(NASA-CR-120938; PWA-FR-5028) Avail: NTIS HC $8.50 CSCL 20D

Stage C, comprised of tandem-airfoil rotor C and tandem-airfoil stator B, was designed and tested to establish performance data for comparison with the performance of conventional single-airfoil blading. Velocity diagrams and blade leading and trailing edge metal angles selected for the conventional rotor and stator blading were used in the design of the tandem blading. The rotor had an inlet hub/tip ratio of 0.8 and a design tip velocity of 757 ft/sec. At design equivalent rotor speed, rotor C achieved a maximum adiabatic efficiency of 91.8% at a pressure ratio of 1.31. The stage maximum adiabatic efficiency was 86.5% at a pressure ratio of 1.31. Author

N72-28797# Vought Aeronautics, Dallas, Tex.
A FEASIBILITY STUDY TO DEFINE INLET FLOW QUALITY AND DEVELOPMENT CRITERIA Final Report, 15 May 1971 - 15 Mar. 1972
H. Clyde Melick, Jr. Wright-Patterson AFB, Ohio AFAPL Mar. 1972 286 p refs.
(Contract F33615-71-C-1500)
(AD-739858; AFAPL-TR-72-14) Avail: NTIS CSCL 21/5

A method has been developed for quantitatively accounting for flow non-uniformity in an inlet. This method is recommended for use as an additional indicator of design excellence during the early inlet development cycle, prior to the time firm engine indices can be established. A concept of flow quality, Q, has been defined for this purpose. It is related to the area weighted total pressure below average at the exit of the inlet system. This quality indicator can be related to all existing engine indices and was screened from 24 candidate definitions. The total pressure below average can be a function of time, in which case quality will include unsteady effects. GRA

N72-28798# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Energy Conversion Research Lab.
THE PERFORMANCE CHARACTERISTICS OF THE 7/10'S NOZZLES IN THE FIVE FOOT SINGLE CHANNEL VERTICAL EJECTOR. Final Report
Richard B. Fancher Oct. 1971 99 p refs
(AF Proj. 7116)
(AD-739863; ARL-71-0236) Avail: NTIS CSCL 21/5

The report is a contribution to the research of V/STOL propulsion. The results on a compact two-dimensional rectangular ejector are described. Although thrust augmentation performance was not distinctive, some of the other findings are of value. There appears to be a definite relationship between the flow turning angle and ejector performance. Also an unexpected but beneficial mixing phenomena occurs when two adjacent jets merge. Penetration of the primary flow through the mixing section is important to ejector performance. GRA

N72-28801# Atlantic Research Corp., Alexandria, Va.
ADVANCED FUEL SYSTEMS FOR RAMJET-POWERED VEHICLES Technical Report, 30 Jun. 1969 - 30 Oct. 1971
Donald H. Sargent Feb. 1972 276 p refs
(Contract F33615-69-C-1849; AF Proj. 3012)
(AD-738634; TR-PL-9870-04-Vol-1; AFAPL-TR-72-1-Vol-1) Avail: NTIS CSCL 21/5

A study of advanced fuel systems for ramjet-powered vehicles is presented. The fuel considered in this study was the dense hydrocarbon RJ-5. Components of the fuel system studied included the fuel tank, tank pressurization subsystem, expulsion bladder, booster pump, transfer lines, valves, seals and insulation. Thermal conditioning is also evaluated. The fuel itself, RJ-5, was studied for design purposes, to evaluate storability, and to

determine compatibility of the fuel with materials with which it might come into contact. A full-scale fuel system simulator is described to evaluate fuel system properties over a wide range of operating and test results are presented. GRA

N72-28899*# Lockheed-Georgia Co., Marietta.
RESIDUAL STRENGTH AND CRACK PROPAGATION TESTS ON C-130 AIRPLANE CENTER WINGS WITH SERVICE-IMPOSED FATIGUE DAMAGE
H. Lawrence Snider, Franklin L. Reeder, and William Dirkin Washington NASA Jul. 1972 67 p ref
(Contract NAS1-9485)
(NASA-CR-2075; ER-11178) Avail: NTIS HC $3.00 CSCL 20K

Fourteen C-130 airplane center wings, each containing service-imposed fatigue damage resulting from 4000 to 13,000 accumulated flight hours, were tested to determine their fatigue crack propagation and static residual strength characteristics. Eight wings were subjected to a two-step constant amplitude fatigue test prior to static testing. Cracks up to 30 inches long were generated in these tests. Residual static strengths of these wings ranged from 56 to 87 percent of limit load. The remaining six wings containing cracks up to 4 inches long were statically tested as received from field service. Residual static strengths of these wings ranged from 98 to 117 percent of limit load. Damage-tolerant structural design features such as fastener holes, stringers, doublers around door cutouts, and spanwise panel splices proved to be effective in retarding crack propagation. Author

N72-28903# *Aeronautical Research Labs., Melbourne (Australia).*
THE INTERPRETATION OF THE SCATTER FACTOR
Feb. 1972 17 p refs
(ARL/SM-Note-373) Avail: NTIS HC $3.00

The application of scatter factors for determining aircraft fatigue life is discussed. Examples of national practices in scatter factor application are presented. A table of scatter factors for aircraft of Australia, U.S., and France is included. Author

N72-28908# Laboratoriqm fur Betriebsfestigkeit, Darmstadt (West Germany).
OPTIMIZATION OF THE BOLTED JOINT WING LOWER SURFACE-WING BODY FITTING OF A MILITARY AIRCRAFT [OPTIMIERUNG DER VERSCHRAUBTEN FUEGUNG ZWISCHEN FLUEGELUNTERDECKE UND ANSCHLUSSBESCHLAG EINES MILITAERFLUGZEUGES]
D. Schuetz and O. Goekgoel (Hamburger Flugzeugbau) 1971 172 p refs In GERMAN; ENGLISH summary Prepared jointly with Hamburger Flugzeugbau
(TB-95) Avail: NTIS HC $10.75

The fatigue strength of a joint wing lower surface-body wing fitting was optimized by manufacturing measures. With applied optimal measures variable amplitude fatigue tests exhibit an increase in fatigue life by a factor of 5 for the wing lower surface in the joint area and by a factor of 25 for the fitting. Factors 5 and 25 are related to the fatigue life resulting from conventional processing methods. Author (ESRO)

N72-28919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF HEAT-TRANSFER TEST DATA FOR A CHORDWISE-FINNED, IMPINGEMENT-COOLED TURBINE VANE TESTED IN A FOUR-VANE CASCADE AND A RESEARCH ENGINE
Herbert J. Gladden and Frederick C. Yeh Jul. 1972 38 p refs
(NASA-TM-X-2595; E-6870) Avail: NTIS HC $3.00 CSCL 20M

The heat-transfer characteristics of a chordwise-finned, impingement-cooled vane were investigated in both a modified J-57 research engine and a four-vane cascade. The data were compared by a correlation of temperature difference ratio with coolant- to gas-flow ratio and also by two modifications of this correlation. The results indicated that the cascade vane temperature data can generally be used to represent the engine vane temperature data. A discussion of engine and cascade gas-side heat-transfer coefficients is also presented. A redesign of the vane leading edge could significantly increase the potential turbine-inlet temperature operating limit. Author

N72-28966 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
THE ROCKET PIONEER FRIEDRICH WILHELM SANDER [DER RAKETENPIONIER FRIEDRICH WILHELM SANDER]
F. Alber *In* DGLR Report on the DGLR-Symp. Pioneers of Space Flight Sep. 1971 p 51-54 In GERMAN

Original experiments with liquid propelled rocket engines are attributed to this space flight pioneer. Also illustrated are the development of a rocket driven racing car with electrical ignition and the production of rocket engines for aircrafts.
Transl. by G.G.

N72-28975# Committee on Interstate and Foreign Commerce (U. S. House).
NOISE CONTROL ACT OF 1972
Staggers 19 Feb. 1972 39 p refs Rept. to accompany H.R. 11021 presented by the Comm. on Interstate and Foreign Com. to the Comm. of the Whole House on the State of the Union, 92d Congr., 2d Sess., 19 Feb. 1972
(H-Rept-92-842) Avail: US Capitol, House Document Room

The Committee on Interstate and Foreign Commerce presents an amendment to a proposed bill to control the emission of noise detrimental to the human environment. Considered is the nature and extent of noise as an element of environmental concern; the adequacy of technology to deal with the problem of noise abatement; the extent and effectiveness of present Federal programs for noise control and the cost of noise control; the responsibility of the Federal Government, the States and their political subdivisions in abating and controlling noise; and the proper roles of the Environmental Protection Agency and the Federal Aviation Administration with respect to aircraft noise.
G.G.

N72-28976# National Business Aircraft Association, Inc., Washington, D.C.
FAA PLANNING REVIEW CONFERENCE PRESENTATION "PRIORITIES AND INVESTMENTS" PROGRAM
John A. Pope 27 Apr. 1971 10 p
Avail: NTIS HC $3.00

The present and projected airport requirements for the corporate/executive/business aircraft users are discussed. The business aircraft operators agree with the FAA in requiring ILS installation and control tower at more small airports. The business aircraft operators wish to be separated from all other general aviation operations and to have access to the system and metropolitan hub airports, with improved landside passenger service. Reliever airports in metropolitan areas should have good traffic flow to and from the airports, good surface conditions and facilities, and good surface transportation facilities. It is pointed out that business aircraft operations extend to thousands of airports while the airlines serve only approximately 525 points. It is felt that an established program for improvement of these airports in less populous areas is needed, along with the acquisition of valid data on airport use, passenger enplanements, numbers and types of aircraft, and related information. N.E.N.

N72-28978# Speas (R. Dixon) Associates, Manhasset, N.Y.
AIRPORT AND AIRSPACE CAPACITY ANALYSIS: SUPPLEMENTAL REPORT, PHASE 2
Sep. 1971 96 p refs Sponsored in part by the Dept. of Housing and Urban Development
Avail: NTIS HC $7.00

An analysis is presented of the airport air traffic capacity of several preliminary airport system alternatives to meet the 1985 San Francisco Bay area demand forecast of 83.5 million annual passengers. Aviation facilities include both airports and transitional airspace. Airline and general aviation traffic is included along with military traffic to the extent that it affects the capacity of civil facilities. Airport capacity is computed for individual airports, and the interrelation between airports is considered. Each of the eleven airport systems was found to be quantitatively capable of meeting its required air carrier demand. Residual capacity for general aviation is indicated where required, after forecast air carrier demand is satisfied. The effect each airport system would have upon transition and enroute airspace is also evaluated.
Author

N72-28979# Department of Transportation, Washington, D.C.
COMMUTER AIR CARRIERS
May 1972 75 p
Avail: NTIS HC $5.75

The usefulness and importance of commuter air carriers are discussed; it was found that 80 percent of their passengers connect with major airlines. Commuter carriers operate successfully without Federal requlation of rates and routes and Federal subsidies. The utilization of higher capacity aircraft for commuter service is being considered by the Civil Aeronautics Board. The commuter airline industry's history, Federal policies and programs, and regulatory problems are also presented.
J.A.M.

N72-28980*# National Aeronautics and Space Administration, Washington, D.C.
ADVANCED TECHNOLOGY AND EUROPEAN UNITY
R. Bloch Jul. 1972 18 p Transl. into ENGLISH from l'Aeronautique et l'Astronautique (Paris), no. 35, 1972 p 5-11
(NASA-TT-F-14354) Avail: NTIS HC $3.00 CSCL 05B

During the first forty years of the Twentieth Century, great scientific discoveries were still chiefly European; but in the last twenty-five years, nearly all discoveries are coming from the United States of America. Creative power remains a necessity of human progress; but personal genius, unless associated with a well structured modern organization, is no longer sufficient to fully develop practical invention. The present superiority of our American friends, and our Soviet neighbor's potential development, challenge the ability to materialize European ideas. Thanks to the gradual awakening of some European conscience successful cooperation will substantially promote European progress.
Author

N72-28981# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.
AIRPORT RANKING OF AIR CARRIER PASSENGER ENPLANEMENTS FISCAL YEAR 1971
Feb. 1972 7 p
Avail: NTIS

Data are provided for Fiscal Year 1971 on total air carrier passenger enplanements at all airports boarding more than 100,000 passengers within the 50 states of the United States, the District of Columbia, Guam, Puerto Rico, and the Virgin Islands. The data cover all domestic and international passengers enplaned by United States certificated route, foreign flag, supplemental and intrastate air carriers.
Author

N72-28982# Federal Aviation Administration, Washington, D.C Office of Aviation Policy and Plans.
PASSENGER UTILIZATION OF FAA FACILITIES
Jul. 1972 11 p
(AV-72-1) Avail: NTIS HC $3.00

An analysis of airport facilities is presented, showing that major portions of airports are not equipped with towers, radar, and instrument landing system. The concentration of passengers was found to benefit from FAA services at large air traffic airports. Percentage distributions of passenger enplanements for commissioned and programmed facilities are also given in tabular form.
J.S.M.

N72-28985# Department of Transportation, Washington, D.C.
CARGO SECURITY EQUIPMENT APPLICATIONS GUIDE
Report of the Technical Coordination Subcommittee
1 Jun. 1972 79 p Prepared for Interagency Comm. on Transportation Security with the assistance of MITRE Corp.
Avail: NTIS HC $6.00

Research and development efforts by DOT to assist civil aviation security programs are outlined. Particular attention was given to cargo security. An inventory was made of off-the-shelf equipment available for immediate use, and recommendations for the solution of common security problems using this equipment are given. Data cover physical protection, detection of theft or intrusion, and effective response to such problems.
E.H.W.

