NASA SP-7037 (25)

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 25

DECEMBER 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (25)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 25

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 November 1972 in

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

Scientific and Technical Information Office
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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 373 reports, journal articles, and other documents originally announced in November 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.

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

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA. A listing of public collections of NASA documents is included on the inside back cover.

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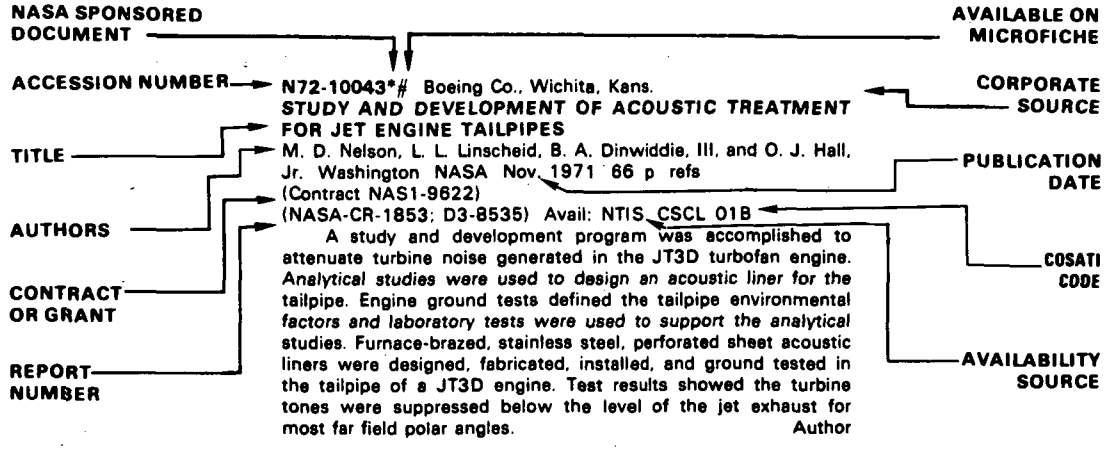

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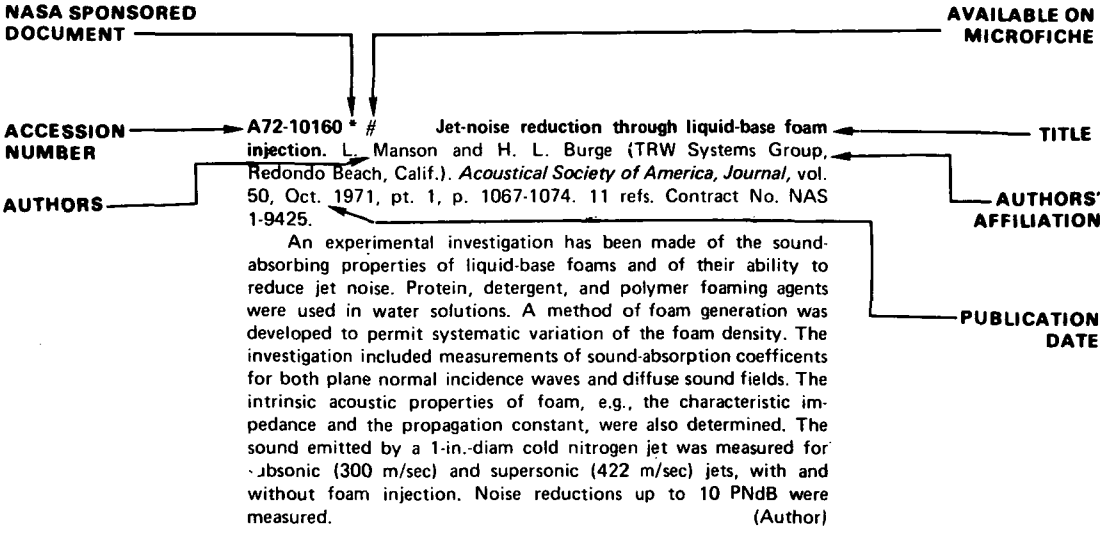

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 25) DECEMBER 1972

IAA ENTRIES

A72-40171 # **Electrostatic charge on an aircraft and lightning striking the aircraft (Elektrostatische Aufladung und Blitzeinschlag am Flugzeug).** H. Karow (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 6, 1972, p. 248-252, 292. In German.

The aircraft can acquire an electrostatic charge on the ground, at takeoff, during the landing maneuver, and during the flight. The differences in the electrical potential between aircraft and environment have a pronounced effect on radio communications of the aircraft in presence of thunderclouds. An electrostatic charge on the aircraft produced by electric fields in a thunderstorm area can have the effect that the aircraft is struck by lightning. In this case the lives of passengers and crew in the aircraft can be endangered because of the high electrical potential which is produced by the lightning stroke within the aircraft. A fire may be started and structural components of the aircraft may be damaged. Protective measures against lightning effects are discussed. G.R.

A72-40173 # **The special equipment of airliners (Die Spezialausrüstung der Passagierflugzeuge).** L. L. Kerber (Proektno-Konstruktorskoe Biuro Tupolev, Moscow, USSR). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 6, 1972, p. 260-264, 276. In German.

The installation of new devices and equipment into Soviet airliners in addition to the autopilot was begun soon after 1945. The additional equipment made in many cases the work of the flying personnel more difficult. The automatization of the aircraft control functions was, therefore, considered. The gradual introduction of features of this automatization into Soviet airliners is discussed, giving attention to control systems in the Tu-104, the Tu-134, and the Tu-154. G.R.

A72-40174 # **Airbus IL-86.** *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 6, 1972, p. 265-276. In German.

The airbus has the capacity to carry 350 passengers. There are three passenger sections with 104 seats, 132 seats, and 114 seats respectively. The aircraft is to have a cruising range of 3250 km. Details of the aircraft design are provided, giving attention to the dimensions of the wings, the fuselage, the control system, the hydraulic system, the duel system, the air-conditioning system including the cabin pressure control, the deicing system, the propulsion system, the power supply, and the accommodations for the baggage. G.R.

A72-40175 # **Flight-mechanical analysis of various flight conditions of conventional aircraft. V - Mechanical foundations /Dynamics of the rigid body/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. V - Mechanische Grundlagen /Dynamik des starren Körpers/).** F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 8, no. 6, 1972, p. 280-292. In German.

A72-40178 # **A method of solving the operational planning problem for an engineering aircraft base (Ob odnom metode resheniia zadachi operativnogo planirovaniia proizvodstvennoi deiatel'nosti aviatsionno-tekhnicheskoi bazy).** S. E. Prozorov. In: Mathematical modeling and electrical circuit theory. Number 9. Kiev, Izdatel'stvo Naukova Dumka, 1971, p. 77-82. In Russian.

A72-40225 **An advanced variometer system.** I. W. Toutanhoofd (National Center for Atmospheric Research, Boulder, Colo.) and R. H. Ball (Ball Engineering Co., Boulder, Colo.). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 12th, Alpine, Tex., June 1970.) Aero-Revue,* Aug. 1972, p. 440, 441.

The Ball variometer for sailplanes is discussed. It gives a direct readout of the vertical speed of the air regardless of the attitude, speed, or acceleration of the sailplane. When the sailplane gains or loses altitude, air flows out from or into a reservoir through the basic capillary to or from the static pressure ports of the sailplane. The pressure difference that is established across the capillary is a measure of the vertical speed of the sailplane. The properties of reservoir capillary systems are discussed. F.R.L.

A72-40276 **NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volumes 1 & 2.** Symposium sponsored by the International Federation of Air Line Pilots' Associations. Frankfurt am Main, Vereinigung Cockpit, 1972. Vol. 1, 222 p.; vol. 2, 221 p.

Area coverage navigation, self-contained navigational systems, and satellites for navigational purposes are covered. The use of automatic navigation management in the cockpit is treated. The present status of self-contained systems combining Doppler velocity sensors with attitude and heading references are considered. Satellites for aeronautical uses over the ocean and their application to radio navigation are discussed. F.R.L.

A72-40277 # **The use of automated navigation management in the cockpit.** T. J. Newman and M. G. Pearson. In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-1-1 to I-1-30.

The MONA (Modular Navigation) dual channel system is considered. The primary purpose of the duality is to provide a second system for increased reliability. Each system consists of the navigation computer unit (NCU), the flight data storage unit (FDSU), and the control and display unit (CDU). A single map display is also included. It is considered that the development of computerized automated navigation management systems, while motivated primarily by requirements of area navigation, will also prove to have much to offer aircraft which fly standard airways. F.R.L.

A72-40278 # **Area coverage navigation.** A. Beriot (Thomson - CSF, Paris, France). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-2-1 to I-2-12, I-2-16 to I-2-25.

The TCE 71A R/NAV system is designed to make sure that the full economic benefits of area navigation (R/NAV) are realized by offsetting hardware costs with reduction in operating costs. Manual data entry is provided as a backup through a keyboard mounted on the control display unit. The system utilizes presently installed flight directors and/or flight control systems and sensors. Automatic data loading and automatic frequency tuning provisions hold cockpit workload to a minimum, relieving the pilot of routine navigational tasks. F.R.L.

A72-40279 # **Operational implementation of area navigation.** L. E. DeGroot and J. H. Sheldrick (General Motors Corp., Delco Electronics Div., Milwaukee, Wis.). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-3-1 to I-3-9.

The evolutionary introduction of the RNAV system appears to be essential to effective planning by both airlines and ATC organizations. A configuration growth plan that permits expansion of inertial navigation systems to eventually provide full area navigation capabilities is one means of assuring the economical and safe introduction of this new equipment. The accuracy of any INS is unacceptable for use in the terminal arrival area because of the time-dependent error growth. The accuracy may be made acceptable by manually updating the system with distance-measuring equipment. Vertical navigation, due to wide variations in aircraft performance, creates special problems for both ATC and RNAV systems. F.R.L.