N72-28986# Federal Aviation Administration, Washington, D.C.
A SELECTED, ANNOTATED BIBLIOGRAPHY RELATED TO AVIATION'S RESPONSES TOWARD IMPROVING THE ENVIRONMENT
Nov. 1971 21 p refs
(GA-300-89) Avail: NTIS HC $3.25

A brief bibliography is presented in an effort to counteract some of the negativism found in print about aircraft environment pollution. Data given here cover a partial list of magazine articles, leaflets, booklets, speeches, and congressional testimony on the environmental problem solving efforts of the industry.
Author

N72-28989# Army Foreign Science and Technology Center, Charlottesville, Va.
ANTIAIRCRAFT DEFENSE HERALD. NUMBER 5, MAY 1971
3 Jan. 1972 188 p Transl. into ENGLISH of Vestn. Protivovozdushnoi Oborony (Moscow), No. 5, May 1971
(AD-739972; FSTC-HT-23-902-72) Avail: NTIS CSCL 15/3

Contents: Combat readiness, Air tactical exercises, Teamwork, Military training, Technical inspection quality, Noise control, Computer programming, Optical ranging, Winged rocket countermeasures, Military psychology.
GRA

N72-28994*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
CALCULATIVE TECHNIQUES FOR TRANSONIC FLOWS ABOUT CERTAIN CLASSES OF WING BODY COMBINATIONS
Stephen S. Stahara and John R. Spreiter Washington NASA Aug. 1972 99 p refs
(Contract NAS2-6259)
(NASA-CR-2103) Avail: NTIS HC $3.00 CSCL 01A

Procedures based on the method of local linearization and transonic equivalence rule were developed for predicting properties of transonic flows about certain classes of wing-body combinations. The procedures are applicable to transonic flows with free stream Mach number in the ranges near one, below

the lower critical and above the upper critical. Theoretical results are presented for surface and flow field pressure distributions for both lifting and nonlifting situations. Author

N72-28995# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

AN APPROXIMATE TREATMENT OF THE STABILITY OF A TOWED UNBANKED OBJECT IN A CONDITION OF ZERO LIFT

H. R. Hopkin London Aeron. Res. Council 1971 33 p refs Supersedes RAE-TR-69076; ARC-31359

(ARC-R/M-3675; RAE-TR-69076; ARC-31359) Avail: NTIS HC $3.75; HMSO: £1.20; PHI: $4.90

An approximate method is given for assessing the stability of a towed object. The analysis is developed in terms of lateral stability but can be simply translated to deal with the longitudinal case. Stability criteria are derived which involve a number of parameters including the mass and moment of inertia of the body its drag and transverse aerodynamic force and yawing moment characteristics, and the vertical separation between towed body and the tug. Formulas and charts are given for application of the method. Author (ESRO)

N72-28996# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE TWO-DIMENSIONAL FLOW AROUND A SLOTTED FLAP

D. N. Foster, H. P. A. H. Irwin, and B. R. Williams London Aeron. Res. Council 1971 70 p refs Supersedes RAE-TR-70164; ARC-32681

(ARC-R/M-3681; RAE-TR-70164; ARC-32681) Avail: NTIS HC $5.50; HMSO £2.45; PHI $9.60

Experimental measurements and theoretical analysis of the flow around a wing with a single slotted flap under two-dimensional flow conditions are reported. The particular experimental techniques of testing and measurement are described. The results show that the measured flow is strongly dependent on the inviscid solution for the flow around the wing and the flap, and that near to the optimum flap position there is only weak interference between the wake from the wing and boundary layer on the flap. The reasons for the occurence of an optimum flap position are given, and some comments made on the influence of Reynolds number on this position.

Author (ESRO)

N72-28997# National Physical Lab., Teddington (England). Aerodynamics Div.

THE VORTEX DRAG OF A SWEPT WING WITH PART-SPAN FLAPS

H. C. Garner London Aeron. Res. Council 1972 19 p refs Supersedes ARC-32395

(ARC-R/M-3695; ARC-32395) Avail: NTIS HC $3.00; HMSO 70p; PHI: $2.95

Two theoretical methods of calculating the vortex drag factor from a prescribed spanwise loading and a novel third method, on the reverse-flow principle without a definitive spanwise loading, are applied to an untapered swept wing with symmetrically deflected outboard flaps. Results are consistent within + or - 1 1/2 percent. The third method is used to study the large influence of flap span and chord. Author (ESRO)

N72-28998# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

EXPLORATORY TESTS ON A FORWARD-MOUNTED OVERWING ENGINE INSTALLATION

D. J. Kettle, A. G. Kurn, and J. A. Bagley London Aeron. Res. Council 1972 60 p refs Supersedes RAE-TR-70150; ARC-32661

(ARC-CP-1207; RAE-TR-70150; ARC-32661) Avail: NTIS HC $5.00; HMOS 95p: PHI $3.90

Wind-tunnel tests have been made to assess the aerodynamic potential of an overwing installation for fan-jet engines on a typical modern transport aeroplane. Low-speed tests on a complete model with free-flow nacelles and tests at higher speed on a partial model incorporating a blown jet are described. It is concluded that the lift-dependent drag associated with such an installation would be significantly greater than that of a conventional underwing engine installation. Author (ESRO)

N72-28999# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

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

D. R. Roberts London Aeron. Res. Council 1972 60 p refs Supersedes RAE-TR-71033; ARC-33171

(ARC-CP-1208; RAE-TR-71033; ARC-33171) Avail: NTIS HC $5.00; HMSO: 90p; PHI: $3.65

Measurements were made of the boundary-layer pressure fluctuations 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 215 millions. Pressure spectra were deduced, and were found to compare reasonably with a theoretical spectrum for homogeneous isotropic turbulence. The scale of the boundary-layer turbulence was found to fluctuate between 47% and 76% of the turbulence boundary-layer thickness over a range of Mach numbers from 1.5 to 2.2, while being essentially equal to 50% of this thickness over the range M = 2.0 to M = 2.2. At M = 2.2 the root mean square boundary-layer pressure was equal to 0.0045 of the free stream dynamic pressure.

Author (ESRO)

N72-29000# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AERODYNAMICS

A. M. Mkhitaryan 7 Feb. 1972 326 p refs Transl. into ENGLISH from the publ. "Aerodinamika" 1970 p 175-428

(Contract F33657-71-D-0057)

(AD-740190; FTD-HC-23-720-71) Avail: NTIS CSCL 01/1

The book deals with the fundamentals of aerodynamics in application to passenger aircraft configurations and includes the laws of motion of gases and bodies submerged in them, similarity laws for gas flows, and the fundamentals of finite-wing and boundary-layer theory. The characteristics of the earth's atmosphere are presented. Aerodynamic experiment techniques and equipment are described. The aerodynamic characteristics of wing profiles, wings and tails of various shapes, bodies of revolution, and the airplane as a whole are examined. Special chapters are devoted to the specific features of hypersonic aerodynamics and fundamentals of airscrew (puller and pusher) theory. Author (GRA)

N72-29001# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.

THE CONTROL VOLUME CONCEPT IN AERONAUTICAL ENGINEERING M.S. Thesis

Carlos Tromben Corbalan Dec. 1971 88 p refs

(AD-741132) Avail: NTIS CSCL 01/2

The thesis is concerned with the fundamental physical laws of continuity, momentum, and energy used in aeronautical engineering which are transformed from the control mass or system form into the control volume form. It is intended for the document to serve as a self-studying guide for students in the core of the aeronautical engineering program at the Naval Postgraduate School and as a reference during the graduate level courses. GRA

N72-29002# Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
COMPLETE SOLUTION FOR LIFTING WINGS WITH PARABOLIC TIPS
Peter F. Jordan Mar. 1972 70 p refs
(Contract F44620-69-C-0096; AF Proj. 9781)
(AD-741883; RIAS-TR-72-040; AFOSR-72-0814TR) Avail: NTIS CSCL 01/1

A complete investigation of the solution for lifting wings with parabolic wing tips is presented. All the leading components of the tip pressure singularity are identified. Specific solutions differ from each other by the amplitudes of elements which converge to higher order at the tip; the order of convergence of the specific components also is established. The model used in the analysis is the circular wing in incompressible flow, but the essence of the results is valid for wings of any aspect ratio. For the circular wing, several numerical solutions are given to high accuracy, and several conclusions of immediate technical interest are drawn. As a by-product of the analysis summation formulas for infinite progressions which involve the logarithm were developed. Author (GRA)

N72-29003*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COOLANT PRESSURE AND AIRFLOW DISTRIBUTION IN A STRUT-SUPPORTED TRANSPIRATION-COOLED VANE FOR A GAS TURBINE ENGINE
Albert Kaufman, David J. Poferl, and Hadley T. Richards Washington Aug. 1972 25 p refs
(NASA-TN-D-6916; E-6800) Avail: NTIS HC $3.00 CSCL 20D

An analysis to predict pressure and flow distribution in a strut-supported wire-cloth vane was developed. Results were compared with experimental data obtained from room-temperature airflow tests conducted over a range of vane inlet airflow rates from 10.7 to 40.4 g/sec (0.0235 to 0.0890 lb/sec). The analytical method yielded reasonably accurate predictions of vane coolant flow rate and pressure distribution. Author

N72-29004*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
EXAMINATION OF THE COLLISION FORCE METHOD FOR ANALYZING THE RESPONSES OF SIMPLE CONTAINMENT/DEFLECTION STRUCTURES TO IMPACT BY ONE ENGINE ROTOR BLADE FRAGMENT
Robert M. Zirin and Emmett A. Witmer May 1972 163 p refs
(Grant NGR-22-009-339)
(NASA-CR-120952; ASRL-TR-154-6) Avail: NTIS HC $10.25 CSCL 01B

An approximate collision analysis, termed the collision-force method, was developed for studying impact-interaction of an engine rotor blade fragment with an initially circular containment ring. This collision analysis utilizes basic mass, material property, geometry, and pre-impact velocity information for the fragment, together with any one of three postulated patterns of blade deformation behavior: (1) the elastic straight blade model, (2) the elastic-plastic straight shortening blade model, and (3) the elastic-plastic curling blade model. The collision-induced forces are used to predict the resulting motions of both the blade fragment and the containment ring. Containment ring transient responses are predicted by a finite element computer code which accommodates the large deformation, elastic-plastic planar deformation behavior of simple structures such as beams and/or rings. The effects of varying the values of certain parameters in each blade-behavior model were studied. Comparisons of predictions with experimental data indicate that of the three postulated blade-behavior models, the elastic-plastic curling blade model appears to be the most plausible and satisfactory for predicting the impact-induced motions of a ductile engine rotor blade and a containment ring against which the blade impacts. Author

N72-29005# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT. APACHE AIRLINES, INCORPORTAED, DE HAVILLAND DH-104-7AXC, N4922V, COOLIDGE, ARIZONA, 6 MAY 1971
1 Jun. 1972 15 p refs
(NTSB-AAR-72-19) Avail: NTIS HC $3.00

Apache Airlines, Inc., De Havilland Model 104-7AXC, crashed near Coolidge, Arizona, on 6 May 1971, at approximately 1315 m.s.t., while en route from Tucson to Phoenix, Arizona. The aircraft was observed to enter a shallow dive which steepened as the aircraft approached the ground. The right wing separated from the fuselage just prior to ground impact. The aircraft disintegrated upon impact and all 10 passengers and the two crewmembers were fatally injured. Author

N72-29006*# Techtran Corp., Glen Burnie, Md.
INFLUENCE OF THE FLEXIBILITY OF THE ROTOR ELEMENTS ON THE DYNAMIC DEFLECTION OF THE ROTOR AS A WHOLE
N. G. Samarov Washington NASA Aug. 1972 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), v. 14, no. 2, 1971 p 67-75
(Contract NASw-2037)
(NASA-TT-F-14390) Avail: NTIS HC $3.00 CSCL 01B

The qualitative influence of an eccentricity of the rotor elements on the dynamic deflection of the rotor is assessed. It is shown that the dynamic deflection of the axis of a rotor of composite design is influenced not only by an eccentricity of the shaft but also by that of the individual rotor elements, in particular of disks and blades. The deflection caused by the individual elements is shown to vary as a function of the rpm to a greater extent than the deflection caused by the eccentricity of the rotor as a whole. A method of determining the rotor imbalance both along the length and radius (and, consequently, determining the spots where balancing loads should be applied) is proposed. Author

N72-29007# National Transportation Safety Board, Washington, D.C.
A STUDY OF US AIR CARRIER ACCIDENTS, 1964 - 1969
10 May 1972 384 p refs
(NTSB-AAS-72-5) Avail: NTIS HC $21.25

The record of aircraft accidents which occurred in U.S. Air Carrier Operations during the period 1964-69 is presented. It includes a statistical recapitulation of all accidents, an analysis, a brief of each accident, and a reference section consisting of several cross reference listings. Author

N72-29008# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: FEDERAL AVIATION ADMINISTRATION DOUGLAS DC-3C, N7, LA GUARDIA AIRPORT, NEW YORK, 4 JANUARY 1971
3 Jun. 1971 16 p
(NTSB-AAR-71-11) Avail: NTIS HC $3.00

A Federal Aviation Administration Douglas DC-3C crashed approximately 2,000 feet short of the approach threshold of Runway 4 at La Guardia Airport, New York, January 4, 1971, at 1832 e.s.t. The crew was attempting to fly an instrument landing system approach in instrument meteorological conditions, at night. The board determines that the probable causes of this accident were: (1) failure of the pilot to recognize the windshear condition and compensate for it; (2) the lack of crew coordination in that the copilot did not monitor the approach due to a selfinduced communications problem and failed to warn the pilot that the aircraft was too low; and (3) the diversion of the pilot's attention from his primary task of completing the approach and landing. These conditions resulted in a mismanaged ILS and landing approach and the continuation of the descent into ground obstructions. Author

N72-29009*# United Aircraft Corp., Stratford, Conn.
APPLICATION OF BORON/EPOXY REINFORCED ALUMINUM STRINGERS AND BORON/EPOXY SKID GEAR FOR THE CH54B HELICOPTER TAIL CONE. PHASE 2: FABRICATION, INSPECTION AND FLIGHT TEST Final Report, May 1971 - Mar. 1972
R. T. Welge 28 Aug. 1972 68 p refs Sponsored in part by Army
(Contract NAS1-10459)
(NASA-CR-112101) Avail: NTIS HC $5.50 CSCL 01B

A CH-54B Skycrane helicopter was fabricated with boron/epoxy reinforced stringers in the tail cone and boron/epoxy tubes in the tail skid. The fabrication of the tail cone was made with conventional tooling, production shop personnel, and no major problems. The flight test program includes a stress and vibration survey using strain gages and vibration transducers located in critical areas. The program to inspect and monitor the reliability of the components is discussed. Author

N72-29010# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
AN EXPERIMENTAL INVESTIGATION OF HIGH-SPEED ROTORCRAFT DRAG Final Report
James C. Linville Fort Eustis, Va. AAMRDL Feb. 1972 215 p refs
(Contract DAAJ02-70-C-0018; DA Proj. 1F1-62203-AA-41)
(AD-740771; SER-50713; USAAMRDL-TR-71-46) Avail: NTIS CSCL 01/3

An experimental investigation was carried out to determine the effect of subsonic Mach number on the drag characteristics of a high-speed wingless and winged helicopter when equipped with two different rotor head fairings. A simulated unfaired rotor head was provided as a basis for comparison. Tests were performed using a 1/9th scale model of a 60,000-pound class helicopter design. Data acquired included gross model force and rotor head force data, wing and pylon surface pressures, and tuft photos. GRA

N72-29011# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NOISE FROM AIRCRAFT OPERATIONS AT MIRAMAR NAVAL AIR STATION, CALIFORNIA AND LAND USE INTERPRETATIONS
Dec. 1971 81 p refs
(Contract N62474-71-C-4781)
(AD-740393; BBN-2098) Avail: NTIS CSCL 20/1

The purpose of the report is to define the noise environment due to military aircraft operations in the vicinity of Miramar Naval Air Station. The noise environment is depicted by means of several noise contours which are interpreted in terms of expected impact on land usage. The major purpose of the study is to provide interpretations of the aircraft noise as an aid in the compatible development of land surrounding Miramar Naval Air Station. Author (GRA)

N72-29012# Boeing Co., Seattle, Wash. Aeronautical and Information Systems Div.
ANALYTICAL INVESTIGATION OF VARIABLE CAMBER CONCEPTS Final Report, 15 Jan. - 15 Aug. 1971
A. Larry DeCosta, Kichio K. Ishimisu, Charles R. Pickrel, Douglas S. Miller, and Thomas A. Zierten Dec. 1971 171 p refs
(Contract N00014-71-C-0199)
(AD-740369; D-180-140013-1) Avail: NTIS CSCL 01/3

The principal objective of the investigation was to determine analytically the potential aerodynamic performance improvements that may be achieved through the use of variable camber. The feasibility study vonsidered initially systematic camber variations on two-dimensional airfoils representative of successful airfoils in widespread current usage and of a most promising research airfoil. The application of variable camber to each of these airfoils resulted in significant expansions of their performance envelopes. It was found that the Whitcomb Supercritical Airfoil achieved outstanding aerodynamic performance throughout the speed regime studied. Author (GRA)

N72-29013# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
THE STUDY OF DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL Yearly Report, 1 Jan. - 31 Dec. 1971
E. B. Lee 13 Apr. 1972 10 p refs
(Grant AF-AFOSR-1502-68)
(AD-740873; AFOSR-72-0918TR) Avail: NTIS CSCL 01/3

The research conducted during the last year has been primarily directed toward the development of new controller synthesis techniques for large modern Air Force aircraft. Control and modeling of systems with distributive parameters and time delays have been considered. The goal has been to evolve techniques which can be readily used in the design of controllers to reduce structural loading during wind gusts and in the design of controllers which can be used in configuring the vehicle to reduce appendage size and weight while maintaining satisfactory aircraft handling characteristics. An eventual goal is to have techniques of synthesis which take account of control capabilities during the original configuring of the vehicle that is, to enable design of the control system in parallel with the structure and propulsion systems. Author (GRA)

N72-29014# Instrument Pilot Instructor School, Randolph AFB, Tex.
CREW DUTIES, MODE AND FUNCTION STUDY
Donald L. Carmack Oct. 1971 28 p
(AD-740502; IPIS-TN-71-4) Avail: NTIS CSCL 01/2

Some of the basic problems associated with low visibility approaches can be traced to doubts concerning piloting roles when operating to lower minimums. Somewhat dependent on piloting procedures are the avionics and mode selection configurations which will not only integrate man and automatics, but provide the apparatus for control/monitoring and decision making. It is quite correct that an autopilot is an extremely important systems component. However, an autopilot in itself will not fulfill piloting requirements. What if the autopilot fails or softens in an axis. The crew must be prepared to take over the failed or softened component. This will only be possible if an adequate man/machine interface has been accomplished. Author (GRA)

N72-29015# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MAINTENANCE MANHOUR SENSITIVITY MODEL FOR CARGO AIRCRAFT M.S. Thesis
Terry R. Little Mar. 1972 124 p refs
(AD-741410; GSA/SM/72-9) Avail: NTIS CSCL 15/5

A statistical study, based on one year's historical data, was made on the effects of certain policy changes on both cargo aircraft maintenance manhours and aircraft out-of-commission time. The results indicated that manhours were highly sensitive to flying hours, but not in constant proportion as implied in the generally used term, manhours/flying hour. Sortie length and number of landings per sortie have no apparent effects on manhours, judging from the sample data. It was further discovered that manhour changes may be expected if an aircraft is deployed either to Pacific Air Forces or Reserve/Guard units. Further manhours were found to be highly correlated with aircraft complexity as primarily measured by aircraft empty weight. Author (GRA)

N72-29016# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRELIMINARY DESIGN OF AN AIRCRAFT

B. T. Goroshchenko, A. A. Dyachenko, and N. N. Fadeev 10 Feb. 1972 404 p refs Transl. into ENGLISH from "Eskiznoe Proektirovanie Samoleta" 1970 p 1-332
(AD-741485; FTD-HC-23-753-71) Avail: NTIS CSCL 01/3

The book sets forth the fundamentals of elaboration of technical specifications for a new aircraft design, problems of the influence of geometrical and other parameters of the aircraft on its flight characteristics and stability indices (together with methods for approximate calculation of these characteristics and indices), and also the principles of layout selection, determination of the basic weight, geometrical, and structural characteristics, over-all configuration, trim, and airframe development for the preliminary design stage. In addition, the book presents an example of the application of the basic principles of preliminary aircraft design. Author (GRA)

N72-29017# Army Aeromedical Research Lab., Fort Rucker, Ala.

CRASH INJURY ECONOMICS: INJURY AND DEATH COSTS IN ARMY UH-1 ACCIDENTS IN FISCAL YEAR 1969

Armand E. Zilioli and Jay C. Bisgard Dec. 1971 37 p refs
(DA Proj. 3A0-62110-A-819)
(AD-741363; USAARL-71-18) Avail: NTIS CSCL 01/2

During fiscal year 69, there was a total of 546 major and minor noncombat aircraft accidents involving UH-1 type helicopters. The report presents an economic study of the 160 individuals with major injuries and 227 fatalities which occurred in 129 of these accidents. Minor injuries were not considered. Personnel costs of aircraft accidents were evaluated using hospitalization and convalescence times and costs, pay costs, replacement costs, funeral costs, death benefits and Veterans Administration and Social Security Administration benefits. These costs were computed using the least expensive method. Human costs, such as pain, suffering, deformity, or the loss of earning power are factors which are real costs but which cannot be determined. The total treatment time for the 160 injured individuals was 19,097 days. When considered on the basis of a 246 day work year, the total treatment time equaled 77.6 work years. Author

N72-29018# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A GRADIENT TECHNIQUE FOR DETERMINING IMPROVED AIRCRAFT TRAJECTORIES FOR REDUCING AIRCRAFT PROBABILITY OF KILL TO ANTI-AIRCRAFT GUN FIRE M.S. Thesis

Floyd L. Cooper, Jr. Mar. 1972 69 p refs
(AD-741373; GAW/MC/72-4) Avail: NTIS CSCL 19/5

The problem is to develop a technique for predicting improved aircraft flight paths that simultaneously reduce the probability of the aircraft being killed by anti-aircraft gun (AAA) fire, and fly the aircraft to certain specified position and velocity vectors, both in and out of gun range. This study develops and demonstrates a gradient minimization technique called OPTAAA for solving this problem. OPTAAA utilizes the SIMFIND1 AAA attrition model, written by the Institute for Defense Analyses, as a subroutine for computing the aircraft probability of kill. OPTAAA is applied to three problems. One of the problems utilizes two-dimensional aircraft trajectories and results in a 39.7 percent reduction in probability of kill. The second and third problems utilize three-dimensional aircraft trajectories and result in a 17.7 percent and a 41.5 percent reduction, respectively, in probability of kill. Author (GRA)

N72-29019# American Nucleonics Corp., Woodland Hills, Calif.

COMPARISON OF UH-1C FLIGHT TEST DATA WITH MOSTAB-C SMALL PERTURBATION MATH MODEL Final Report

Arhtur J. Welch and Edward L. Warren Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Dec. 1971 116 p refs
(Contract DAAJ02-71-C-0023; DA Proj. 1F1-62204-A-A44)
(AD-740774; ANC-95R-1; USAAMRDL-TR-71-66) Avail: NTIS CSCL 20/4

The purpose of the work performed under this contract was to conduct a UH-1C model validation analysis. The model was obtained from Government-furnished MOSTAB-C computer data that defined the UH-1C stability and control derivatives at selected flight conditions. The reference data consisted of Government-furnished UH-1C helicopter flight test data. Overall, the MOSTAB-C data represented a fair first approximation to the actual vehicle dynamics. The MOSTAB-C data that was least representative of the actual vehicle response dynamics was the cross-coupling responses. Author (GRA)

N72-29020# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

CRITERIA FOR EXTERNALLY SUSPENDED HELICOPTER LOADS Final Report

Stanley J. Briczinski and George R. Karas Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Nov. 1971 211 p
(Contract DAAJ02-70-C-0021; DA Proj. 1F1-62203-A-435)
(AD-740772; SER-50731; USAAMRDL-TR-71-61) Avail: NTIS CSCL 01/3

The study was conducted to determine the dynamic effects of a helicopter external load combination by simulating flight using a computer. Design criteria for sling members and hard points of the system were also established. A computerized hybrid simulation of the coupled motion of a CH-54 helicopter and selected external loads was conducted in real time with a pilot in the loop on both fixed-base and moving-base simulators. The results of the study indicate that the dynamic load factors produced in sling elements and at hard points during a maneuver often exceed the normal load factor developed by the helicopter. Data is included for the various loads and maneuvers. GRA

N72-29021# Stanford Research Inst., Menlo Park, Calif.

SLANT RANGE VISIBILITY MEASUREMENT FOR AIRCRAFT LANDING OPERATIONS Final Report, 1 Apr. 1971 - 30 Apr. 1972

William Viezee, John Oblanas, and Ronald R. H. Collis Feb. 1972 94 p refs
(SRI Proj. 1148; AF Proj. 6670)
(AD-742359; AFCRL-72-0154) Avail: NTIS CSCL 01/2

A method of determining slant visibility by lidar observations from the ground during various degrees of fog and low cloud conditions was investigated in an experimental program at a coastal site. The emphasis of the study was on the operational aspects of landing aircraft in Categories I and II conditons, and the first concern was to ascertain whether a pilot might be expected to obtain visual reference from the critical heights of 200 ft and 100 ft respectively. This depends primarily upon the transmittance along the slant path from the cockpit to the ground. The air of the lidar observations was to determine the conditions of atmospheric transmittance aloft, with special reference to whether the appropriate minimum values are exceeded. Author (GRA)

N72-29022# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.

ADVANCED INTEGRATED FIGHTER COCKPIT STUDY Final Draft

D. R. Zipoy, S. T. Premselaar, and N. A. Kopchick Wright-Patterson AFB, Ohio AFFDL Jun. 1971 49 p refs
(Contracts F33615-69-C-1544; F33615-70-C-1832)
(AD-741948; AFFDL-TR-71-57) Avail: NTIS CSCL 01/3

The report presents, in summary fashion, a general description of the work accomplished to date on the development of a concept for the crew station of an advanced tactical fighter

aircraft of the 1980 time period. A composite mission profile and scenario are presented to define the operational requirements for the system concept. Airplane configuration and performance are described, and the characteristics and capabilities of the on-board avionics are summarized. A full-sized, single-place cockpit mockup and three basic interior configurations have been fabricated to reflect study results and to serve as evaluation tools. Author (GRA)

N72-29023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING STABILITY DERIVATIONS FROM FLIGHT TEST RESULTS WITH AID OF REGRESSION ANALYSIS
H. Friedrich 20 Jan. 1972 47 p refs Transl. into ENGLISH from Deutsch Ges. fuer Luft-und Raumfahrt E. V. (West Germany), 1969 p 1-44
(AF Proj. 139A)
(AD-741486; FTD-HT-23-662-71) Avail: NTIS CSCL 01/3

A static method is given for ascertaining stability derivative from the results of flight tests. The theory of the methods used, the so-called regression analysis is traced in detail. The necessary modifications are also reported with respect to practical performance and the computer program is explained in its basic outlines. In conclusion, discussion is entered into with relation to the experiments thus far collected with this evaluation method. Report is first made concerning the tests with the measured values from the flight simulator and finally report is made on the first experiments with results of actual flight tests from the Do 31 flight investigation. Author (GRA)

N72-29024# Army Agency for Aviation Safety, Fort Rucker, Ala.
PREPARATION OF A SYSTEM SAFETY PROGRAM PLAN FOR AVIATION SYSTEMS DEVELOPMENT Final Report
Mar. 1972 36 p ref
(AD-741364; USAAAVS-TR-72-8) Avail: NTIS CSCL 13/12

As an essential part of the Army aviation accident prevention program, System Safety is dedicated to :before the fact: elimination of hazards from aircraft systems by the application of management, science, and technology principles. Army attempts to apply the provisions of MIL-STD-882 in aircraft development programs indicates a significant gap between requirements at the standard and a practical safety program. The purpose of the report is to identify specific areas of concern which lie between the philosophical and the practical applications of system safety. GRA

N72-29025# Dayton Univ. Research Inst., Ohio.
METHOD FOR THE PREDICTION OF PERFORMANCE OF STOL HIGH LIFT SYSTEMS NEAR MAXIMUM LIFT COEFFICIENT Final Report, Jan. - Sep. 1971
Paul T. Bauer Wright-Patterson AFB, Ohio AFFDL Dec. 1971 54 p refs
(Contract F33615-70-C-1019; AF Proj. 1366)
(AD-740476; AFFDL-TR-71-169) Avail: NTIS CSCL 01/3

Potential flow and boundary layer methods are identified and developed for the analytic calculation of the performance of lift systems with significant flow separation. Particular emphasis is given to the use of the presented methods in the calculation of the flow field for a single airfoil in demonstration of their capability. A procedure for application to multiple element high lift systems is indicated. Special consideration is given to the representation of turbulent separating boundary layers and an empirical computational procedure has been developed where none had previously existed. The work presented herein provides a thorough basis on which to develop an accurate computer simulation model of high lift systems with significant flow separation. Author (GRA)