A72-40280 # **Problems of area navigation.** K. E. Karwath (Deutsche Lufthansa AG, Cologne, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-4-1 to I-4-11.

The main problems are (1) the integration of area navigation in existing traffic control systems in such a manner that the airborne equipment can be exploited to its optimum capability, and (2) the man/machine relationship, in particular the cockpit workload arising from the use of area navigation equipment. Radar vectoring, separation minima, cockpit workload coordinating, and vertical guidance are discussed. There is a need to reduce the complexity and cost of RNAV systems. F.R.L.

A72-40281 # **An area navigation system for a long range airplane.** C. M. Ramsey (Vereniging van Nederlandse Verkeersvliegers, Amstelveen, Netherlands). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-5-1 to I-5-22.

The problem of area navigation is the interface of the machine with the man who must operate it. He must ensure that all the data and instructions the machine might require are already in its possession when the need arises. The operation of an RNAV system is described. The system comprises a digital navigation computer which determines position from inertial, radio, and air data sources in the aircraft. Its primary mode of operation is inertial updated with VOR/DME. Some typical application examples are given. F.R.L.

A72-40282 # **Present status of self-contained navigation systems combining Doppler velocity sensors and attitude/heading references.** E. Brewin and D. Wright (Decca Navigator Co., Ltd., London; Sperry Rand, Ltd., Sperry Gyroscope Div., Bracknell, Berks., England). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-6-1 to I-6-13.

A72-40283 # **Self-contained navigation systems.** P. Güldenpfenning (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-7-1 to I-7-53.

Autonomous navigation systems which provide accuracies within plus or minus 0.4 to 0.6 n mi/hr are discussed. The Doppler effect is shown to be extremely well suited for measurement of ground speed. The main parts of a Doppler sensor are the antenna, the transmitter, the modulator, and the receiver, which are frequently combined into one mechanical unit. Inertial navigation technology is considered, and its elements, including various gyros, are described. The application of computers to combined navigation systems is outlined, and equations to be solved by the computer are presented. F.R.L.

A72-40284 # **Satellites for aeronautical uses.** J. A. Vandenkerckhove (ESRO, European Space Research and Technology Centre, Noordwijk, Netherlands). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-8-1 to I-8-15.

An aeronautical preoperational satellite system is described which is intended to bridge the gap in time and knowledge between current experimental efforts and an operational satellite capability anticipated about 1980. In order to achieve permanence of service, the satellites will be geostationary. The preoperational system will have the capability to provide both voice and data communications between mobiles and earth stations. It will provide surveillance of all suitably equipped aircraft with a location accuracy of better than one nautical mile. Ground facilities and avionics are discussed. F.R.L.

A72-40285 # **Satellites for navigational purposes.** T. M. B. Wright. In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 1. Frankfurt am Main, Vereinigung Cockpit, 1972, p. I-9-1 to I-9-7.

A concept based on measuring the total distance round the triangle formed by two satellites and an aircraft is developed. Each of the satellites carries a simple transceiver which reradiates a master signal transmitted from a highly stable ground-based source. Adequate signals can be obtained in the aircraft with antennas of zero nominal gain. The practical advantages of the concept are that the amount of on-board computation required is minimal, existing designs of airborne antennas can be used, and the satellite requirement is extremely simple. F.R.L.

A72-40286 # **Digital data links for the pilot now.** B. D. Parker. In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2.

Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-1-1 to II-1-3.

Review of some of the principal requirements and functions for data link systems, and discussion of the desiderata and problems they involve. Air crew work load reduction, communication ability improvement, aircraft safety enhancement, and affordable costs are viewed as the major needs. Automatic position reporting and ATC communication, dial-in weather information, message and navaid identification techniques are among the particular areas discussed. It is feared that data links may become too complex too soon, and it is suggested that evolution be given a chance by starting at the simple end of the innovation spectrum. M.V.E.

A72-40287 # **Automated meteorological and information service.** S. Bartelski. In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-2-1 to II-2-7.

Discussion of the proposal to replace VOLMET and AIS by a Met intelligence service giving pilots information upon demand, i.e., the Automated Meteorological and Terminal Information Service (AMATIS). It is shown that this system could be operational in the very near future and that it would be available at affordable costs in different versions for different users, with results of significant improvements in cockpit conditions and flight safety. Further system refinements and developments for the future are also briefly reviewed. M.V.E.

A72-40288 # **Conventional and semi-automated SSR-processing systems.** H. G. Laube (Telefunken AG, Konstanz, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2.
Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-3-1 to II-3-17.

The merits of various types of radar equipment currently used by ATC services are discussed. Primary and secondary radar systems are compared, and the signal structure of secondary surveillance radar (SSR) is examined. The conventional ATC system of SSR information decoding and display is reviewed, along with those of a partially automated ATC system. A more sophisticated, fully automated decoding system is also considered. M.V.E.

A72-40289 # **A precision secondary radar.** A. Allen (Cossor Electronics, Ltd., Harlow, Essex, England). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-4-1, II-4-2.

Discussion of some problems arising from the effects of high air traffic density on the use of secondary surveillance radar (SSR) in ATC as a means of establishing identity and position of transponder-equipped aircraft. One of the major problems is the result of expected replies either not being generated or being corrupted by interference. A selective address system compatible with SSR is proposed as a remedy. M.V.E.

A72-40290 # **A multifunction radar including an ILM mode.** Y. Ferraton (Thomson - CSF, Paris, France). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-5-1 to II-5-12.

A multifunction radar is described that is to be used throughout all flight phases. Weather function, ground mapping, and ground avoidance modes will be used during cruise, and an independent landing monitor function is to operate during takeoff and landing. The general principles, design and operation of the independent landing monitor are described, and its advantages are outlined. Straight and slant approach simulation data are presented. M.V.E.

A72-40291 # **Airborne integrated displays and controls.** Y. Brault (Thomson - CSF, Paris, France). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-6-1 to II-6-13.

A next generation of integrated displays is discussed that is designed to provide the pilot with comprehensive sets of decision- and management-supporting data as and when needed. The reviewed displays include: (1) an electronic attitude direction indicator, (2) an electronic head-up display providing information pertinent to the last flight phase and landing approach, (3) a multifunction display relevant to navigation, communications, fuel status, check list data processing, etc., and (4) an electronic keyboard for mode selection and parameter setting. By replacing a large number of conventional electromechanical instruments, these integrated displays will provide all the information pertinent to any given flight situation, including 2- to 3-minute predictions, at the exclusion of all irrelevant information, with the result of significantly alleviating the work load of aircraft crews. M.V.E.

A72-40292 # **Some problems in the development of an advanced integrated flight control system for STOL-approach.** G. Schanzer (Bodenseewerk Gerätetechnik GmbH, Überlingen, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2.
Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-7-1 to II-7-15.

Review of the design, development, operation, and testing of an integrated STOL flight control system that includes automatic angle-of-attack and throttle control and results in significant approach-accuracy and passenger-comfort improvements. The requirements that must be met by a STOL flight control system are discussed, along with the design criteria for optimal flight control systems as contrasted with conventional STOL flight control systems. The superior performance characteristics of an integrated STOL control system of advanced design, demonstrated in more than 200 automatic landings, are shown to make possible effective noise abatement and safe avoidance of obstacles on steep landing approaches. M.V.E.

A72-40293 # **Characteristics and prospects for a new landing guidance system.** S. B. Poritzky (Air Transport Association of America, Washington, D.C.). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-8-1 to II-8-7.

Review of the various stages in the development of recommendations for a new system of precision approach and landing by more than 450 experts that have participated in the work of the RTCA Special Committee 117. Special attention is given to some of the basic issues that continue to cause concern in the aviation community with respect to a new landing guidance system. M.V.E.

A72-40294 # **Some considerations about the future ILS follower system.** E. Kramar (Standard Elektrik Lorenz AG, Stuttgart, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2.
Frankfurt am Main, Vereinigung Cockpit, 1972, p. II-9-1 to II-9-4.

Critical review of some of the operational requirements recommended by the RTCA, ICAO, and NIAG organizations for the Microwave Landing System that is to supersede the current ILS system in the 1980s. Considered aspects include: (1) the range required for the landing phase from acquisition to touchdown; (2) the advisability of handling the terminal approach and possibly also the missed approach by an airborne en-route navigation system; and (3) the economic advantage of utilizing existing radio aids for the approach phase rather than using a universal system activated only for the short five-minute duration of that phase. It is shown that there still is a considerable number of operational problems that have to be settled before detailed technical specifications can be laid down. M.V.E.

A72-40295 # **Collision avoidance system.** A. Browde (McDonnell Douglas Corp., St. Louis, Mo.). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. III-1-1 to III-1-7.

Review of the development, design, operation, and performance of the MDC time frequency cooperative midair collision avoidance system. It consists of a collision avoidance unit, a maneuver indicator, and two antennas, one on top of the fuselage, the other on the bottom. It provides for simultaneous threat evaluation of 2000 aircraft within a 90 mile radius every three seconds. When an aircraft is within the coaltitude band, the time to nearest approach along the flight path is computed by dividing range by range rate. At 25 seconds before a computed nearest approach, a beeping audio warning tone coupled with a flashing red 'climb,' 'dive,' or 'level off' command appears. The effectiveness of the system is discussed. M.V.E.

A72-40296 # **Aircraft collision avoidance system.** J. L. Parsons (RCA, Van Nuys, Calif.). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. III-2-1 to III-2-19.