N72-29026# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
G PROTECTIVE TILTING AIRCRAFT SEATS Interim Report
Harald J. VonBeckh 15 Mar. 1972 57 p refs
(AD-741202; NADC-72063-CS) Avail: NTIS CSCL 01/3

Several tilting, supinating seats which have been tested in flight and on centrifuges are described and their biomedical adequacy assessed. Only those, which assure unrestricted visibility in all directions will be accepted by the pilots. This can be achieved by an adequate selection of the pivot points, and other design criteria which are synthesized. Concerted effort of designers, aeromedical investigators and last but not least - pilots is urged for the realization of such an integrated G protective man-machine system. Supinating seats should also be provided for the crew of winged reentry vehicles (Space-Shuttle). For the passengers multi-directional G protective systems with escape capabilities should be developed. Author (GRA)

N72-29027# Air Force Academy, Colo. Frank J. Seiler Research Lab.
OPTIMAL 3-DIMENSIONAL MINIMUM TIME TURNS FOR AN AIRCRAFT Final Report
Robert P. Humphreys, George R. Hennig, William A. Bolding, and Larry A. Helgeson May 1972 39 p refs
(AF Proj. 7904)
(AD-742266; SRL-TR-72-0006) Avail: NTIS CSCL 01/2

Using a 3-dimensional formulation for an aircraft's dynamics, the required controls for a minimum time-to-turn are calculated. Three controls are used: angle of attack, bank angle, and thrust. The minimum time-to-turn solutions are subject to varying terminal conditions on both flight path angle and heading angle. In general, the times for the turns are not greatly changed by varying thrust/weight ratios or the final flight path angle. Significant effects on the change in total energy, final altitude, final velocity and control histories are noted for variations of the above parameters. Solutions to the above are accomplished through the use of Miele's Sequential Gradient-Restoration Algorithm Author (GRA)

N72-29028# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS
Lester R. Burroughs, Edwin Stolper, and Richard Hawkins Feb. 1972 52 p refs
(Contract DAAJ02-70-C-0040; DA Proj. 1F1-62203-A-143)
(AD-742248; SER-50710; USAAMRDL-TR-71-74) Avail: NTIS CSCL 01/3

The H-3 series helicopter program has been used to provide a basis for the trade-off studies. The test and service experience has been reviewed to provide a data bank on the performance of transmission and rotor system components and to determine modes and types of failures. The extent of correlation between failures during the initial test programs and those problem areas that were later detected during actual usage was investigated to determine the effectiveness of the test programs. Several changes have been advocated in both testing philosophy and the corresponding test techniques since the H-3 helicopter test program commenced. Various testing concepts have been considered and compared to develop a recommended test program for a single-rotor helicopter having a nominal gross weight of 15,000 pounds. Author (GRA)

N72-29030# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN OF A LONGITUDINAL FLIGHT CONTROL SYSTEM FOR A STOL TRANSPORT IN THE LANDING CONFIGURATION M.S. Thesis

Edwin L. Hamilton Mar. 1972 122 p refs
(AD-742314; GE/EE/72-13) Avail: NTIS CSCL 01/3

The longitudinal dynamics of a medium STOL transport are studied to determine the augmentation necessary to provide an acceptable longitudinal flight control system, and a flight control system is synthesized and evaluated. Wind tunnel data is analyzed and an operating envelope is defined. Longitudinal handling qualities of the unaugmented aircraft are compared to Air Force requirements, and design criteria are formulated. A longitudinal flight control system which utilizes parallel actuation of both elevator and direct-lift control spoilers through movement of the pilot's stick is synthesized using root locus techniques. The system is based upon control of the flight path.

Author (GRA)

N72-29031# Systems Technology, Inc., Hawthorne, Calif.
PILOT EXPERIMENTS FOR A THEORY OF INTEGRATED DISPLAY FORMAT Final Report
Warren F. Clement, R. Wade Allen, and Dunstan Graham Oct. 1971 200 p refs
(Contract N00014-68-C-0443; NR Proj. 213-044)
(AD-742127; STI-TR-183-2; JANAIR-711107) Avail: NTIS CSCL 01/4

In support of a theory for manual control displays, and, in particular, for integrated displays, a series of two pilot experiments were performed to enlarge the data base for the theory. A single-axis tracking experiment was performed with two different controlled elements and four different display formats. The effects of display format were separately evaluated from task difficulty and task performance with a particular view toward quantification of the pilots: parafoveal perceptual ability. In the second experiment four different integrated displays were tested in a precision tracking task with a view toward quantifying the effect of integration in the display. Author (GRA)

N72-29119# Federal Aviation Administration, Washington, D.C. Communications Branch.
APPLICATION OF SSB TECHNIQUES TO A/G COMMUNICATIONS
Charles Santora Jan. 1972 42 p
Avail: NTIS HC $4.25

Single sideband (SSB) transmission is studied for possible advantageous use in very high frequency (VHF) and ultrahigh frequency (UHF) ground stations. Author

N72-29134# Rome Air Development Center, Griffiss AFB, N.Y.
CALIBRATION OF C-131 AND KC-135 AIRCRAFT AS HF TEST VEHICLES Final Report, Dec. 1970 - Dec. 1971
Edward J. Christopher and Joseph L. Parry Feb. 1972 91 p refs
(AD-740553; RADC-TR-72-14) Avail: NTIS CSCL 09/5

The report describes a method of accurately calibrating two aircraft test vehicles by using an HF standard gain ground reference antenna whose design includes ground conductivity parameters. Analytical and experimental test programs were performed with a C-131 aircraft and its wing-tip mounted loop antenna and a KC-135 aircraft with its boom mounted loop antenna and fuselage mounted long wire antenna. Both type aircraft were calibrated as a complete receiving unit thereby taking into account variations in antenna pattern performance which result when the frequency of operation approaches the resonant frequency of the air frame. Author (GRA)

N72-29171# Naval Postgraduate School, Monterey, Calif.
THE DESIGN, DEVELOPMENT AND TRANSLATION OF GENERAL PURPOSE SOFTWARE FOR THE P3 C AIRCRAFT'S DIGITAL COMPUTER M.S. Thesis
Dennis Edward Ray Dec. 1971 79 p refs
(AD-741066) Avail: NTIS CSCL 09/2

The Navy has incorporated a modified UNIVAC 1830-A (CP 901 or ASQ/114) mini digital computer into its P3C aircraft. This ASQ/114 computer system is presently used only during aircraft testing and flying. In the near future, fifty or more of these digital systems will be operational and will sit virtually idle about 40% of the time. Hence, this project was undertaken to improve the computer utilization, and to provide the individual squadrons with an administrative computer capability. Six specific tasks leading to the implementation of a general purpose operating system have been undertaken: a feasibility study, development of a CP 901 translator, design and development of an assembler, design study of the bootstrapping technique, design of a FORTRAN compiler, and the design of a control operating system. Author (GRA)

N72-29207*# North Carolina State Univ., Raleigh. Center for Acoustical Studies.
DEVELOPMENT AND EVALUATION OF A DEVICE TO SIMULATE A SONIC BOOM
L. C. Rash, R. F. Barrett, and F. D. Hart May 1972 58 p refs
(Grant NGL-34-002-095)
(NASA-CR-112117) Avail: NTIS HC $5.00 CSCL 14B

A device to simulate the vibrational and acoustical properties of a sonic boom was developed and evaluated. The design employed a moving circular diaphragm which produced pressure variations by altering the volume of an air-tight enclosure that was located adjacent to an acoustical test chamber. A review of construction oriented problems, along with their solutions, is presented. The simulator is shown to produce the effects of sonic booms having pressure signatures with rise times as low as 5 milliseconds, durations as short as 80 milliseconds, and overpressures as high as 2.5 pounds per square foot. Variations in the signatures are possible by independent adjustments of the simulator. The energy spectral density is also shown to be in agreement with theory and with actual measurements for aircraft. Author

N72-29210# Association of Bay Area Governments, Berkeley, Calif.
AIRPORT NOISE AND LAND USE ANALYSIS
Paul K. Dygert, Judy A. Ungerer, and Fred L. Collins Mar. 1972 46 p refs Sponsored by HUD
Avail: NTIS HC $4.50

Two separate but related activities which were undertaken to provide a tool for the evaluation of changes in aircraft noise around airports are presented. The two activities involved, first, the development of extensive and detailed data on land uses around the three major air carrier airports in the area encompassed by the Regional Airport Systems Study; and, secondly, the creation of a computer-based system for manipulating the data so that it can be conveniently used for the study of alternative airport development plans. As inputs, the analysis uses the noise contours computed for the Regional Airport Systems Study and detailed land use data prepared by the Regional Airport Systems Study. The computer program for merging the land-use data and the noise contours is described. Author

N72-29220# Honeywell, Inc., St. Paul, Minn. Systems and Research Center.
DISPLAY AND SYSTEM REQUIREMENTS FOR LOW-VISIBILITY FORMATION FLIGHT; SUMMARY OF RESULTS Final Report, Jun. 1966 - Jun. 1971
P. A. Anderson and M. L. Toivanen Apr. 1972 220 p refs
(Contract N00014-66-C-0362; NR Proj. 213-054)
(AD-740375; Honeywell-12543-FR8; JANAIR-710803) Avail: NTIS CSCL 05/8

A summary of results of an eight-phase, applied research

program on low-visibility (IFR) formation flight display and system requirements is presented. The objective of this program was to define and validate through simulation total formation flight system concepts from the pilot's viewpoint. System characteristics and features that were investigated included: displays, display control laws, flight control, measurement systems, aircraft types, pilot skill acquisition, and system failures. Study results show comprehensively how manual formation flight system performance relates to various system element and operational characteristics. Steps to further validate and demonstrate the system concepts are suggested. Author (GRA)

N72-29221# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
SUBSONIC WIND TUNNEL FACILITIES
M. Alan Kidd Jan. 1972 29 p
(AD-741213; ASED-1186; NSRDC-3782) Avail: NTIS CSCL 14/2

Subsonic facilities available at the Naval Ship Research and Development Center (NSRDC) include two 8- by 10-foot general-purpose wind tunnels, a 15- by 20-inch research wind tunnel, and a vertical test facility. This report describes these facilities, some of the associated test support equipment, and the personnel services available at NSRDC. Procedures are included to indicate how potential users may arrange for test and analysis services. Author (GRA)

N72-29222# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
AIR CUSHION VEHICLE CONTROL SIMULATION. PROPOSED AMPHIBIOUS ASSAULT LANDING CRAFT PROGRAM PLAN Final Report
Pierre Dogan Aug. 1971 164 p refs
(Contract N00600-71-C-0575)
(AD-740851; CSDL-R-698) Avail: NTIS CSCL 13/10

The report is a summary of simulation needs and recommendations specific to the current Navy Amphibious Assault Landing Craft (AALC) Program which is developing high speed amphibious air cushion vehicles (ACV). The recommendations fall within three categories: mathematical modelling, hybrid computer facility, and man-in-the-loop simulation. To a large extent the needs and recommendations presented here are applicable to other Navy programs as well, since many factors are common to any craft development program. Author (GRA)

N72-29223# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
A HYBRID COMPUTER PROGRAM TO COMPUTER SIMULATE A PILOT CONTROLLED AIRCRAFT Final Report
John Houtz Jan. 1972 101 p ref
(AF Proj. 8222)
(AD-740434; AFFDL-TR-71-71) Avail: NTIS CSCL 01/3

The program is specifically oriented for use on an EAI 8400 Hybrid Computing System that is operated by the Control Systems Development Branch (FGL), Air Force Flight Dynamics Laboratory (AFFDL), Air Force Systems Command (AFSC), Wright-Patterson Air Force Base, Ohio. The program is written in FORTRAN 4 computer language. Author (GRA)

N72-29226*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
LEADING-EDGE PRESSURE MEASUREMENTS OF AIRFOIL VORTEX INTERACTION
Robert G. Walsh, Jr. Jan. 1970 34 p refs
(Grant NGR-22-009-303)
(NASA-CR-112129; ASRL-TR-153-1) Avail: NTIS HC $3.75 CSCL 20D

Experimental pressure-differential measurements made at 10% chord of an airfoil-vortex interaction are presented. A line vortex was oscillated over an airfoil perpendicular to the span and parallel to the chord. The pressure time history was recorded in order to show the sharp pressure pulses resulting from the bursting of the vortex core as it impinges upon the airfoil. Results for various vortex sizes and free stream velocities were obtained. Measurements were also made when the airfoil was yawed to the line vortex. Maximum pressure differences were observed to occur in phase across the blade even with yaw, and were directly proportional to the square of the free stream velocity. The maximum dynamic pressure coefficients obtained were as high as 1.0 when vortex bursting occurred. Author

N72-29227*# Advanced Technology Labs., Inc., Jericho, N.Y.
UNSTEADY FLOW THROUGH COMPRESSOR STAGES
Edgar Alzner and John Erdos Dec. 1971 72 p refs
(Contract NASw-2057)
(NASA-CR-127765; ATL-TR-168) Avail: NTIS HC $5.75 CSCL 20D

The application of the nonsteady Lax-Wendroff technique to problems with asymptotically periodic solution which offers a potentially powerful method for the investigation of the interaction of rotating and stationary blade rows in turbomachinery is reported. A technique for specifying boundary conditions with phase lag was developed to accomplish this. A complete nonlinear analysis is carried out numerically to determine the entire flow field without recourse to the assumption of small disturbances of linear equations which underlie the previous acoustic theories. The result, obtained for the case of equal number of rotor and stator blades shows that transonic flow can be handled without difficulty. In addition, the program is not limited with regard to blade thickness, camber or loading. Extension of this method to incorporate viscous wakes and to analysis of fully three dimensional configuration is feasible, and would greatly expand its utility in practical applications. Author

N72-29228*# National Aeronautics and Space Administration, Washington, D.C.
NASA AIRCRAFT TRAILING VORTEX RESERACH
William A. McGowan 1971 44 p refs Presented at the FAA Symp. on Turbulence, Washington, D. C., 22-24 Mar. 1971
(NASA-TM-X-68566) Avail: NTIS HC $4.25 CSCL 20D

A brief description is given of NASA's comprehensive program to study the aircraft trailing vortex problem. Wind tunnel experiments are used to develop the detailed processes of wing tip vortex formation and explore different means to either prevent trailing vortices from forming or induce early break-up. Flight tests provide information on trailing vortex system behavior behind large transport aircraft, both near the ground, as in the vicinity of the airport, and at cruise/holding pattern altitudes. Results from some flight tests are used to show how pilots might avoid the dangerous areas when flying in the vicinity of large transport aircraft. Other flight tests will be made to verify and evaluate trailing vortex elimination schemes developed in the model tests. Laser Doppler velocimeters being developed for use in the research program and to locate and measure vortex winds in the airport area are discussed. Field tests have shown that the laser Doppler velocimeter measurements compare well with those from cup anemometers. Author

N72-29229*# Boeing Co., Renton, Wash.
PREDICTION OF UNSTEADY AERODYNAMIC LOADINGS CAUSED BY TRAILING EDGE CONTROL SURFACE MOTIONS IN SUBSONIC COMPRESSIBLE FLOW: COMPUTER PROGRAM DESCRIPTION
M. C. Redman, W. S. Rowe, and B. A. Winther [1972] 207 p refs

(Contract NAS1-10536)
(NASA-CR-112015) Avail: NTIS HC $12.50 CSCL 20D

A digital computer program has been developed to calculate unsteady loadings caused by motions of lifting surfaces with trailing edge control based on the subsonic kernal function approach. The pressure singularities at hinge line and side edges have been extracted analytically as a preliminary step to solving the integral by collocation. The program calculates generalized aerodynamic forces for user supplied deflection modes. Optional intermediate output includes pressure at an array of points, and sectional generalized forces. From one to four controls on the half span can be accommodated. Author

N72-29237*# Virginia Polytechnic Inst., Blacksburg. Dept. of Aerospace Engineering.
FARFIELD STRUCTURE OF AN AIRCRAFT TRAILING VORTEX, INCLUDING EFFECTS OF MASS INJECTION
William Henry Mason and James Franklin Marchman, III Apr. 1972 161 p refs
(Grant NGL-47-004-067)
(NASA-CR-62078) Avail: NTIS HC $10.25 CSCL 20D

Wind tunnel tests to predict the aircraft wake turbulence due to the tip trailing vortex are discussed. A yawhead pressure probe was used in a subsonic wind tunnel to obtain detailed mean flow measurements at stations up to 30 chordlengths downstream in an aircraft trailing vortex. Mass injection at the wingtip was shown to hasten the decay of the trailing vortex. A theoretical method is presented to show the effect which the circulation distribution on the wing has on the structure of the outer portion of the vortex. Author

N72-29244# Cambridge Univ. (England). Dept. of Engineering.
BOUNDARY-LAYER SUCTION TO ELIMINATE CORNER SEPARATION IN CASCADES OF AEROFOILS
R. E. Peacock London Aeron. Res. Council 1971 26 p refs Supersedes ARC-27291 Sponsored by Rolls-Royce
(ARC-R/M-3663; ARC-27291) Avail: NTIS HC $3.50; HMSO £1.25; PHI $4.90

Results of a series of experiments are presented in which the corner separation existing at the junction between a cascade sidewall and a moderately loaded compressor blade in cascade was eliminated by means of a boundary-layer suction technique. The relationship which was investigated between suction flow required for control of the corner separation and the suction slot geometry is also reported. It was found that with careful positioning of the suction slot, bleed flows of less than 0.1 per cent of a half channel mass flow could result in elimination of the separation region. As a result, stagnation pressure profiles at the cascade trailing-edge plane became much more uniform, and the high loss core of fluid that would otherwise be shed downstream and into succeeding blade rows of a multi-row turbomachine was eliminated. Author (ESRO)

N72-29247# Cambridge Univ. (England). Dept. of Engineering.
THEORETICAL ANALYSIS OF FLUCTUATING LIFT ON THE ROTOR OF AN AXIAL TURBOMACHINE
R. E. Henderson and H. Daneshyar London Aeron. Res. Council 1972 30 p refs Supersedes ARC-42368
(ARC-R/M-3684; ARC-42368) Avail: NTIS HC $3.50; HMSO £1.10; PHI $4.30

A theoretical analysis is presented for the determination of the fluctuating lift generated by a moving blade row interacting with the potential flow disturbances of an upstream blade row. This analysis is an extension of the existing theories for an isolated airfoil moving through transverse and chordwise gusts. When the case of infinite spacing between the airfoils of the cascade is considered, the analysis gives the same results as the isolated airfoil theory. The mathematical representation of the cascade of airfoils is by a continuous distribution of vorticity on a reference blade and in the wakes of all the other blades. The effect of the bound vorticity of the neighboring blades is simulated by a vortex at their quarter chord points. This representation is suggested by the steady state cascade analysis. Using thin airfoil theory, an expression for the unsteady lift acting on a two-dimensional cascade of thin, slightly cambered airfoils moving through a sinusoidal disturbance in through flow velocity, is derived. Author (ESRO)

N72-29248# Royal Aircraft Establishment, Teddington (England). Aerodynamics Dept.
A COMPARISON BETWEEN TWO METHODS OF ANALYSIS OF OSCILLATORY PRESSURE MEASUREMENTS, ONE METHOD REQUIRING THE USE OF A TAPE RECORDER
A. W. Moore and B. L. Welsh London Aeron. Res. Council 1972 25 p refs Supersedes RAE-TR-71203; ARC-33470
(ARC-CP-1205; RAE-TR-71203; ARC-33470) Avail: NTIS HC $3.25; HMSO 45p; PHI $1.95

In one, a digital transfer function analyzer is used on-line to measure the in-phase and in-quadrature components of oscillatory pressure signals, with respect to a given reference signal. In the other method, the pressure signals are recorded on magnetic tape, then the recorded signals are analyzed on a digital computer at a later time. Pressures were produced by oscillating a model wing in a wind tunnel. Pressure transducers were mounted in the model at six chordwise stations, and the responses from the transducers were measured by both methods for a range of frequency and Mach number. A comparison of the results shows that there is no significant loss of accuracy in magnitude when the oscillatory pressure signals are recorded on magnetic tape for later analysis, and that the measurement of phase angle is accurate to within 1 deg. Author (ESRO)

N72-29335* Michigan Univ., Ann Arbor. Willow Run Labs.
MULTISPECTRAL IMAGING RADAR
L. J. Porcello and R. A. Rendleman *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p

(Contract NAS9-1106)
CSCL 17I

A side-looking radar, installed in a C-46 aircraft, was modified to provide it with an initial multispectral imaging capability. The radar is capable of radiating at either of two wavelengths, these being approximately 3 cm and 30 cm, with either horizontal or vertical polarization on each wavelength. Both the horizontally- and vertically-polarized components of the reflected signal can be observed for each wavelength/polarization transmitter configuration. At present, two-wavelength observation of a terrain region can be accomplished within the same day, but not with truly simultaneous observation on both wavelengths. A multiplex circuit to permit this simultaneous observation has been designed. A brief description of the modified radar system and its operating parameters is presented. Emphasis is then placed on initial flight test data and preliminary interpretation. Some considerations pertinent to the calibration of such radars are presented in passing. Author

N72-29480# Bell Helicopter Co., Fort Worth, Tex.
EVALUATION OF AN ADVANCED INSTRUMENTATION SYSTEM FOR HELICOPTER ROTORS Final Report
Gerald A. Shockey and Thomas H. Bowden Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Feb. 1972 100 p refs
(Contract DAAJ02-70-C-0036; DA Proj. 1F1-62204-A-139)
(AD-740773; BHC-299-099-497; USAAMRDL-TR-71-72) Avail: NTIS CSCL 14/2

A test was conducted on the Bell Helicopter High Accuracy Rotor Test Stand to evaluate a time division multiplexing system

for a rotor environment. The test model was a standard UH-1 tail rotor with a 0.1-inch-thick glove wrapped around the surface for the installation of transducers. The objective of this program was to develop and test a method of obtaining numerous channels of transducer information from a rotating system using a small number of slip rings. The system multiplexed the signal in the rotating system and demultiplexed the signal in the stationary system. Aerodynamic data were measured to evaluate the instrumentation system. Comparisons were made between multiplexed and unmultiplexed signals and between measured data and theory. Author (GRA)

N72-29483# Edgerton, Germeshausen and Grier, Inc., Waltham, Mass. Environmental Equipment Div.
INSTRUCTION MANUAL EG AND G MODEL 196, AIRCRAFT HYGROMETER SYSTEM Final Report, 12 Feb. 1969 - 22 Nov. 1971
Arthur Bisberg Nov. 1971 77 p
(Contract F19628-69-C-0218; AF Proj. 6020)
(AD-740638; TM-71-200; AFCRL-72-0208) Avail: NTIS CSCL 14/2

An aircraft optical dew-point hygrometer was designed and fabricated. The instrument incorporates a cryogenic heat pump to provide an extended range of mirror temperature depressional capability with rapid response. The hygrometer will be installed aboard a C-130 aircraft for flight testing. GRA

N72-29533*# Mobil Research and Development Corp., Paulsboro, N.J. Research Dept.
MICROFOG LUBRICANT APPLICATION SYSTEM FOR ADVANCED TURBINE ENGINE COMPONENTS, PHASE 2. TASKS 3, 4 AND 5: WETTABILITY AND HEAT TRANSFER OF MICROFOG JETS IMPINGING ON A HEATED ROTATING DISC, AND EVALUATION OF RECLASSIFYING NOZZLES AND A VORTEX MIST GENERATOR
J. Shim and S. J. Leonardi 1 Jun. 1972 207 p refs
(Contract NAS3-13207)
(NASA-CR-120843) Avail: NTIS HC $12.50 CSCL 11H

The wettabilities and heat transfer rates of microfog jets (oil-mist nozzle flows) impinging on a heated rotating disc were determined under an inert atmosphere of nitrogen at temperatures ranging from 600 to 800 F. The results are discussed in relation to the various factors involved in the microfog lubricant application systems. Two novel reclassifying nozzles and a vortex mist generator were also studied. Author

N72-29539# Oceanics, Inc., Plainview, N.Y.
AN INVESTIGATION OF THE RELATIVE MOTIONS OF ACV LANDING CRAFT AND LARGE AMPHIBIOUS ASSAULT SHIPS Final Report
Paul Kaplan, Theodore P. Sargent, Alfred I. Raff, James Bentson, and Placido S. Bono Feb. 1972 108 p refs
(Contract N00014-71-C-0399)
(AD-741245; TR-72-90) Avail: NTIS CSCL 13/10

A mathematical analysis is used to determine the relative motions between an ACV landing craft and different assault ships under operating modes corresponding to well entry and alongside conditions associated with cargo transfer. The technique used is based on linear equations of motion, with probabilities of transfer determined from response data obtained via spectral analysis methods. The results provide guidance vs best operating speed of the assault ship and of the ACV; preferred heading relative to the waves; best orientation and position of the ACV relative to the assault ship; and limiting sea state conditions for safe and/or best operations to occur. GRA

N72-29564*# General Electric Co., Cincinnati, Ohio.
RENE 95 BRAZED JOINT METALLURGICAL PROGRAM Final Report
C. Gay, J. Givens, S. Mastrorroco, and A. Sterman [1972] 97 p refs
(Contract NAS2-6056)
(NASA-CR-120957; TM-72-326) Avail: NTIS HC $7.00 CSCL 11F

This metallurgical program was specifically conducted for the establishment of material properties required for the design of the LF460 fan. The LF460 lift fan is an advanced 18:1 high thrust to weight single stage design. It has a turbine attached to the outer flowpath of the fan blade tip which minimizes the axial depth of the fan. Advanced lightweight attachment designs are employed in this concept to achieve minimum mass polar moments of inertia which are required for good aircraft flight response control. The design features which are unique to this advanced LF460 lift fan are the 0.010 inch thin Udimet 700 alloy integral tip turbine design, minimum weight braze attachment of the turbine to the fan blade, and the high strength and elevated temperature capability of the Rene'95 alloy for the fan blade. The data presented in this report show that the LF460 fan rotor design is feasible and that the design stresses and margins of safety were more than adequate. Prior to any production application, however, additional stress rupture/shear lap joints should be run in order to establish a firm 1200 F stress rupture curve for the CM50 braze metal. Author

N72-29570# Ministry of Defence, London (England).
FACTORS AFFECTING THE ELECTRODEPOSITION OF PAINTS ON AIRCRAFT ALLOYS
G. A. Dunn London Min. of Defence Aug. 1971 47 p
(Contract KS/1/0503/C.B.43(a)2)
(D-MAT/AV-175) Avail: NTIS HC $4.50

Experiments concerned with the electropainting of aluminum alloys and magnesium alloys are summarized. It is shown that, in the case of aluminum, anodizing is a precursor to paint deposition. A system is described whereby aluminum alloys may be electropainted with a low (100 C) temperature curing system which contains a chromate pigment, and which imparts good salt spray resistance. The advantage of the system in penetrating crevices in complex structures and assemblies is demonstrated. Methods are described for electropainting magnesium alloys to provide a finish with a measure of salt spray resistance and for electropainting relatively deep holes in magnesium castings with a paint layer of controllable thickness. Author (ESRO)

N72-29589# Advisory Group for Aerospace Research and Development, Paris (France).
COMPOSITE MATERIALS
B. Walter Rosen May 1972 125 p refs
(AGARD-LS-55) Avail: NTIS HC $8.25

The material reported was assembled to support a lecture series presented in Oslo (Norway), Lyngby (Denmark) and Lisbon (Portugal) in June 1972. The objective of the lectures was to present the modern composites concept, a review of materials for advanced composites (fibers, reinforced plastics, metal matrix composites). Considerations in the application of advanced composites and airframe application are covered

N72-29592 General Dynamics/Fort Worth, Tex.
COMPOSITES IN THE STRUCTURAL DESIGN PROCESS
M. E. Waddoups *In* AGARD Composite Mat. May 1972 13 p refs

The use of advanced composites as a primary structural material for aircraft structures has required alteration of the

characterization and design process. Specific departures from conventional lightweight metal design practices have resulted because of the fabrication and process control characteristics, the failure characteristics of the material, and the additional structural design variables. Each of these subject areas with the attendant impact of composite materials on design practice are reviewed. Case examples for actual prototype hardware are presented. Author

N72-29595 British Aircraft Corp., Warton (England). Military Aircraft Div.
GENERAL CONSIDERATIONS IN THE APPLICATIONS OF ADVANCED COMPOSITES
I. C. Taig *In* AGARD Composite Mat. May 1972 14 p refs