Review of the basic principles, operation, potential capabilities, and current and forthcoming tests of the RCA midair collision avoidance system involving separation control of aircraft by nonsynchronous techniques. With this system, large numbers of aircraft, all using the same frequency and basic message structure and all transmitting at will without any prearranged order or sequence, can accomplish the anticollision-protection required information transfer, each one to all the others, without the slightest confusion or interference, and with unambiguous identification of each source. M.V.E.

A72-40297 # **Aircraft collision prevention - A worldwide problem.** T. G. Linnert (Air Line Pilots Association, International, Washington, D.C.). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. III-3-1 to III-3-16. 5 refs.

Discussion of the collision hazard situation in the vicinity of major airports, and review of the urgent need for expediting midair collision prevention. Considered collision prevention approaches include: (1) strobe anticollision lighting on aircraft as an aid for reducing the collision hazard; (2) expanded research and development of a collision avoidance system for all aircraft; and (3) expanded research and development for a proximity warning indicator. M.V.E.

A72-40298 # **The role of the communication service in aeronautical satellite systems.** T. M. B. Wright. In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. IV-1-1 to IV-1-8.

Discussion of the advisability of an objective assessment of the economics of an aeronautical communication system via satellite. Preliminary estimates of the capital costs of such a satellite system, the number of its users, the cost of special airborne equipment, and the annual charge per user are presented and discussed. M.V.E.

A72-40299 # **An air traffic controller's view on area navigation and ATS requirements related thereto.** W. Gobel (Verband Deutscher Flugleiter, Langenhagen, West Germany). In: NEWNAV Symposium, Frankfurt am Main, West Germany, October 5-7, 1971, Report. Volume 2. Frankfurt am Main, Vereinigung Cockpit, 1972, p. IV-2-1 to IV-2-3.

Discussion of some of the requirements to be met on the ground and in the air for the creation of an area navigation capability in the European-Mediterranean region. The requirements considered include the integration of the civil and military air traffic control systems, and replacement of the present manual ATC system by an automatic one. M.V.E.

A72-40334 **Optimization of acoustic linings in presence of wall shear layers.** S. Mariano (Boeing Co., Renton, Wash.). *Journal of Sound and Vibration,* vol. 23, July 22, 1972, p. 229-235.

The effect of re-optimizing single layer linings in the presence of wall shear layers is investigated theoretically for an inlet Mach number of 0.40 and for four values of the non-dimensional frequency at which maximum attenuation is desired. A lining optimized in the absence of shear has its performance degraded by boundary layer refraction, but re-optimizing the lining in the presence of shear results in a substantial recovery of the attenuation loss. This recovery is achieved by reducing the lining resistance R/rhoc and increasing its airspace backing depth. A set of curves that could be used for preliminary lining design is also presented for an inlet Mach number of 0.40 giving the optimum non-dimensional resistance R/rhoc and the optimum d/h when shear is present. These curves are based on the assumption of uniform distribution of acoustic energy among the modes. (Author

A72-40372 **A metallized channel guide antenna for use over a cylindrical ground screen.** R. J. Mailloux and W. G. Mavroides (USAF, Microwave Physics Laboratory, Bedford, Mass.). *IEEE Transactions on Antennas and Propagation,* vol. AP-20, Sept. 1972, p. 659-661. 6 refs.

A72-40376 # **Landing 'in the backyard' with quiet aircraft (Landa 'pa bakgarden' med tyst flygplan).** S. Engstrom. *Teknisk Tidskrift,* vol. 102, Aug. 18, 1972, p. 22-24, 26. In Swedish.

Consideration of the possibility of developing a short-haul aircraft requiring runways of only modest length and featuring quiet operation. Factors justifying the development of such an aircraft are outlined, and an overqualified preliminary design of an aircraft of this type is described. The final design calls for the development of an aircraft featuring a steep final approach for landing in order to shorten the runway length required, thus increasing airport capacity. Such factors as engine choice, aerodynamic design, and the required electronic monitoring system are discussed. A.B.K.

A72-40459 # **Handbook of aircraft materials (Spravochnik po aviatsionnym materialam).** V. G. Aleksandrov. Moscow, Izdatel'stvo Transport, 1972. 328 p. In Russian.

A compilation is given of the physicochemical and mechanical properties of various steels, nonferrous alloys, nickel-base alloys, refractory alloys, cermets, plastics, and lubricants. Specific applications are recommended as a function of the operational conditions (loads, temperatures, composition and properties of the ambient medium, aircraft lifting power, etc.). V.P.

A72-40463 # **The ASh-62IR aircraft engine /4th enlarged edition/ (Aviatsionnyi dvigatel' ASh-62IR /4th enlarged edition/).** P. S. Labazin. Moscow, Izdatel'stvo Transport, 1972. 384 p. In Russian.

A brief introduction to the theory of piston engines is presented, and the design and principles of operation of the units, elements, and subsystems of the ASh-62IR piston engine employed in the An-2 aircraft are discussed. Much attention is given to maintenance aspects and to malfunctions, their causes, and means of avoiding and eliminating them. The ASh62M and ASh62N modifications of the ASh-62 engine are examined. V.P.

A72-40509 **The basic principle and possibilities of constructing a Doppler navigation antenna (Prinzip und Aufbaumöglichkeiten für eine Dopplernavigationsantenne).** A. Brunner, W. Jatsch, and K. Rieskamp (Siemens AG, Zentral-Laboratorium für Nachrichtentechnik, Munich, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports. Berlin, VDE-Verlag GmbH, 1972, p. 41-45. In German.

Consideration of the possibility of designing a ground-based Doppler navigation antenna which is capable of receiving three or four highly directional lobes radiated from an aircraft at various solid angles to the ground. In order to ensure such reception without using more than one antenna, the use of a waveguide slot antenna is recommended in which each lobe is deflected both in the plane parallel to the feed waveguides and in the plane parallel to the radiation waveguides and lies in one of the four quadrants formed by the projection of the aircraft axes on the ground. The optimization of the radiation patterns is discussed, as well as methods of compensation of errors due to such factors as the land-sea effect, cross-polarization, and temperature and frequency fluctuations. A.B.K.

A72-40510 **Experimental investigation regarding Archimedean spiral antennas for the L-band, and radiator groups constructed from them whose radiation directions are controlled by a conduction matrix (Experimentelle Untersuchung an archimedischen Spiralantennen für das L-band und daraus aufgebauten Strahlergruppen, deren Strahlrichtungen durch eine Leitungsmatrix gesteuert werden).** E. Hörmann (Siemens AG, Zentral-Laboratorium für Nachrichtentechnik, Munich, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports. Berlin, VDE-Verlag GmbH, 1972, p. 46-50. In German.

A72-40527 **Active receiving antennas for predominantly mobile applications (Aktive Empfangsantennen für überwiegend mobilen Einsatz).** A. Stark (Rohde und Schwarz, Munich, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports.
Berlin, VDE-Verlag GmbH, 1972, p. 146-150. In German.

An active polydirectional receiving antenna for the VHF air traffic control range from 100 to 156 MHz is considered, together with active polydirectional receiving antennas for applications with vehicles, and active directional receiving antennas for the use with vehicles. Other subjects discussed include an active dipole for a device for measuring field intensity, and measurements conducted to compare the characteristics of two antennas. G.R.

A72-40530 **A brief report regarding the development of a double-beam radar antenna with special dielectric radiators (Kurzbericht über die Entwicklung einer Doppel-Beam-Radar-Antenne mit speziellen dielektrischen Strahlern).** H. Brunner (Telefunken AG, Berlin, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports. Berlin, VDE-Verlag GmbH, 1972, p. 162-166. In German.

The requirements for a new radar system for the control of the air traffic in West Germany are briefly examined. These requirements can be satisfied by a radar installation designed for an intermediate range. The radar installation operates in the frequency range from 1250 to 1350 MHz. Two reflectors which are displaced against each other by 180 deg are the salient features of the antenna of the installation. The reflector height is 9 m and the width is 14.5 m. A polarizer makes possible the emission of linearly, circularly, or elliptically polarized waves. Design details of the radar antenna are discussed, giving attention to aspects of coupling and changes in the radiator form. G.R.

A72-40534 **Determination of the radiation characteristics of aircraft antennas in flight (Ermittlung der Strahlungscharakteristiken von Flugzeugbordantennen im Fluge).** H. Mattes and U. Hinzpeter (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugfunk und Mikrowellen, Oberpfaffenhofen, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports. Berlin, VDE-Verlag GmbH, 1972, p. 180-185. In German.

According to the new method for the determination of the antenna characteristics the diagrams are directly drawn during the flight. This procedure has the advantage that possible errors in a measurement can be recognized immediately. It is then possible to repeat the measurement during the same flight. The basic principles of the new method are discussed together with the determination of the aspect angle, the determination of the relative field intensity, and various corrections which have to be applied to the measured data. The described method has been used in a number of cases involving various antennas with aircraft of different types. G.R.

A72-40545 **Diagram and gain measurements regarding antennas conducted with a helicopter for the range from 0.5 to 800 MHz (Diagramm- und Gewinnmessungen an Antennen im Bereich von 0,5 bis 800 MHz mit Hubschrauber).** P. Henss (Deutsche Bundespost, Fernmeldetechnisches Zentralamt, Darmstadt, West Germany). In: Antennas; Specialists' Meeting, Darmstadt, West Germany, February 22-24, 1972, Reports.
Berlin, VDE-Verlag GmbH, 1972, p. 232-236. In German.