The characteristics of advanced composites are compared with those of conventional airframe materials. It is shown that many considerations other than conventional mechanical properties and fabrication technology influence the selection and realization of effective applications of composites. Particular attention is given to the assessment of cost effectiveness; to the achievement of integrity in a broad sense, including protection against adverse environmental effects and to some practical aspects of producibility. Trends in material and manufacturing costs are presented to show that in the airframe industry, most parts of the structure could benefit from the extensive use of composites in the next ten years. Expansion and redirection of the research and development effort will be needed to exploit the economic potential of the materials. Author

N72-29596 British Aircraft Corp., Warton (England). Military Aircraft Div.
AIRFRAME APPLICATIONS OF ADVANCED COMPOSITES
I. C. Taig *In* AGARD Composite Mat. May 1972 12 p refs

A wide variety of primary and secondary structural applications of advanced composites are presented. It illustrates, using actual or projected examples, the progressive introduction into service of components of increasing complexity and cost effectiveness. All previously unpublished information relates to carbon fiber epoxy composites under development in the U.K., but to broaden the picture, the coverage also includes boron/epoxy, carbon/epoxy and, to a lesser extent, boron/aluminum applications in the U.S.A. The range of components covered includes: composite reinforced metal members; sandwich panel structures such as doors, floors and control surfaces; rod and the tube members, box structures such as tail surfaces and wings: frames, bulkheads and fuselage shell structures. Particular emphasis is given to the design principles and practical features embodied in each application illustrating as far as possible the general considerations of the previous paper. Where information is available, mass savings and cost effectiveness data are quoted and comments on the operating environment and experience in service are included. Author

N72-29612# Prodesco, Inc., Perkasie, Pa.
PRODUCTION OF A SERIES OF HIGH TEMPERATURE RESISANT FABRICS TO REPLACE CURRENT SPECIFICATION NYLON AND COTTON FABRICS Final Report, Jun. 1970 - Dec. 1971
Robert Donnelly Wright-Patterson AFB, Ohio ASD Feb. 1972 78 p refs
(Contract F33657-70-C-1173; AF Proj. 412)
(AD-740600; ASD-TR-2) Avail: NTIS CSCL 11/5

A development program designed to replace flammable fabrics in aircraft is reported. Specification materials used by the Air Force, generally cotton, nylon or combinations of the two, were replaced by aromatic polyamide (Nomex) fabrics of equal or better properties for a given requirement. Seven different fabrics were developed, tested, and draft specifications suitable for future prototype procurement were written. Serviceability, costs, and large quantity production considerations were not within the scope. Primarily, staple fabrics were developed because of volume requirements. However, three filament items were developed, two narrow fabrics, and a new warp knit fabric which can serve as a basic fabric for applications requiring moderate stretch characteristics. Author (GRA)

N72-29615# Solar, San Diego, Calif.
TUNGSTEN REINFORCED OXIDATION RESISTANT COLUMBIUM ALLOYS Final Report, 1 Nov. 1970 - 1 Dec. 1971
Mark J. Klein, Brad R. Domes, and Arthur G. Metcalfe Feb. 1972 88 p refs
(Contract N00019-17-C-0158; N00019-71-C-0137)
(AD-740844; RDR-1693-4) Avail: NTIS CSCL 11/4

High-strength, oxidation-resistant composites are being developed for use in gas turbine engines at temperatures exceeding 2000 F. In previous work a model system composite consisting of a CB-40Ti-9Cr-4Al matrix and W-3Re filaments was developed and tested. During the present period, testing of the model system was continued to further characterize this material. In addition, the matrix composition was modified to improve composite ductility. The improved matrix selected for use in the composite is Cb-42Ti-4Cr-4Al-1V. The composite developed has good oxidation resistance but is intended to be used in the coated condition with the oxidation resistance serving as a fail-safe protection. Author (GRA)

N72-29632# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE IDENTIFICATION OF LINEAR STOCHASTIC SYSTEMS M.S. Thesis
Adolph Harris Mar. 1972 109 p refs
(AD-741437; GSA/MA/72-5) Avail: NTIS CSCL 12/1

The report considers the problem of the identification of linear stochastic systems. A current state-of-the-art assessment of the general field of system identification is given, and criteria for the classification and selection of identification methods are presented and discussed. Several of the more popular identification methods from the literature are investigated and summarized. A bibliography containing 185 references, keyed by identification methods and other relevant headings, is included. Using the state variable formulation for a discrete linear stochastic system, a detailed exposition of a few of the on-line identification methods currently appearing in the literature is presented.
Author (GRA)

N72-29633# Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.
CONTROL THEORY FOR LARGE SCALE AND UNCERTAIN SYSTEMS APPLICABLE TO AEROSPACE SYSTEMS Final Report, 1 Feb. 1971 - 31 Jan. 1972
Michael Athans and Sanjoy K. Mitter Mar. 1972 43 p refs
(Grant AF-AFOSR-1941-70; AF Proj. 9769)
(AD-740869; ESL-FR-474; AFOSR-72-0947TR) Avail: NTIS CSCL 12/1

The report describes the research carried out by members of the Decision and Control Sciences Group at the Electronic Systems Laboratory, M.I.T. Research was carried out on the following main topics: Control and Decision Making under Uncertainty; Studies in Large-Scale Systems; Control of Distributed Parameter Systems; Control of Hereditary Differential Systems; and Air Traffic Control. Technical details of the research may be found in the reports and papers cited in the references Author (GRA)

N72-29671# Federal Aviation Agency, Oklahoma City, Okla.
EVALUATION OF APPROACH PROCEDURES FOR ILS BACK COURSE WITH GLIDE SLOPE Final Report
Allan W. Hunting Jul. 1972 36 p ref
(FAA-FS-600-8) Avail: NTIS HC $4.00

An operational evaluation was performed to compare ILS back course approaches with front course approaches in an effort to determine flyability problems associated with back course ILS with glide slope and the appropriate obstacle clearances to be applied. Simulated approaches were flown in the B720 flight simulator. Hooded approaches were flown in 6 different aircraft. Facility and airborne systems include back and front courses; localizer only and localizer with glide slope; normal and reverse course sensing. All were flown using raw ILS data for guidance. A questionnaire was filled out on each subject pilot at the end of his runs. Heights above touchdown at which ILS guidance became unusable were computed from simulator tracings and data logs. It was found that the established ILS obstacle clearance criteria for front course ILS approaches with glide slope is adequate for back course approaches with glide slope. Author

N72-29672# National Aviation Facilities Experimental Center, Atlantic City, N.J.
COLLISION AVOIDANCE: AN ANNOTATED BIBLIOGRAPHY, SEPTEMBER 1968 - APRIL 1972 Final Report, 1968 - 1972
Dorothy E. Bulford, comp. Aug. 1972 267 p refs
(FAA-NA-72-41) Avail: NTIS HC $15.50

In November 1968 a bibliography consisting of 1013 references without annotations was issued as FAA report number NA-68-54. This present work supplements that report. In addition to the subject and corporate author indexes of the 1968 listing, this bibliography includes a personal names index which will help find secondary authors or locate names mentioned in titles and abstracts. Author

N72-29674# Societe d'Etudes des Systemes d'Automation, Paris (France).
SUPPLEMENT TO THE THEORETICAL STUDY OF SATELLITE AIR TRAFFIC CONTROL SYSTEMS. SIMULATION OBJECTIVES FOR SYSTEM INTEGRATION Final Report [COMPLEMENT A L'ETUDE THEORIQUE DE SYSTEMES DE CONTROLE DE LA CIRCULATION AERIENNE PAR SATELLITES. OBJECTIFS DE SIMULATION POUR L'INTEGRATION DU SYSTEME. RAPPORT FINAL]
26 Apr. 1972 176 p In FRENCH
(Contract ESTEC-1377/71-CG)
(SESA-Ex-5072-15.786/72; ESRO-CR(P)-103) Avail: NTIS HC $11.00

Arrangements proposed for the pre-operational simulation of air traffic control and message management for the ESRO Aerosat project are presented. A simulation plan is proposed which is to be developed in parallel with the hardware availability. Ten different stages are analyzed, with the introduction of new elements at each stage, to realize a program that will support full transatlantic air traffic control including extension of the zone covered; eastbound, westbound flights in both directions, full load or reduced load of circuits; subsonic or supersonic aircraft; present or reduced distance between flying aircraft and taking into account failures of the system. Specifications for the software to be developed are listed and the characteristics of the computer required are evaluated. ESRO

N72-29676# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR TRAFFIC CONTROL Quarterly Technical Summary, 1 Nov. 1971 - 31 Jan. 1972
Herbert G. Weiss 15 Feb. 1972 19 p refs
(Contract F19628-70-C-0230)
(AD-740877; ESD-TR-72-57) Avail: NTIS CSCL 17/7

The report summarizes the progress on Air Force funded tasks within the Division between 1 November 1971 and 31 January 1972. The four areas under investigation are: radar MTI technology, airborne graphical displays, the influence of propagation effects on CNI system performance and the analysis of various microwave landing guidance systems. Author (GRA)

N72-29680# Defense Documentation Center, Alexandria, Va.
AIR TRAFFIC CONTROL SYSTEMS Report Bibliography, Jan. 1969 - Dec. 1971
May 1972 156 p refs
(AD-741200; DDC-TAS-72-25-1) Avail: NTIS CSCL 17/7

Air Traffic Control Systems in the bibliography relate to air traffic control centers, air traffic control operators, communication systems, computer applications, display systems, approach and landing systems, navigational aids, human factors, radar approach control, decision making and systems value engineering. Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes are included. GRA

N72-29799# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
SPONTANEOUS IGNITION OF AVTUR VAPOUR IN VARIOUS OXYGEN-NITROGEN MIXTURES
J. T. Cansdale London Aeron. Res. Council 1972 25 p refs Supersedes RAE-TR-71012; ARC-32962
(ARC-CP-1209; RAE-TR-71012; ARC-32962) Avail: NTIS HC $3.25; HMSO £45p; PHI $195

The spontaneous ignition of Avtur vapor in closed heated vessels was investigated to determine the maximum oxygen concentration required to limit ignition pressure rises to 6.9 kN/m2. The aim was to establish the maximum safe oxygen concentration to be permitted within the nitrogen filled heating ducts of the BAC Concorde fuel system test facility. Tests were made in a uniformly heated 0.46 m (18 in) diameter sphere, over a temperature range from 260 to 440 C. An oxygen concentration of less than 1% by volume was necessary to limit ignition pressures. The effect of oxygen concentration on ignition delay time was also studied. Secondly, ignition in the presence of a 0.15 m (6 in) diameter hot pipe in a temperature controlled 0.46 m sphere was investigated at sphere temperatures up to 180 C and pipe temperatures up to 440 C. An oxygen concentration of less than 2.5% by volume was found to limit ignition pressures as required at all conditions considered. It was concluded that in the BAC test rig, a 2.5% oxygen concentration would be low enough to prevent any undesirable ignitions.
Author (ESRO)

N72-29803*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIGITAL-COMPUTER NORMAL SHOCK POSITION AND RESTART CONTROL OF A MACH 2.5 AXISYMMETRIC MIXED-COMPRESSION INLET
George H. Neiner, Gary L. Cole, and Dale J. Arpasi Washington Aug. 1972 50 p refs
(NASA-TN-D-6880; E-6498) Avail: NTIS HC $3.00 CSCL 21E

Digital computer control of a mixed-compression inlet is discussed. The inlet was terminated with a choked orifice at the compressor face station to dynamically simulate a turbojet engine. Inlet diffuser exit airflow disturbances were used. A digital version of a previously tested analog control system was used for both normal shock and restart control. Digital computer algorithms were derived using z-transform and finite difference methods. Using a sample rate of 1000 samples per second, the digital normal shock and restart controls essentially duplicated the inlet analog computer control results. At a sample rate of 100 samples per second, the control system performed adequately but was less stable. Author

N72-29806*# General Electric Co., Cincinnati, Ohio.
HIGHLY LOADED MULTI-STAGE FAN DRIVE TURBINE-TANDEM BLADE CONFIGURATION DESIGN
D. C. Evans and G. W. Wolfmeyer Washington NASA Aug. 1972 67 p refs
(Contract NAS3-14304)
(NASA-CR-2097) Avail: NTIS HC $3.00 CSCL 21E

The results of the tandem blade configuration design study are reported. The three stage constant-inside-diameter turbine utilizes tandem blading in the stage two and stage three vanes and in the stage three blades. All other bladerows use plain blades. Blading detailed design is discussed, and design data are summarized. Steady-state stresses and vibratory behavior are discussed, and the results of the mechanical design analysis are presented. Author

N72-29808*# General Electric Co., Cincinnati, Ohio. Aircraft Gas Turbine Div.
EXPERIMENTAL QUIET ENGINE PROGRAM AERODYNAMIC PERFORMANCE OF FAN B
R. G. Giffin, D. E. Parker, and L. W. Dunbar Aug. 1972 117 p refs
(Contract NAS3-12430)
(NASA-CR-72993) Avail: NTIS HC $8.00 CSCL 21E

This report presents the aerodynamic component test results of Fan B, one of two high-bypass-ratio, 1160 feet per second (353.6 m/sec) single-stage fans, which was designed and tested as part of the NASA Experimental Quiet Engine Program. The fan was designed to deliver a bypass pressure ratio of 1.50 with an adiabatic efficiency of 87.0% at a total fan flow of 950 lb/sec (430.9 kg/sec). It was tested with and without inlet distortion. A bypass total pressure ratio of 1.52 and an adiabatic efficiency of 86.9% at a total fan flow of 966 lb/sec (438.2 kg/sec) were actually achieved. An operating margin of 19.5% was demonstrated at design speed. Author

N72-29809# Joint Publications Research Service, Arlington, Va.
ENSURING RELIABLE PERFORMANCE OF AIRCRAFT ENGINE PARTS
A. M. Zaytsev 3 Aug. 1972 257 p refs Transl. into ENGLISH of the book "Obespecheniye Nadezhnoy Raboty Detaley Aviatsionnykh Dvigateley" Moscow, Transport Publ. House, 2 Sep. 1971 196 p
(JPRS-56674) Avail: NTIS HC $15.00

Methods for obtaining reliable performance of aircraft engine parts are presented. The causes of flaws and failures in aircraft engine parts are discussed. Methods of evaluating and predicting the service life of engine parts are explained. Author