Fundamental considerations to be taken into account for measurements with a helicopter are discussed. Field intensity recordings along certain flight paths are required for the determination of the diagrams. An evaluation of the performance of an antenna system can be obtained on the basis of a gain measurement. The receiving device in the helicopter must be calibrated for this measurement. Details regarding the calibration procedure are presented. The characteristics of the helicopter needed for the measurements are discussed together with the equipment, the conduction of the measurements, and the results obtained in the measurement procedure. G.R.

A72-40546 **Present problems of landing area navigation (Aktuelle Probleme der Rollfeldnavigation).** C. Wöltge (Hannover, Technische Universität, Hanover, West Germany). *Ortung und Navigation,* no. 2, 1972, p. 39-53. In German.

It is pointed out that in the not too distant future the ILS approach will be replaced by a microwave landing system. Studies regarding the definitions for the new organization of the terminal airspace are in progress. Problems connected with runways, taxiways, and aprons are analyzed together with questions of landing area navigation and the direction of aircraft movements. The functions of pilot and air traffic control are examined, giving particular attention to the capability of the employees in air traffic control to carry out their activities. The automatization of individual control functions is to reduce the work load of the controller. G.R.

A72-40553 # **Boron polyimide composite development.** H. K. Mathewson and C. L. Hendricks. *SAMPE Quarterly,* vol. 3, Apr. 1972, p. 23-27.

Preliminary study of techniques and processes for the fabrication of boron/polyimide tape and wide goods, their subsequent lamination and bonding to titanium, and ultimate utilization in supersonic-airplane primary structural components. The feasibility of making boron/polyimide wide goods on a conventional lathe, fabricating laminates with standard vacuum bag techniques, machining and grinding laminates to desired width and thickness, and secondary bonding to titanium with polyimide adhesive are demonstrated. Fatigue test results seem to substantiate the general

Ukrainian SSR). *Problemy Prochnosti,* vol. 4, May 1972, p. 103-107. 9 refs. In Russian.

The characteristics of a titanium-base beta-alloy are studied experimentally, with particular reference to the initial phase of

A72-40651 Semi-infinite vortex trails, and their relation to oscillating airfoils. D. Weihs (Cambridge University, Cambridge, England). *Journal of Fluid Mechanics,* vol. 54, Aug. 22, 1972, p. 679-690. 14 refs.

Use of semiinfinite double rows of vortices to study the periodic wave of both oscillating and stationary two-dimensional bodies immersed in a uniform incompressible stream. Analytical expressions for the induced velocities on the body (for trails with constant spacing), which are valid for small values of the oscillation amplitude, are presented, while, for the general case of vortex shedding, an iterative procedure for the representation of trails of variable spacing is developed and used. Vortex streets due to oscillating bodies are obtained as a function of three nondimensional parameters: the Strouhal number (initial spacing ratio), a nondimensional vortex strength, and the downstream spacing ratio. Criteria establishing when such trails are expected to widen, become narrow, or stay of constant width are presented, as well as expressions for the induced velocities. (Author)

A72-40683 A new look at area navigation. C. M. Ramsey (KLM - Royal Dutch Airlines, Schiphol Airport, Netherlands). *Shell Aviation News,* no. 409, 1972, p. 9-11.

The major feature of area navigation in the horizontal plane is its two-dimensional character, as opposed to airways navigation, where paths are constrained to flight directly to or from a ground transmitter. The newly emerging area navigation can penetrate into critical environments and perform its task with the required full time continuity and accuracy. To do this, track computations and steering functions are mechanized and performed in real time. The problem of implementation is discussed and the navigation problem is analyzed. It is anticipated that a system complex will evolve in which all routings and route changes will be automatically transmitted to an on-board computer which will present the instruction to the pilot before proceeding with it. F.R.L.

A72-40684 The augmentor wing concept. J. H. Stevens. *Shell Aviation News,* no. 409, 1972, p. 16-21.

The elements of the augmentor wing are: leading edge slat, duplicated blowing duct, and 'biplane' flap. The slat lies under the leading edge. It is the form of the upper surface and the slot relationship with it that are critical. The essential factor is that the nozzle exhausts slightly downward over a curved leading edge on the lower flap section. The fast jet is turned downward by the Coanda effect, and as it does so it entrains air from above and below the wing into the divergent zone between the flap surfaces. The overall effect of the augmentor wing is to provide an attached flow at the leading edge of the wing (with a large 'suction bubble' above the wing) which is sucked down by the jet to flow between the flap surfaces, and to emerge, greatly augmented by the entrained air, as a jet sheet giving a powerful lifting reaction. Some results of flight and wind tunnel tests are given. F.R.L.

A72-40814 # The energy balance for moving open systems (Bilans energii dla ukladow otwartych ruchomych). J. Szargut. *Archiwum Budowy Maszyn,* vol. 19, no. 3, 1972, p. 437-445. In Polish.

Derivation of a formula for the flow energy of a medium intersecting a balanced screen moving at a constant velocity relative to the coordinate system. Examples of applications of this formula to the calculation of the thrust of a jet engine and to the estimation of the energy balance in the case of a turbojet engine are presented. A.B.K.

A72-40881 The impact of the Air Transport Association of America /ATA/ collision avoidance system on the 1600 MHz aeronavigation band. J. E. Adams, G. G. Ax, and R. D. Jennings (U.S. Department of Commerce, Office of Telecommunications, Boulder, Colo.). In: Annual International Conference on Communications, 8th, Philadelphia, Pa., June 19-21, 1972, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 20-20 to 20-24. 8 refs.

The effects of different types of possible interfering electromagnetic signals on the collision avoidance system (CAS) are examined. This CAS operates only with other aircraft that have similar equipment as a cooperative system. There are six radar altimeters (four military and two civilian) designed for use in the 1600 MHz band. They are of the pulsed carrier and frequency-modulated continuous wave (CW) types. It is shown that certain radar altimeters can operate under normal FAA aircraft separation rules with less than 50% reduction in CAS performance parameters. F.R.L.

A72-40884 Shaped coverage patterns with satellite array antennas. J. L. Hult (RAND Corp., Santa Monica, Calif.). In: Annual International Conference on Communications, 8th, Philadelphia, Pa., June 19-21, 1972, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 26-15 to 26-18.

Outline of attractive theoretical potentials of satellite array antennas, and development of techniques for quickly estimating the shaping possibilities for arbitrary geographical coverages as a function of the array size. It is shown that antenna arrays can be developed to provide a given quality of service that would use less satellite power, produce less interference, and provide more independent reusable spectrum capacity than is possible with more conventional reflector antennas. Urgent development programs for application to television broadcasting (below 2700 MHz) and air traffic control are suggested. (Author)

A72-40925 # Analysis of dynamic aircraft landing loads, and a proposal for rational design landing load requirements. J. Ijff. Delft, Technische Hogeschool, Doctor in de Technische Wetenschappen Dissertation, 1972. 182 p. 83 refs.

The study is concerned with the possibility of formulating more up to date, yet simple, requirements for landing impact cases. An extensive investigation is made into the relative importance of the large number of variables involved in the landing impact problem, so that it will be possible to determine the design loads (i.e., limit and ultimate loads) in a more rational way than is the case with existing requirements. Following a survey of existing literature, the theory of landing impact load analysis is examined. The initial conditions for the landing impact problem are outlined, and details of example calculations are given for the Fokker F-27. The influence of constitutive parameters on landing impact loads is considered, and calculated and measured landing impact quantities are compared. F.R.L.

A72-40930 Numerical solution of the off-design problem of axial-flow compressors in intrinsic coordinates. E. Zahavi, K. Winikoff (Negev, University, Beersheba, Israel), and J. Sinai (Bet Shemesh Engines, Ltd., Bet-shemesh, Israel). *(Israel Conference on Mechanical Engineering, 6th, Haifa, Israel, June 26, 27, 1972.) Israel Journal of Technology,* vol. 10, no. 4, 1972, p. 307-313. 10 refs.

The paper describes the development and application of a

numerical solution to the off-design problem of axial flow compressors. To facilitate the solution, axial symmetry and blade element flow are assumed. In solving the meridional flow problem, an intrinsic coordinate system is used. An ordinary differential equation is developed for the meridional velocity distribution along the exit normal. An iterative procedure is developed to determine the exit normal and the flow properties there. To show the correlation with actual compressor performance, the computational results are compared to NASA test data. (Author)

A72-40969 # **Aeroelasticity in turbomachines - A field all aflutter.** S. Fleeter (General Motors Corp., Detroit Diesel Allison Div., Detroit, Mich.). *Astronautics and Aeronautics,* vol. 10, Sept. 1972, p. 56-59.

A method of calculating the unsteady supersonic aerodynamic coefficients by means of the classical work concept is considered. A fundamental difficulty in the supersonic case is connected with the mathematical analysis of the Mach waves which lie ahead of the cascades airfoils. Other subjects discussed include a high-speed schlieren movie on unsteady cascade flow, improvement goals of engine manufacturers, and present trends in fan and compressor technology. Such trends are leading to tip Mach numbers on the order of 2 and stage pressure-ratios of 2.8. This means that the present knowledge of flutter must be extended to new high-speed regimes. G.R.

A72-40971 **Air Force looks forward to return to prototyping.** O. J. Glasser (USAF, Washington, D.C.). *Defense Management Journal,* vol. 8, July 1972, p. 14-18, 60.

An effective balance must be achieved between theoretical studies and hardware prototyping in determining what defense systems can and should be developed to meet future needs. The basic motivating factor concerning a return to prototyping is to reduce the uncertainty regarding the merits of a new defense system. Prototypes will contribute to a solution of many problems encountered while penetrating unexplored flight performance regions. Prototypes help also to expose many design oversights. General aspects of the advanced prototype program are discussed together with specific advanced prototype projects. G.R.

A72-41068 # **Fly by wire control system.** D. J. Millard (Dowty Boulton Paul, Ltd., Wolverhampton, Staffs., England). *Aircraft Engineering,* vol. 44, Aug. 1972, p. 4, 5, 7.

The Concorde is the first civil aircraft to employ electrical signalling as the main form of control, the mechanical control linkage being used only as a standby system in the event of a series of electrical failures. The basic system comprises six elevon units, two rudders, and three relay units. The pilots' controls operate on three relay or booster units. They also operate position synchros which produce electrical signals which, when amplified, are used to command the main power units electrically. F.R.L.

A72-41069 # **Variable feel simulation.** *Aircraft Engineering,* vol. 44, Aug. 1972, p. 8-11.

Variable feel systems were developed to provide the pilots of high performance jet aircraft, equipped with powered flying controls, with simulated aerodynamic reaction forces at the controls. The systems are designed to provide an essentially linear stiffness characteristic at the pilot's control, with the load being proportional to the aircraft's dynamic pressure. Control law variations are discussed, and duplex variable feel systems are described. F.R.L.

A72-41070 # **Counter rotating STOL discs.** G. M. Andrew. *Aircraft Engineering,* vol. 44, Aug. 1972, p. 11, 12.

The high lift coefficients of rotating disks were studied experimentally, using a doughnut-shaped rotating water tank. Two counter-rotating disks, each with the cross section of a thin ellipse, were immersed in the water. The disks were driven by electric motors at speeds from 100 to 3000 rpm. The experiments demonstrated a considerable increase of lift and decrease of drag. It is suggested that larger models be tested in wind tunnels in order to obtain better quantitative data. F.R.L.

A72-41071 # **The cost effective use of sheet material.** T. O. Williams (British Aircraft Corp., Ltd., Military Aircraft Div., Warton Aerodrome, Lancs., England). *Aircraft Engineering,* vol. 44, Aug. 1972, p. 13, 14, 16-18.

In terms of ultimate operating economics it is sound to pay a high price to achieve reductions in weight. Because of the importance of strength/weight and stiffness/weight ratio the principal material has been aluminum alloy. In the higher temperature ranges titanium sheet alloys have a clear advantage. Shaping of titanium requires specialized equipment with additional operations both for manipulation and protection from oxidation leading to increased manufacturing costs. To produce the developed blank, from which the majority of sheet metal parts are made, the choice is between routing, nibbling, or blanking on a power press. Forming and welding methods are discussed, and future trends are outlined. F.R.L.

A72-41072 # **Automatic landing and microwave guidance system potential.** A. M. Patrick (Plessey Radar, Ltd., Weybridge, Surrey, England). *Aircraft Engineering,* vol. 44, Aug. 1972, p. 19-22.

The striking advances in ILS performance in the last decade are related to the impetus given by specific changes in operational requirements, particularly as regards automatic landing systems. The article goes on to review the long term project for microwave landing guidance systems, planned to see service in the 80's, with which ILS will co-exist to an extent, and for a period, impossible as yet to foretell. (Author)

A72-41077 **System analysis for an airline operational environment through a computerized network simulation model.** G. Radnoti (Seaboard World Airlines, Inc., John F. Kennedy International Airport, N.Y.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, July 1972, p. 419-427.

A72-41079 **In-flight alignment and calibration of inertial measurement units. I - General formulation. II - Experimental results.** J. Baziw (TRW Systems Group, Redondo Beach, Calif.) and C. T. Leondes (California, University, Los Angeles, Calif.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, July 1972, p. 439-465. 14 refs. Grant No. AF-AFOSR-699-67.

A very general formulation of the inertial measurement unit error model and of the physical environment is considered. Depending on the particular problem being considered, this formulation may be suitably simplified to obtain the canonical equations for minimum-variance estimation of the error parameters of interest. Filter equations are discussed together with dynamic equations, inertial measurement unit instrument errors, the structure of the minimum-variance estimator, a specialized calibration and alignment problem, and the use of angular velocity observations. G.R.

A72-41080 **Aperture synthesis for ionospherically propagated HF radio signals.** J. T. Lynch (MIT, Lexington, Mass.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-8, July 1972, p. 466-471. 7 refs. Contract No. Nonr-225(64).

A high-frequency (HF) aperture was synthesized by receiving ionospherically propagated signals in an airplane. The signals used the

one-hop F lower ray mode to propagate a distance of 2600 km and were processed to yield equivalent aperture lengths of 10 km and 70 km. It was shown that apertures of up to 10 km in length could sometimes achieve their ideal free-space directivity without use of ionospheric compensation. (Author)

A72-41126 # **Choice and balance - A research programme in aerodynamics in perspective /The Daniel and Florence Guggenheim Memorial Lecture/.** G. Y. Nieuwland (Vrije Universiteit, Amsterdam, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-01.* 13 p. 13 refs.

Aspects of the problem of choice in aerospace research are discussed together with the objectives of the research conducted in aerodynamics, some methodical developments, and questions of program development. Attention is given to the annular wing project, shockless transonic aerofoils, and panel methods. The panelling of a cylinder-vortex model is considered together with the wave drag of a body in supersonic flow, an axially symmetric body with zero wave drag, the decrease in wave drag due to the addition of an annular wing, the flowfield about an inclined body of revolution, and questions of wave generation by cavity flow. G.R.

A72-41127 **Sand erosion of gas turbines.** G. P. Tilly (National Gas Turbine Establishment, Mechanical Behaviour Section, Farnborough, Hants., England). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-02.* 9 p. 20 refs.

Consideration of the relationships between erosion of gas turbine compressor blading and the impact conditions. The equations governing the behavior are given. The factors determining the erosiveness of natural sands are summarized. Using these relationships, it is shown that the damage produced in engines tested under controlled environments can be related to laboratory erosion data. Consideration of methods of minimizing erosion indicates that there is little scope for use of materials better than the martensitic steels and nickel alloys currently used in later stages of compressor blading. Estimates of the degree of protection to be obtained through use of intake filters indicate higher figures than are achieved in service. A helicopter trial subsequently showed that this is due to failure to achieve the filtration efficiencies given in controlled laboratory testing. (Author)

A72-41129 # **Future trends in air traffic control and landing.** G. B. Litchford (Litchford Systems, Northport, N.Y.) and G. L. Yingling (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-04.* 13 p.

Discussion of the total aviation systems approach to integrating the disciplines of electronics and aeronautics that is essential for solving many of the major problems already identified, such as area navigation, collision avoidance, microwave landing, and general aviation, i.e., the acceptance of tens of thousands of light aircraft. As an advanced example of this new total system thinking, the microwave landing system (MLS) national plan and its interface with air traffic control are examined. The MLS plan can cost over $1 billion to develop and implement. It is mandatory, therefore, that total system planning and validation be applied. Interagency MLS planning, techniques investigation, and application to user needs are some of the areas given special attention. M.V.E.

A72-41130 # **A new method of calculating the natural vibrations of a free aeroplane.** M. Nowak (Polska Akademia Nauk, Instytut Podstawowych Problemow Techniki, Warsaw, Poland). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-05.* 11 p.

A method for calculation of the natural vibrations of an elastic aeroplane taking into account all the rigid body degrees of freedom and additional degrees of freedom, due to e.g. free controls, is presented. Contrary to commonly used methods the proposed procedure leads to an eigenvalue problem of a positive definite symmetric matrix of degree equal to the total number of coordinates used for the description of the vibration modes minus the number of rigid degrees of freedom. The basic data for calculations consist of matrices describing the rigid degrees of freedom as well as of the mass and flexibility influence coefficients matrices. For the reduction of matrices and calculations, only numerically stable methods were used. (Author)

A72-41132 # **An exploratory study of flying qualities of very large subsonic transport aircraft in landing approach.** H. A. Mooij and W. P. de Boer (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-07.* 14 p. 24 refs.

For two hypothetical subsonic jet transports with aircraft weights of two and eight times those of our contemporary jumbo jets, estimated characteristic parameters for the handling qualities are presented and discussed in the light of contemporary regulations. Controllability in vertical windshear and maneuver performance for lateral-directional control during the lateral offset maneuver are discussed. The need for command augmentation flight control systems and direct lift control is clearly established. (Author)

A72-41134 # **Laminar and turbulent boundary-layer studies at hypersonic speeds.** J. L. Stollery (Imperial College of Science and Technology, London, England). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-09.* 12 p. 58 refs.

The paper reports the results of theoretical and experimental boundary layer investigations relevant to the space shuttle and future hypersonic aircraft. Laminar and turbulent flows over flat plate, wedge, concave, convex and compression corner surfaces are considered, including the effects of strong viscous interaction, shock-boundary layer interaction and flow separation. Comparisons are made between the surface heat transfer and pressure measurements and predictions from the wide variety of theories now available. The conditions for incipient separation are specified and it is shown that both laminar and turbulent boundary layers become more resistant to separation as the Mach number rises. (Author)

A72-41136 # **Experimental study of flows in supersonic compressors (Etude expérimentale des écoulements dans les compresseurs supersoniques).** J. Surugue and J. Fabri (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-11.* 11 p. 16 refs. In French.

The solely theoretical representation of the flow encounters many difficulties arising mainly from the uncertainty attached to the configuration of shock waves which establish themselves in the interblade passages. ONERA has developed experimental setups which make extensive use of visualization. They consist of flat or annular, fixed or moving grids of blades. The study analyzes the conditions determining the mass flow of the compressor in the transonic, supersonic, and saturated supersonic regimes. F.R.L.

A72-41137 # **Two-dimensional subsonic linearized theory of the unsteady flow through a blade-row with small steady pitch and camber angle.** J. Leclerc (ONERA, Châtillon-sous-Bagneux, Hauts-de-

Seine, France). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-12.* 7 p. 6 refs.