N72-29810# Delaware Univ., Newark.
USE OF A RADIAL TURBINE IN A THRUST AUGMENTATION SCHEME
Ronald J. Wills, Barry S. Seidel, and Robert B. Cotton (Wedge Co., Inc., Media, Pa.) 27 Jul. 1972 28 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft on Dec. 1972
(Contract N00019-69-C-0668)
Avail: NTIS HC $3.50

A thrust augmentation scheme which uses a partial admission radial inflow impulse turbine placed in the exhaust of a jet engine 15 described. The torque developed by the turbine is used to wrap up, on a capstan, a cable, fixed at some distant point down the runway. The turbine-capstan is mounted on a wheeled platform so that it tends to follow the jet down the runway. A rigid member connects the platform to the turbojet, allegedly exerting an additional thrust. The equations of motion of the system are presented, and experiments on the turbine's characteristics are described. These characteristics are incorporated in the equations of motion, which are then integrated to yield such information as turbojet distance and velocity versus time, both with and without the augmentation device. Author

N72-29812# Army Foreign Science and Technology Center, Charlottesville, Va.
STARTING OF AIRCRAFT GAS TURBINE ENGINES
M. A. Alabin, B. M. Kats, and Yu. A. Litvinov 12 Jan. 1972 232 p refs Transl. into ENGLISH from the monograph "Zapusk Aviatsionnykh Gazoturbinnykh Dvigatelei" Moscow, 1968 227 p
(AD-740291; FSTC-HT-23-766-70) Avail: NTIS CSCL 21/5

Examined in this book is the theory of starting aviation gas turbine engines on the ground and in flight. This discussion goes into considerably greater detail than previously published literature on aviation engines. The design principles and operating features of individual components of the starter system and engine accessories during start up are examined, the methods of calculating the starting characteristics of various types of engines on the ground and in flight are set forth and the physical essence of starting processes is explained. The inxluence of various factors on engine starting reliability is examined in detail. Methods of calculating engine parameters in the authorotation and low rpm regimes and engine starting reliability limits in flight are given, which can be used in the testing and operation of gas turbine engines. Author (GRA)

N72-29813# Boeing Co., Philadelphia, Pa. Vertol Div.
REGENERATIVE ENGINE POWERED AIRCRAFT DESIGN STUDY Final Report
Richard D. Semple Fort Eustis, Va. Army Air mobility R and D Lab. Jan. 1972 217 p refs
(Contract DAAJ02-70-C-0061; DA Proj. 1G1-62203-D-144)
(AD-741379; D210-10245-1A; USAAMRDL-TR-71-53) Avail: NTIS CSCL 21/5

Characteristics of aircraft with integrated regenerative engine propulsion systems and aircraft with nonregenerative turboshaft engines were determined in order to assess the relative advantages and disadvantages of the engines in a utility transport helicopter application. Conceptual designs of aircraft, powered by regenerative engines and nonregenerative engines of approximately 1000 shp, were based on existing and future Army mission requirements for a typical utility transport helicopter. Comparative weight and performance parameters, reliability aspects, maintenance requirements, life-cycle cost and cost effectiveness for various missions, and overall mission effectiveness and system cost were assessed for these aircraft. Author (GRA)

N72-29814# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT POWERPLANTS. SYSTEMS AND COMPONENTS
N. T. Domotenke, A. S. Kravets, A. I. Pugachev, and T. I. Sivashenko 4 Feb. 1972 467 p refs Transl. into ENGLISH of the publ. "Aviatsionnyye Silovyye Ustanovki. Sistemy i Ustroystva" 1970 p 1-352
(AD-740211; FTD-HC-23-374-71) Avail: NTIS CSCL 21/5

The book deals with general problems of layout and operation of equipment of aircraft power plants. Given are methods for calculation of systems and devices. The assumptions accepted for educational purposes, which hardly effect the accuracy of results, enabled the authors to obtain comparatively simple formulas and graphs for checking the operation of systems and devices and their design. The book represents a text book for students of civil aviation educational institutions. It can be used also by engineering technical personnel of operational and maintenance enterprises of civil aviation, factories of the aircraft industry, as well as students of aviation institutes. Author (GRA)

N72-29816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONTROL SYSTEM OF THE SOVIET TURBOFAN ENGINE D-30
Emil Wegrzyn 16 Feb. 1972 13 p Transl. into ENGLISH from Tech. Lotnicza Astronaut, (Poland), v. 25, no. 10/11, 1970 p 7-10
(AD-742368; FTD-HC-23-1791-71) Avail: NTIS CSCL 21/5

In the article they have described the operation principles of main components of control system of sovietic turbofan engine D-30: the fuel flow control unit NR 30 that retains constant rotational speed of the high pressure compressor in various flight conditions; the centrifugal governor CR IW that limits the low pressure compressor speed and the centrifugal governor CR 2W that controls the bleed valves and the inlet guide vanes of the high pressure compressor. Author (GRA)

N72-29817# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DETERMINATION OF THE DRAG OF A WIND TUNNEL MODEL ENGINE DUCT BY APPLICATION OF THE MOMENTUM EQUATION M.S. Thesis
James A. Eggers Mar. 1972 136 p refs
(AD-741744; GAM/AE/72-3) Avail: NTIS CSCL 21/5

A wing body model of an advanced manned interceptor was tested for subsonic force and moment data in a five-foot wind tunnel. A removable engine package contained twin internal airflow passages. Following the collection of force data both with and without the engine package, the inlets and exits of the ducts were instrumented with pressure rakes in order to determine the momentum loss and hence the drag on the model due to the internal flow. Author (GRA)

N72-29893# Advisory Group for Aerospace Research and Development, Paris (France).
ACOUSTIC FATIGUE DESIGN DATA, PART 1
A. G. R. Thomson (Eng. Sci. Data Unit Ltd.) May 1972 58 p refs
(AGARD-AG-162-Pt-1; AGARDograph-162-Pt-1) Avail: NTIS HC $5.00

The problem of acoustic fatigue life of a structure subjected to jet noise is introduced. A framework of a design procedure applicable especially to skin panels is described. A method of estimating the near field sound pressure levels due to high velocity jet noise is described, including its limitations. Methods are described to predict the first two groups of natural frequencies of flat and singly curved skin-stringer structures with four different end conditions. The parameters considered are: (1) stringer torsional stiffness, (2) aspect ratio of a typical section, and (3) the number of half-waves across the frame pitch. A method of estimating the root mean square in rectangular skin panels subject to random acoustic loading is presented. Author

N72-29895*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED APPROACHES TO FATIGUE EVALUATION
Washington 1972 675 p refs Proc. of the 6th ICAF Symp., Miami, 13-14 May 1971
(NASA-SP-309) Avail: NTIS HC $9.00 CSCL 20K

The evaluation of fatigue tests is discussed for supersonic aircraft structures. Aspects of the test program dealing with problems associated with aircraft reliability are emphasized.

N72-29896* Royal Aircraft Establishment, Farnborough (England).
THE PHILOSOPHY WHICH UNDERLIES THE STRUCTURAL TESTS OF A SUPERSONIC TRANSPORT AIRCRAFT WITH PARTICULAR ATTENTION TO THE THERMAL CYCLE
E. L. Ripley *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 1-91 refs
CSCL 20K

The information presented is based on data obtained from the Concorde. Much of this data also applies to other supersonic transport aircraft. The design and development of the Concorde is a joint effort of the British and French, and the structural test program is shared, as are all the other activities. Vast numbers of small specimens have been tested to determine the behavior of the materials used in the aircraft. Major components of the aircraft structure, totalling almost a complete aircraft, have been made and are being tested to help the constructors in each country in the design and development of the structure. Tests on two complete airframes will give information for the certification of the aircraft. A static test was conducted in France and a fatigue test in the United Kingdom. Fail-safe tests are being made to demonstrate the crack-propagation characteristics of the structure and its residual strength. Aspects of the structural test program are described in some detail, dealing particularly with the problems associated with the thermal cycle. The biggest of these problems is the setting up of the fatigue test on the complete airframe; therefore, this is covered more extensively with a discussion about how the test time can be shortened and with a description of the practical aspects of the test. Author

N72-29897* Saab Aircraft Co., Linkoping (Sweden).
FATIGUE EXPERIENCE FROM TESTS CARRIED OUT WITH FORGED BEAM AND FRAME STRUCTURES IN THE DEVELOPMENT OF THE SAAB AIRCRAFT VIGGEN
S. E. Larsson *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 93-126 refs
CSCL 20K

A part of the lower side of the main wing at the joint of the main spar with the fuselage frame was investigated. This wing beam area was simulated by a test specimen consisting of a spar boom of AZ 74 forging (7075 aluminum alloy modified with 0.3 percent Ag) and a portion of a honeycomb sandwich panel attached to the boom flange with steel bolts. The cross section was reduced to half scale. However, the flange thickness, the panel height, and the bolt size were full scale. Further, left and right portions of the fuselage frame intended to carry over the bending moment of the main wing were tested. Each of these frame halves consisted of a forward and a rear forging (7079 aluminum alloy, overaged) connected by an outer and inner skin (Alclad 7075) creating a box beam. These test specimens were full scale and were constructed principally of ordinary aircraft components. The test load spectrum was common to both types of specimens with regard to percentage levels. It consisted of maneuver and gust loads, touchdown loads, and loads due to ground roughness. A load history of 200 hours of flight with 15,000 load cycles was punched on a tape. The loads were randomized in groups according to the flight-by-flight principle. The highest positive load level was 90 percent of limit load and the largest negative load was -27 percent. A total of 20 load levels were used. Both types of specimens were provided with strain gages and had a nominal stress of about 300 MN/sq m in some local areas. As a result of the tests, steps were taken to reduce the risk of fatigue damage in aircraft. Thus stress levels were lowered, radii were increased, and demands on surface finish were sharpened. Author

N72-29898* Boeing Co., Everett, Wash.
THE BOEING 747 FATIGUE INTEGRITY PROGRAM
Max M. Spencer *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 127-178 refs
CSCL 20K

The fatigue integrity program which was established to insure economic operations and to provide foundation data for

inspection and maintenance is discussed. Significant features of the 747 fatigue integrity program are: (1) fatigue analyses which are continually updated to reflect design changes, fatigue test results, and static and flight load survey measurements; (2) material selection and detail design by using initial fatigue analyses, service experience, and testing; and (3) fatigue testing to check detail design quality and to verify the analyses, culminated by the test of a structurally complete airframe. Fatigue stress analyses were performed with the aid of experimental as well as analytical procedures. Extensive application was made of the stress severity factor, developed at Boeing, for evaluating peak stresses in complex joints. A frame of reference was established by families of structural fatigue performance curves (S-N curves) encompassing the range of materials and fatigue qualities anticipated for the 747 airplane design. Author

N72-29899* Douglas Aircraft Co., Inc., Long Beach, Calif.
FATIGUE AND FAIL-SAFE DESIGN FEATURES OF THE DC-10 AIRPLANE
M. Stone *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 179-211 refs

CSCL 20K

The philosophy and methods used in the design of the DC-10 aircraft to assure structural reliability against cracks under repeated service loads are described in detail. The approach consists of three complementary parts: (1) the structure is designed to be fatigue resistant for a crack-free life of 60,000 flight hours; (2) inasmuch as small undetected cracks could develop from other sources, such as material flaws and manufacturing preloads, the structure also is designed to arrest and control cracks within a reasonable service-inspection interval; and (3) a meaningful service-inspection program has been defined on the basis of analysis and test experience from the design development program. This service-inspection program closes the loop to assure the structural integrity of the DC-10 airframe. Selected materials, fasteners, and structural arrangements are used to achieve these design features with minimum structural weight and with economy in manufacturing and maintenance. Extensive analyses and testing were performed to develop and verify the design. The basic design considerations for fatigue-resistant structure are illustrated in terms of material selection, design loads spectra, methods for accurate stress and fatigue damage analysis, and proven concepts for efficient detail design. Author

N72-29900* Royal Aircraft Establishment, Farnborough (England).
THE PRACTICAL IMPLEMENTATION OF FATIGUE REQUIREMENTS TO MILITARY AIRCRAFT AND HELICOPTERS IN THE UNITED KINGDOM
R. D. J. Maxwell *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 213-229 refs

CSCL 20K

The methods adopted in the United Kingdom to ensure the structural integrity of military aeroplanes and helicopters from the fatigue point of view are described. The procedure adopted from the writing of the specification to the monitoring of fatigue life in service are presented along with the requirements to be met and the way in which they are satisfied. Some of the outstanding problems that remain to be solved are indicated.
Author

N72-29901* Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
A PROPOSED USAF FATIGUE EVALUATION PROGRAM BASED UPON RECENT SYSTEMS EXPERIENCE
G. P. Haviland and G. F. Purkey *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 231-251 refs
CSCL 20K

The United States Air Force has published a document entitled Aircraft Structural Integrity Program. One phase of the program is concerned with the fatigue life certification of all types of military aircraft. The document describes the criteria, analyses, and tests that are necessary in order to satisfy the USAF fatigue life requirement. Some recent and valid criticism has been directed toward the document, particularly the fatigue-life requirements contained in it. Some changes are proposed based on surveys conducted in the United States and abroad as well as some recent systems' experience. The surveys covered both military and civilian organizations. The fatigue certification case histories of selected military and commercial aircraft are presented. The design development element tests, preproduction design verification tests, and full-scale fatigue tests of each are described. A brief status report on the revisions to the MIL-A-008860 series specifications is included. Author

N72-29902* National Aerospace Lab., Amsterdam (Netherlands).
FATIGUE TESTS WITH RANDOM FLIGHT SIMULATION LOADING
J. Schijve *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 253-273 refs

CSCL 20K

Crack propagation was studied in a full-scale wing structure under different simulated flight conditions. Omission of low-amplitude gust cycles had a small effect on the crack rate. Truncation of the infrequently occurring high-amplitude gust cycles to a lower level had a noticeably accelerating effect on crack growth. The application of fail-safe load (100 percent limit load) effectively stopped subsequent crack growth under resumed flight-simulation loading. In another flight-simulation test series on sheet specimens, the variables studied are the design stress level and the cyclic frequency of the random gust loading. Inflight mean stresses vary from 5.5 to 10.0 kg/sq mm. The effect of the stress level is larger for the 2024 alloy than for the 7075 alloy. Three frequencies were employed: namely, 10 cps, 1 cps, and 0.1 cps. The frequency effect was small. The advantages and limitations of flight-simulation tests are compared with those of alternative test procedures such as constant-amplitude tests, program tests, and random-load tests. Various testing purposes are considered. The variables of flight-simulation tests are listed and their effects are discussed. A proposal is made for performing systematic flight-simulation tests in such a way that the compiled data may be used as a source of reference. Author