A72-41138 # Potential flow calculations to support two-dimensional wind tunnel tests on high-lift devices. Th. E. Labrujere, G. J. Schipholt, and O. de Vries (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-13.* 9 p. 10 refs. Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart.

Evaluation of the applicability of potential flow calculations for developing high-lift devices by comparing calculated pressure distributions over wing sections with trailing and leading edge high-lift devices, and experimental results, obtained during routine wind tunnel tests. From these comparisons it was found that the results of the calculations can be used for a number of purposes - namely, the load estimation on an element of a multiple air-foil, the interpretation of wind tunnel test results, and the modification of a configuration already tested. (Author)

A72-41141 # The future of short haul air transportation systems. R. W. Simpson (MIT, Cambridge, Mass.). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-16.* 8 p.

Discussion of the existing potential for introducing new forms of air transportation to provide improved services for the short haul intercity passenger over distances from 100 to 250 miles in competition with lower cost ground modes. Careful design is felt to be the essential prerequisite to the successful introduction of such services. System times and costs are more important than aircraft costs. Community acceptance of new airports at desirable locations requires satisfactory noise performance from the aircraft. A less noisy aircraft which is slower and more expensive may be part of a faster, less expensive complete system of aircraft and airports. Government leadership is essential for creating policies and programs fostering the development of these new forms of air transportation. M.V.E.

A72-41143 # Technological advances in airframe-propulsion integration. D. Zonars (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-18.* 17 p. 18 refs.

F-111A aircraft inlet system and TF-30 engine compatibility is reviewed based on an assessment of time averaged and instantaneous distortion parameters. In addition, recent advances in research on inlet configurations associated with steady-state and dynamic distortions are presented. A complete random data acquisition, editing and processing method is described for accomplishing data analysis as an inlet flow diagnostic tool. Finally, recent afterbody and nozzle research results, which improve the technology base for understanding airframe-nozzle interactions, are reviewed. A basic aircraft configuration incorporating a common forebody, wing, inlet system and a twin engine installation was utilized during high Reynolds number wind tunnel tests to determine the relative merits of a wide spectrum of afterbody-nozzle geometrical variations. (Author)

A72-41144 # Some aspects of inlet/engine flow compatibility. D. D. Williams and J. O. Yost (Rolls-Royce, Ltd., Bristol Engine Div., Bristol, England). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-19.* 15 p. 28 refs.

Discussion of some results obtained from test programs carried out to investigate the effects of simulated total pressure distortion on the performance and stability margins of various isolated multistage axial compressors, and on turbojet and turbofan engines. Distortion propagation through the turbomachinery is also discussed. Some of the limitations of such testing are judged against contemporary developments on the inlet/engine compatibility scene. Results derived from the application of some theoretical ideas to the problem of compatibility are cited. Some comments are made on the choice of suitable parameters for describing inlet distortion. (Author)

A72-41145 # The development of inlet flow distortions in multi-stage axial compressors of high hub-tip ratio. H. Mokelke. *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-20.* 18 p. 5 refs.

A small perturbation theory is presented for the prediction of circumferential flow distortions in high hub-tip ratio multi-stage axial compressors with inlet maldistribution. The analytical model replaces the stages by actuator discs. Numerical examples have been presented which demonstrate the influence of varying stage characteristics on the attenuation of the distortions and which show how the distorted flow redistributes in large axial clearances within a compressor. The theory has been compared with interstage traverse data obtained from a 4-stage axial flow compressor. Results show that circumferential crossflow within the compressor is small but further numerical evidence indicates that crossflow may become significant as the number of stages, and hence the overall gap length, increase. (Author)

A72-41147 * # Noise radiation from V/STOL aircraft. M. V. Lowson (Loughborough University of Technology, Loughborough, Leics., England). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-22.* 13 p. 44 refs. Research supported by the National Gas Turbine Establishment and NASA.

This paper presents a detailed evaluation of design factors affecting noise annoyance by V/STOL aircraft. Community noise annoyance is quantified on the basis of recent analyses of survey data, and the implications on V/STOL design discussed. The effect of fundamental design choices on noise levels is analysed. The principal noise sources, and therefore the optimum noise control measures, are a function of disc loading. It is found that increase in rotor scale gives a substantial benefit in subjective levels at the lower disc loadings. Rotor noise source mechanisms are discussed in detail and the dominant effect of the unsteady aerodynamic input to the rotor demonstrated. Data on the effects of recirculation on noise is presented. Two approaches for low noise V/STOL seem to be feasible. These are the low disc loading open rotor, and a ducted fan with substantial duct attenuation treatment. The principal noise control methods for each approach are given. (Author)

A72-41149 # Theoretical and experimental study of a dual-mode ramjet /flight range from Mach 3.5 to 7/ (Etude théorique et expérimentale d'un statoréacteur à combustion mixte /domaine de vol Mach 3,5/7/). P. Contensou, R. Marguet, and C. Huet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-24.* 16 p. 12 refs. In French.

Consideration of the possibility of using a dual-mode ramjet (one in which transonic and supersonic combustion occur in the same chamber) to propel hypersonic vehicles up to velocities of Mach 6 or 7. In theory, this configuration makes it possible to obtain performances close to those of a continuously adapted ramjet while retaining a fixed geometry for the air intake and the nozzle for the entire mission. The results of experimental studies carried out in a high-enthalpy wind tunnel on a 400-mm-diam ramjet under flight conditions approaching Mach 6 are cited, noting that specific impulses of the order of 3000 sec were obtained. A method of optimizing the combustion in a fixed-geometry ramjet by varying the combustion regime is described. A.B.K.

A72-41150 # Experimental investigations of separated flows on wing-body combinations with very slender wings at free-stream Mach numbers from 0.5 to 2.2. W. Stahl, K. Hartmann, and W. Schneider (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-25.* 9 p. 7 refs.

Investigation undertaken in order to find out to what extent the flowfield of a slender delta wing with its favorable properties would be carried over to a wing-body combination. Such a flow is governed by the leading edge vortices, and it does not change essentially over a wide range of Mach numbers and angles of attack. A wing-body combination with a very slender wing (A = 0.52) extending along most of the body was tested to this end. Forces and pressure distributions on suction and pressure sides were obtained at subsonic, transonic, and supersonic flow velocities for angles of attack up to 30 deg. The Reynolds number was held constant for all Mach numbers at R = 2,700,000 (based on two-thirds of the wing length). Oil and smoke flow visualization techniques gave some insight into the flow structure. (Author)

A72-41151 # Canadian sonic boom simulation facilities. I. I. Glass, H. S. Ribner (Toronto, University, Toronto, Canada), and J. J. Gottlieb. *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-26.* 15 p. 20 refs. Research supported by the Ministry of Transport, National Research Council of Canada, and Air Canada.

The motivation, design, theory, and initial performance of two Canadian sonic-boom simulation facilities - a loudspeaker-driven booth and a large travelling-wave horn - are described. Early performance and some research results are outlined, and the potential for a variety of future investigations is pointed out. The horn and booth-type simulators complement each other by providing flexibility for the study of human, animal, and structural response to sonic boom. This study is to provide the information needed in the preparation of accurate guidelines for new legislation that will govern SST flight paths as affected by Canadian weather, terrain, wildlife, and population distribution. M.V.E.

A72-41155 # Broadened applications of advanced composites. A. M. Lovelace, R. K. Saxer, and S. W. Tsai (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-30.* 8 p.

Assessment of the current status and review of the prerequisites to future expansion of the emerging technology and application field for advanced boron composites. Effort to date has been on a substitutional basis, i.e., replacing metals with composites while keeping the geometry and function constant. The benefit from the use of composites can be increased substantially if the total design is reconsidered. The constraints imposed by traditional metal structures should be removed. Research and development should place emphasis on cost reduction and enhancement of reliability and durability. The 'high technology' of composites developed primarily for the aerospace industry can have equal significance for much broader industrial applications. The future for composites is there, but innovations in technology and management are needed along the way. M.V.E.

A72-41156 # Modern landing impact load calculations and old-fashioned requirements. J. Yff (Fokker-VFW, Schiphol, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-31.* 10 p. 7 refs.

Discussion of the need for modern airworthiness requirements in regard to design loads due to landing impacts. Present requirements are based on an obsolete state of art in which dynamic effects were not yet known. At present, very refined calculations can be performed in which all dynamic effects are fully taken into account. Modern requirements based on the possibility of performing an accurate dynamic analysis, considering the most general landing - i.e., an asymmetric one-wheel-first landing with a lateral velocity component between wheel and runway, are formulated. With such requirements, combinations of initial conditions have to be prescribed for the definition of design load conditions. These combinations can be derived from statistical considerations of measured landing parameters. A comparison is presented between results obtained with such a set of proposed rational requirements and with calculations based upon conventional requirements. M.V.E.

A72-41157 * # Hypersonic transports - Economics and environmental effects. R. H. Petersen and M. H. Waters (NASA, Advanced Concepts and Missions Div., Aeronautical Missions and Technology Branch, Moffett Field, Calif.). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-32.* 13 p. 27 refs.

An economic analysis of hypersonic transports is presented to show projected operating costs (direct and indirect) and return on investment. Important assumptions are varied to determine the probable range of values for operating costs and return on investment. The environmental effects of hypersonic transports are discussed and compared to current supersonic transports. Estimates of sideline and flyover noise are made for a typical hypersonic transport, and the sonic boom problem is analyzed and discussed. Since the exhaust products from liquid hydrogen-fueled engines differ from those of kerosene-fueled aircraft, a qualitative assessment of air pollution effects is made. (Author)

A72-41158 # Some results from tests in the NAE high Reynolds number two-dimensional test facility on 'shockless' and other airfoils. L. H. Ohman, J. J. Kacprzynski, and D. Brown (National Research Council, Ottawa, Canada). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-33.* 40 p. 26 refs.

Results from investigations in the NAE high Reynolds number two-dimensional test facility on two classical NACA airfoils and two contemporary supercritical airfoils have been presented. The results have been compared with other published experimental data. Comparisons have also been made with results from theoretical calculations performed at NAE for subcritical as well as supercritical flow, incorporating boundary layer displacement effects for some subcritical cases. Experimental and theoretical results have compared favourably. The comparisons with other experimental data have demonstrated good correspondence in some cases as well as gross discrepancies in other cases. For the latter, the discrepancies have been attributed to Reynolds number effects or differences in experimental techniques. (Author)

A72-41159 # Possibilities and problems of achieving community noise acceptance of VTOL. W. Z. Stepniewski (Boeing Co., Vertol Div., Philadelphia, Pa.) and F. H. Schmitz (U.S. Army, Air Mobility Laboratory, Moffett Field, Calif.). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-34.* 21 p. 27 refs.

Two methods of decreasing the acoustical annoyance of VTOL aircraft to the surrounding community are reviewed; reducing the noise at the source through aircraft design, and managing the flight path in the terminal area. Advanced rotorcraft and lift-fan aircraft are discussed in this context with emphasis placed upon understanding the noise performance tradeoffs of rotary-wing designs. A method of evaluating total community annoyance is proposed which accounts for the population distribution within the acoustically affected areas and the ambient noise levels of the community. The

resulting methodology is applied to two hypothetical VTOL ports located in existing urban communities, assuming present and 1980 levels of technology. (Author)

A72-41160 # **Description and use of a method for characterizing noise sources in jets (Déscription et mise en oeuvre d'une méthode de caractérisation des sources de bruit dans les jets).** J. Taillet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-35.* 12 p. 21 refs. In French.

Description of a technique for characterizing noise sources in jets which is based on the measurement of infrared emission. The proposed method is an extension of Lighthill's theory and takes as the initial variables the mean parameters and the moments derived from experimentally obtained fluctuating parameters, which are introduced into a computer program yielding the spectrum and the radiation pattern of the sonic far field. The acoustic variables can thus be calculated from the measured characteristics of the jet turbulence, so that the problem of noise reduction is reduced to an aerodynamics problem. A.B.K.

A72-41163 # **Weight saving by composite primary structures.** U. Hütter (Stuttgart, Universität, Stuttgart, West Germany). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-38.* 19 p. 40 refs.

The advanced fiber-matrix composite materials show great promise as component materials for aircraft structures which weigh less than structures built with conventional materials. Recent advances involving boron/tungsten fibers in an epoxy, polyimide, aluminum or titanium-alloy matrix have resulted in savings of weight and the improvement of stiffness characteristics. Data regarding the anisotropic elastic and failure behavior of composite light shell structures provide a basis for structural optimization. G.R.

A72-41165 # **Fatigue crack propagation in stiffened panels.** A. Salvetti and A. Del Puglia (Pisa, Università, Pisa, Italy). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-40.* 13 p. 13 refs. Grant No. DAJA37-72-C-1783.

Results of research on fatigue crack propagation in stiffened panels. Two problems were considered - namely, evaluation of the Paris theory for stiffened panels, and evaluation of the fatigue strength of overloaded stiffeners in cracked stiffened panels. The research is based on a theoretical evaluation of the stress intensity factor and of the overload coefficient in the stiffeners for cracked stiffened panels, and on fatigue tests of 2024-T 3 and 7075-T 6 riveted stiffened panels. The theoretical approach is based both on the classical methods of two-dimensional elasticity theory and on finite-element methods. Tests have been performed utilizing load apparatuses suitable to test panels in a wide range of loads and dimensions. (Author)

A72-41166 # **The development of a prototype STOL system demonstration.** D. L. Button (Ministry of Transport, Canadian Air Transportation Administration, Ottawa, Canada). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-41.* 8 p.

Description of a program to implement a downtown-to-downtown intercity IFR STOL demonstration service. The system will operate between specially constructed STOLports built in Ottawa and Montreal. The demonstration is designed to test passenger and nonpassenger public acceptance of STOL operations and to develop standards, criteria and regulations for STOL. Area navigation and scanning beam microwave landing systems are an integral part of the system, as well as steep approaches and departures, including newly developed zoning standards. Specially modified de Havilland DHC-6 Twin Otter aircraft will be used. (Author)

A72-41167 # **Calculation of the recirculation flow of VTOL lift engines.** E. Schwantes (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für luftsaugende Antriebe, Braunschweig, West Germany). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-42.* 23 p.

A method is developed to predict theoretically the increase of temperature due to wind-recirculation in the inlet of a VTOL lift engine exhausting normally to the ground. It is shown how to calculate with the potential-theory the velocities in the recirculation flow and how to determine the temperatures with the laws of spread of buoyant plumes. Model-investigations are done to check these results. The model-jets operated with critical nozzle pressure ratio and temperatures up to 1000 C. (Author)

A72-41168 # **Investigations on the use of a Kalman filtering method in tracking systems for air traffic control.** H. J. Kamphuis (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-43.* 10 p. 15 refs.

A72-41171 # **Multiloop piloting aspects of longitudinal approach path control.** I. L. Ashkenas and S. J. Craig (Systems Technology, Inc., Hawthorne, Calif.). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-46.* 21 p. 29 refs. U.S. Department of Transportation Contract No. FA70WA-2395; Contract No. F33615-72-C-1456.

The multiple-loop aspects of longitudinal approach path control are analyzed to show the piloting problems involved in airspeed and altitude, or climb-rate, regulation and trim. Theoretically desirable and undesirable features of overall control, which in detail depend on the stick and throttle piloting technique (loop structure) employed, are delineated in general terms. Certain of the more important piloting problems are illustrated by applying the theoretical considerations to pertinent examples of experimental flying qualities results. (Author)

A72-41172 # **Wave energy exchanger for hybrid propulsion system.** F. Berner and M. Hermann. *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-47.* 6 p.

Experimental investigation of a new concept of momentum transfer from a fluid of high specific momentum to a fluid of low specific momentum in ducts by means of pressure waves. This mode of direct momentum exchange can be implemented in a wave energy exchanger which is a very attractive alternative to the ejector. Such a device can be used in ramjet-type engines that incorporate a rocket-type gas generator to entrain ambient air under static and low flight speed conditions to generate thrust under these conditions. Tests with a device that achieves the proposed process under conditions that are typical for such an application showed that its efficiency exceeds that of an equivalent ejector by factors of 5 and 9 when laid out for maximum compression and entrainment, respectively. Compression ratios between 2.5 and 2.6 were measured with the wave energy exchanger, while an equivalent ejector was found to have a compression ratio of about 1.4 at vanishing entrainment ratios. (Author)

A72-41173 * # **NASA aircraft engine noise research.** J. J. Kramer (NASA, Washington, D.C.) and R. G. Dorsch (NASA, Lewis Research Center, Cleveland, Ohio). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-48.* 8 p.

NASA research and development work on the noise of aircraft engines suitable for use on conventional take-off and landing subsonic cruise airplanes is reviewed. The work discussed was part of the NASA Quiet Engine program. Salient results in the areas of fan, jet and complete propulsion system noise are presented and briefly discussed. (Author)

A72-41174 # **Aerodynamic interference between aircraft components - Illustration of the possibility for prediction.** Th. E. Labrujere and H. A. Sytsma (National Luchtvaartlaboratorium, Amsterdam, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-49.* 11 p. 10 refs.

A72-41175 * # **Noise control technology for jet-powered STOL vehicles.** H. H. Hubbard, D. Chestnutt, and D. J. Maglieri (NASA, Langley Research Center, Hampton, Va.). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-50.* 9 p. 11 refs.

Progress report on the problem of community noise control for jet-powered STOL aircraft. Noise goals are discussed, along with noise control approaches for meeting these goals. Such significant noise control factors as the basic engine cycle, engine-airframe integration varieties, and certain details of the lift augmentation system are given special attention. M.V.E.

A72-41176 # **Quasi-homogeneous approximation for wing with curved subsonic leading edges at supersonic speeds.** R. Coene (Delft University, Delft, Netherlands). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-54.* 12 p. 6 refs.

A72-41200 **Pipe dream or possibility.** F. W. Hyde. *Interavia,* vol. 27, Sept. 1972, p. 1008, 1009.

The possibility of reviving the rigid airship as a practical means of transportation is discussed. Airships are considered to be suitable for indivisible loads such as large transformers and generators, tanks and boilers, and civil engineering units. They would be useful for special loads such as equipment which would ordinarily require expensive crating, and for scientific purposes. The airship tends to increase in efficiency as the size increases. Some aspects of airship construction are examined. F.R.L.

A72-41229 # **Analysis of measurement errors in balancing of rotors.** T. Iwatsubo (Kobe University, Kobe, Japan), Y. Murotsu (Osaka Prefecture, University, Sakai, Osaka, Japan), and F. Watanabe. In: Japan National Congress for Applied Mechanics, 20th, Tokyo, Japan, October 23, 24, 1970, Proceedings. Tokyo, Central Scientific Publishers, 1971, p. 19-26. 6 refs. Research supported by the Sakkokai Foundation.