N72-29903* Aeronautical Research Labs., Melbourne (Australia).
RELIABILITY ANALYSIS APPLIED TO STRUCTURAL TESTS
Patricia Diamond and A. O. Payne *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 275-332 refs
CSCL 20K

The application of reliability theory to predict, from structural fatigue test data, the risk of failure of a structure under service conditions because its load-carrying capability is progressively reduced by the extension of a fatigue crack, is considered. The procedure is applicable to both safe-life and fail-safe structures and, for a prescribed safety level, it will enable an inspection procedure to be planned or, if inspection is not feasible, it will evaluate the life to replacement. The theory has been further developed to cope with the case of structures with initial cracks, such as can occur in modern high-strength materials which are susceptible to the formation of small flaws during the production process. The method has been applied to a structure of high-strength steel and the results are compared with those obtained by the current life estimation procedures. This has shown that the conventional methods can be unconservative in certain cases, depending on the characteristics of the structure and the design operating conditions. The suitability of the probabilistic approach to the interpretation of the results from full-scale fatigue testing of aircraft structures is discussed and the assumptions involved are examined. Author

N72-29905* Boeing Co., Seattle, Wash.
FATIGUE DESIGN PROCEDURE FOR THE AMERICAN SST PROTOTYPE
Ralph J. Doty *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 365-403

CSCL 20K

For supersonic airline operations, significantly higher environmental temperature is the primary new factor affecting structural service life. Methods for incorporating the influence of temperature in detailed fatigue analyses are shown along with current test indications. Thermal effects investigated include real-time compared with short-time testing, long-time temperature exposure, and stress-temperature cycle phasing. A method is presented which allows designers and stress analyzers to check fatigue resistance of structural design details. A communicative rating system is presented which defines the relative fatigue quality of the detail so that the analyst can define cyclic-load capability of the design detail by entering constant-life charts for varying detail quality. If necessary then, this system allows the designer to determine ways to improve the fatigue quality for better life or to determine the operating stresses which will provide the required service life. Author

N72-29909* Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
FRACTURE CONTROL PROCEDURES FOR AIRCRAFT STRUCTURAL INTEGRITY
Howard A. Wood *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 437-483 refs

CSCL 20K

The application of applied fracture mechanics in the design, analysis, and qualification of aircraft structural systems are reviewed. Recent service experiences are cited. Current trends in high-strength materials application are reviewed with particular emphasis on the manner in which fracture toughness and structural efficiency may affect the material selection process. General fracture control procedures are reviewed in depth with specific reference to the impact of inspectability, structural arrangement, and material on proposed analysis requirements for safe crack growth. The relative impact on allowable design stress is indicated by example. Design criteria, material, and analysis requirements for implementation of fracture control procedures are reviewed together with limitations in current available data techniques. A summary of items which require further study and attention is presented. Author

N72-29911* Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
STATISTICAL ANALYSIS OF MISSION PROFILE PARAMETERS OF CIVIL TRANSPORT AIRPLANES
Otto Buxbaum *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 541-563 refs

CSCL 20K

The statistical analysis of flight times as well as airplane gross weights and fuel weights of jet-powered civil transport airplanes has shown that the distributions of their frequency of occurrence per flight can be presented approximately in general form. Before, however, these results may be used during the project stage of an airplane for defining a typical mission profile (the parameters of which are assumed to occur, for example, with a probability of 50 percent), the following points have to be taken into account. Because the individual airplanes were rotated during service, the scatter between the distributions of mission profile parameters for airplanes of the same type, which were flown with similar payload, has proven to be very small. Significant deviations from the generalized distributions may occur if an operator uses one airplane preferably on one or two specific routes. Another reason for larger deviations could be that the maintenance services of the operators of the observed airplanes are not representative of other airlines. Although there are indications that this is unlikely, similar information should be obtained from other operators. Such information would improve the reliability of the data. Author

N72-29912* National Aerospace Lab., Amsterdam (Netherlands).
STATISTICAL LOAD DATA PROCESSING
G. M. vanDijk *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 565-598 refs

CSCL 20K

A recorder system has been installed on two operational fighter aircrafts. Signal values from a c.g.-acceleration transducer and a strain-gage installation at the wing root were sampled and recorded in digital format on the recorder system. To analyse such load-time histories for fatigue evaluation purposes, a number of counting methods are available in which level crossings, peaks, or ranges are counted. Ten different existing counting principles are defined. The load-time histories are analysed to evaluate these counting methods. For some of the described counting methods, the counting results might be affected by arbitrarily chosen parameters such as the magnitude of load ranges that will be neglected and other secondary counting restrictions. Such influences might invalidate the final counting results entirely. The evaluation shows that for the type of load-time histories associated with most counting methods, a sensible value of the parameters involved can be found. Author

N72-29913* British European Airways, London (England).
DETECTION OF STRUCTURAL DETERIORATION AND ASSOCIATED AIRLINE MAINTENANCE PROBLEMS
H. D. Henniker and R. G. Mitchell (BOAC, London, England) *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 599-609

CSCL 20K

Airline operations involving the detection of structural deterioration and associated maintenance problems are discussed. The standard approach to the maintenance and inspection of aircraft components and systems is described. The frequency of inspections and the application of preventive maintenance practices are examined. The types of failure which airline transport aircraft encounter and the steps taken to prevent catastrophic failure are reported. P.N.F.

N72-29914* National Transportation Safety Board, Washington, D.C.
FATIGUE FAILURE OF METAL COMPONENTS AS A FACTOR IN CIVIL AIRCRAFT ACCIDENTS
William L. Holshouser and Ruth D. Mayner *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 611-630
CSCL 20K

A review of records maintained by the National Transportation Safety Board showed that 16,054 civil aviation accidents occurred in the United States during the 3-year period ending December 31, 1969. Material failure was an important factor in the cause of 942 of these accidents. Fatigue was identified as the mode of the material failures associated with the cause of 155 accidents and in many other accidents the records indicated that fatigue failures might have been involved. There were 27 fatal accidents and 157 fatalities in accidents in which fatigue failures of metal components were definitely identified. Fatigue failures associated with accidents occurred most frequently in landing-gear components, followed in order by powerplant, propeller, and structural components in fixed-wing aircraft and tail-rotor and main-rotor components in rotorcraft. In a study of 230 laboratory reports on failed components associated with the cause of accidents, fatigue was identified as the mode of failure

in more than 60 percent of the failed components. The most frequently identified cause of fatigue, as well as most other types of material failures, was improper maintenance (including inadequate inspection). Fabrication defects, design deficiencies, defective material, and abnormal service damage also caused many fatigue failures. Four case histories of major accidents are included in the paper as illustrations of some of the factors involved in fatigue failures of aircraft components. Author

N72-29915* Societe Nationale Industrielle Aerospatiale, Toulouse (France).
FATIGUE TESTS ON BIG STRUCTURE ASSEMBLIES OF CONCORDE AIRCRAFT
V. P. NGuyen and J. P. Perrais (Centre d'Essais Aeron., Toulouse, France) *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 631-648

CSCL 20K

Fatigue tests on structural assemblies of the Concorde supersonic transport aircraft are reported. Two main sections of the aircraft were subjected to pressure, mechanical load, and thermal static tests. The types of fatigue tests conducted and the results obtained are discussed. It was concluded that on a supersonic aircraft whose structural weight is a significant part of the weight analysis, many fatigue and static strength development tests should be made and fatigue and thermal tests of the structures are absolutely necessary. Author

N72-29916* British Aircraft Corp., Filton (England).
STRUCTURAL TESTING OF CONCORDE AIRCRAFT: FURTHER REPORT ON UNITED KINGDOM TESTS
Norman Harpur *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluations 1972 p 649-665

CSCL 20K

A summary of tests conducted on the Concorde aircraft nacelle structure is presented. The tests were conducted as a part of the structural development and certification program. The nacelle structural specimens are described. The problems associated with the intake testing and engine-bay and nozzle testing are discussed. Author

N72-29927# Technische Hochschule Stuttgart (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
DESIGN AND APPLICATION OF INTERACTIVE PROGRAM SYSTEMS [ENTWURF UND ANWENDUNG INTERAKTIVER PROGRAMMSYSTEME]
I. Grieger 1972 31 p refs In GERMAN Presented at the DFVLR Symp. on Bildverarbeitung und Interaktive Systeme, Oberpfaffenhofen, West Ger., 10 Dec. 1971
(ISD-121) Avail: NTIS HC $3.75

Principles for the design of interactive computer systems are discussed and an application in the field of aircraft fuselage calculation is presented. The interactive system, based on a graphic display terminal, and enabling the three dimensional display of structural members using the finite element method, is described in terms of hardware and software. An application is given in the design of a sandwich fuselage demonstrating the possibility of modification. ESRO

N72-29960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATIONAL RELAXATION IN THE PRODUCTS OF HYDROCARBON FUEL COMBUSTION
V. N. Arkhipov 6 Jan. 1972 10 p refs Transl. into ENGLISH from the publ. "Teplofizicheskie Svoistva Zhidkostei i Gazov pri Vysokikh Temperaturakh i Plazmy, 25-30 Jul. 1966, Vol. 2" 1969 p 371-373
(FTD-AAH9)
(AD-740193; FTD-HT-23-1221-71) Avail: NTIS CSCL 21/2

The oscillating relaxation time in the combustion products of a hydrocarbon fuel as it flows from a nozzle under supersonic flow conditions was calcualted. For certain components the duration of the oscillating relaxation is comparable to the characteristic gas dynamic duration of flow. This leads to the fact that the oscillating temperature of the gases at the output of the nozzle essentially exceeds the progressive temperature.
Author (GRA)

N72-29962# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF NONEQUILIBRIUM EFFECTS ON IGNITION DELAY IN A SUPERSONIC AIRSTREAM M.S. Thesis
Donald M. Teasdale Mar. 1972 61 p refs
(AD-741581; GAM/ME/72-1) Avail: NTIS CSCL 21/2

The purpose of the study was to determine analytically the effects of water vapor on the ignition delay process in the burning of gaseous hydrogen in a supersonic flowing vitiated airstream. A low temperature (950 - 1000 K) regime was used so the reaction rates would dominate over the diffusion rates. In the study two chemical kinetic computer programs were used to analytically predict the ignition delay times using the inputs from seven vitiated-air heater experimental investigative conditions. The analytically calculated ignition delay times, for the seven comparitive clean-air and vitiated-air cases, were then compared to the experimental results to determine the effects of water vapor on the ignition delay time. Author (GRA)

N72-29967# Naval Air Propulsion Test Center, Trenton, N.J. Aeronautical Turbine Dept.
STUDY OF ALTITUDE AND MACH NUMBER EFFECTS ON EXHAUST GAS EMISSIONS OF AN AFTERBURNING TURBOFAN ENGINE Final Report
J. Lawrence Palcza Dec. 1971 27 p refs
(AD-741249; NAPTC-ATD-212; FAA-RD-72-31) Avail: NTIS CSCL 21/2

A TF30-P-412 augmented turbofan engine was tested at simulated altitudes and Mach numbers to determine the effects of these parameters (altitude and Mach number) on exhaust pollution emissions. Emission measurements were made over a range of engine power settings from idle to full augmentation at altitudes from sea level to 70,000 feet and a Mach number range of 0 to 1.8. There was no apparent effect on emission levels due to altitude or Mach number. Author (GRA)

N72-29981# Committee on Commerce (U. S. Senate).
REGULATION OF RATES AND PRACTICES OF AIR CARRIERS AND FOREIGN AIR CARRIERS
Washington GPO 1972 281 p refs Hearings on S. 2423 before the Comm. on Com., 92d Congr., 1st Sess., 19-21 Oct. 1971
Avail: Subcomm. on Aviation

Senate hearings on rates and practices of domestic and foreign air carriers are presented. International airline fare-setting practices and procedures, and the recent failure of the International Air Transportation Association to come to an agreement on a common fare package over the North Atlantic are emphasized. The question of whether current procedures and existing U.S. law adequately protect the U.S. traveling public, the U.S. air carriers, and the U.S. air transport system is also discussed. N.E.N.

N72-29982# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE ECONOMICAL CLUB OF DETROIT, DETROIT, MICHIGAN
Secor D. Browne 17 Jan. 1972 6 p
Avail: NTIS HC $3.00

Data covering the future of the airline industry in production transport aircraft are presented. It was suggested that the industry's problems are caused by financial problems and the Government's refusal to give assistance. E.H.W.

N72-29983# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE DOWNTOWN ROTARY CLUB AND THE GREATER TAMPA CHAMBER OF COMMERCE, TAMPA, FLORIDA
Secor D. Browne 1 Feb. 1972 10 p
Avail: NTIS HC $3.00

The financial condition of the airline industry is discussed as well as its problems in producing new aircraft. Special attention is given to the decline of transport aircraft production, and government aid to the industry. E.H.W.

SUBJECT INDEX

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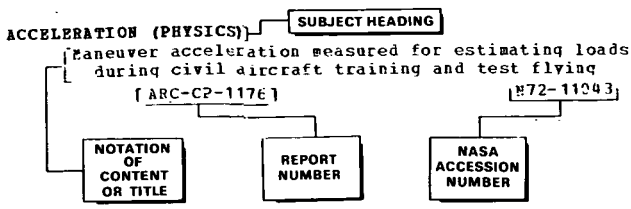

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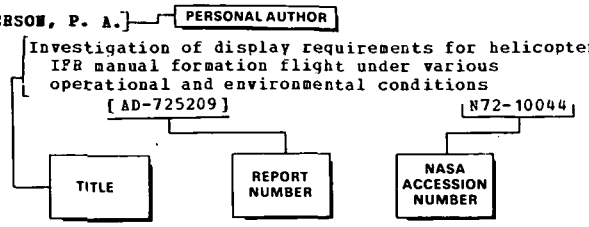

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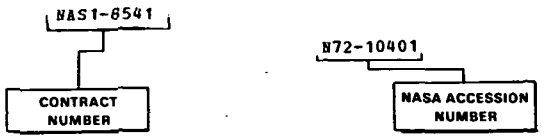

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