This paper is concerned with the error analysis of the balancing of rotors from the statistical point of view. That is, when the standard deviations of the influence coefficients and unbalanced forces are given, the expressions for calculating the standard deviation of the correcting weights and the performance index are derived. The effect of the measurement errors of the influence coefficients and unbalance forces are investigated for several balancing models. (Author)

A72-41236 # **The lift coefficient of a supercavitating jet-flapped foil in a free jet.** T. Kida and Y. Miyai (Osaka Prefecture, University, Sakai, Osaka, Japan). In: Japan National Congress for Applied Mechanics, 20th, Tokyo, Japan, October 23, 24, 1970, Proceedings. Tokyo, Central Scientific Publishers, 1971, p. 101-115. 7 refs.

A72-41256 # **Application of the head-up display /HUD/ to a commercial jet transport.** J. M. Naish (Douglas Aircraft Co., Long Beach, Calif.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 530-536. 5 refs.

Previous work with HUD is extended by solving problems of installation in a commercial jet transport, and by demonstrating a high order of accuracy in manual control. Spatial aspects of the symbol format are organized to accord with principles promoting a balanced flow of information from the pilot's superimposed visual fields. Alternate installations are compared in DC-9 flight tests, an overhead mounting being found less prone to glare effects. Temporal aspects of the format are optimized by determining empirical relationships between gains and performance measures, for one test pilot, and conditions are chosen which enable subsequent users consistently to demonstrate equivalence between manual and automatic methods of flight control. Consequently, a new basis is suggested for evaluating an all-weather approach system. (Author)

A72-41257 # **Improved qualitative flight data rating scales.** C. V. Shufeldt (U.S. Navy, Washington, D.C.) and D. M. Layton (U.S. Naval Postgraduate School, Monterey, Calif.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 537-541. 11 refs.

Various rating scales have been derived to assist in the quantification flight test data. Several of these scales currently in use are examined and compared with emphasis on transference from scale to scale. The problem of nonlinearity of scales that depend upon adjective descriptions is considered, and a hypothesis is advanced that a rater may transpose his impressions of performance directly to any scale without recourse to adjective descriptions and thereby relate his mentally derived, divisionless scale directly to a numerical index. Experimental data, though limited, tend to support this hypothesis. (Author)

A72-41258 # ***Closed form solution for the sonic boom in a polytropic atmosphere.*** R. Stuff (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für theoretische Gasdynamik, Aachen, West Germany). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 556-562. 22 refs.

Analytic solution of the sonic boom problem for typical aircraft maneuvers in a polytropic atmosphere by means of the analytic method of characteristics. Solutions for singularities in a polytropic atmosphere are derived. Using the analytic methods of singularities and of characteristics, the sonic boom of a body traveling in a parabolic arc is obtained. The asymptotic Whitham formula for the bow wave is improved by an explicit formula which gives sufficiently accurate results for distances of about 20 body lengths or more. A.B.K.

A72-41259 # **A general class of exact airfoil solutions.** R. M. James (Douglas Aircraft Co., Long Beach, Calif.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 574-580. 9 refs. Research supported by the McDonnell Douglas Independent Research and Development Program.

Existing classical analytical airfoil solutions are not flexible enough to provide sufficiently critical test problems for modern numerical techniques. This paper presents the theory and some

results for a very general and versatile form of conformal mapping which can be used to generate local analytical bumps and dips on airfoil profiles. The mapping uses an analytical modulating function constructed from multipoles within the unit circle, and various consequences of this format are presented - where they may have an influence on numerical test cases. For instance, the existence of curvature singularities at the trailing edges of most common airfoils (Joukowski, Von Mises, Karman-Trefftz, etc.) is made particularly evident. Results are presented for zero trailing edge angle from an IBM 2250 Graphics Display System, showing how a variety of severe test problems with exact solutions and involving local surface deformations can be generated at will. (Author)

A72-41260 # **Theoretical tire equations for shimmy and other dynamic studies.** L. C. Rogers (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 585-589. 8 refs.

Equations are developed which relate ground force and torque on the tire to arbitrary swivel angle and lateral displacement of the wheel rim plane. The theory postulates the string model for the tire since it has predicted behavior substantiated in many respects by experimental results. Approximations to the string model itself are made such that the development leads to linear, constant coefficient differential equations identical in form to an empirical set obtained in an earlier paper. Theoretical frequency responses compare favorably with experimental data. (Author)

A72-41261 # **A consistent approach for treating distributed loading in the matrix force method.** L. W. Rehfield (Georgia Institute of Technology, Atlanta, Ga.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 602, 603.

Description of an approach to the treatment of distributed loads applied at other than node points, developed for the matrix force method used in analyses of complex aerospace structures. Although described within an elementary context provided by a simple beam element, it may be readily applied to other, more complex elements. It is believed that this approach fills a theoretical need for an energy-consistent treatment of such loads in the matrix force method. M.V.E.

A72-41262 # **Aerodynamic characteristics of the slotted fin.** P. Daniels and T. A. Clare (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 603-605. 8 refs.

Summary of the results of subsonic wind tunnel tests aimed at determining the effect of slot size on the longitudinal stability of a cruciform finned missile. On the basis of the results obtained, it is concluded that, at subsonic speeds, the slotted fin is superior to the solid fin in that it eliminates roll speedup, appreciably reduces the induced rolling moment, and increases longitudinal stability at high angles of attack. M.V.E.

A72-41263 # **V-wings and diamond ring-wings of minimum induced drag.** J. S. Letcher, Jr. (Colorado State University, Fort Collins, Colo.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 605-607. 5 refs.

For wings of V and diamond ring cross section, added-mass coefficients are presented as a function of dihedral angle in a table and diagrams, along with the equations underlying their computation. The coefficients provide new solutions for slender wings of these shapes. M.V.E.

A72-41264 # **Lift on airfoils with separated boundary layers.** N. Ness (West Virginia University, Morgantown, W. Va.). *Journal of Aircraft,* vol. 9, Aug. 1972, p. 607, 608. 8 refs. Contract No. N00014-68-A-0512.

Description of a method for calculating the sectional lift coefficient on an airfoil as a function of its angle of attack and freestream Reynolds number, even at large angles of attack beyond the maximum lift coefficient. Calculation results show good agreement with experimental data. M.V.E.

A72-41375 **Static electricity in fueling of superjets.** K. C. Bachman and W. G. Dukek (Esso Research and Engineering Co., Linden, N.J.). *Esso Air World,* vol. 24, no. 6, 1972, p. 147-151.

A research study was conducted in full-scale fueling equipment and a simulated aircraft tank to investigate fire hazards which could be caused by static electricity. When a highly resistive fuel is pumped from operating storage to an aircraft, static charges can either be generated or dissipated (relaxed) as the fuel moves through various zones in the fuel system. The facility employed the key principles of tight control of fuel quality to insure freedom from extraneous contamination and uniformity of electrical characteristics, and realistic simulation of fueling systems by using full-scale ground equipment and major features of an actual aircraft tank. It was found that discharges increased with increasing charge density, and that spark energies reach a maximum at intermediate conductivity. The design of the distribution system used to deliver fuel into an aircraft tank has a major influence on spark generation. F.R.L.

A72-41534 * # **A theory of supercritical wing sections, with computer programs and examples.** F. Bauer, P. Garabedian, and D. Korn (New York University, New York, N.Y.). Research supported by the U.S. Atomic Energy Commission and NASA; Grant No. NGR-33-016-167; Contract No. AT(30-1)-1480. Berlin and New York, Springer-Verlag (Lecture Notes in Economics and Mathematical Systems. Volume 66), 1972. 217 p. 29 refs. $6.40.

Mathematical methods for the design of supercritical wings, which depend on the numerical solution of the partial differential equations of two-dimensional gas dynamics, are developed. The main contribution is a computer program for the design of shockless transonic airfoils using the hodograph transformation and analytic continuation into the complex domain. The mathematical theory is described, and a manual for users of the programs is provided. Numerical examples are given and computational results are discussed, and the computer programs themselves are listed. The analysis routine can be used to ascertain whether the profiles behave well at off-design conditions, or to smooth coordinates and obtain a desirable shape more quickly when perfectly shockless flow is not essential. F.R.L.

A72-41587 # **Flow quality improvements in a blowdown wind tunnel using a multiple shock entrance diffuser.** J. W. Arnold and J. M. Cooksey (Vought Aeronautics, Dallas, Tex.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1002.* 12 p. 8 refs. Members, $1.50; nonmembers, $2.00.

The development and evaluation of a new type of flow conditioning system between the control valve and stilling chamber of the Vought Aeronautics Company's 4 x 4-ft transonic-supersonic wind tunnel is reported. The new system results in a series of normal shocks created by four perforated plates to dissipate total pressure differences between the reservoir and stilling chamber. Data are presented which demonstrate flow quality improvements obtained by using the new design, including a significant reduction in test section flow unsteadiness and elimination of flow angularity induced by the control valve at transonic Mach numbers. Design criteria are developed which insure no loss in run time at transonic Mach numbers and minimum run time losses at higher supersonic Mach numbers. (Author)

A72-41588 * # **Evaluation of transonic and supersonic wind-tunnel background noise and effects of surface pressure fluctuation measurements.** J. B. Dods, Jr. and R. D. Hanly (NASA, Ames

Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1004.* 9 p. 9 refs. Members, $1.50; nonmembers, $2.00.

A72-41589 # Design and development of the United Aircraft Research Laboratories acoustic research tunnel. R. W. Paterson, P. G. Vogt, and W. M. Foley (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1005.* 14 p. 18 refs. Members, $1.50; nonmembers, $2.00.

This new wind tunnel, designed specifically for aerodynamic noise research, has a variable area, open jet test section enclosed in an anechoic chamber. Speeds up to a Mach number of 0.65 are possible with a test section area of 5 sq ft. A separate, low noise level, high pressure air source is provided for jet noise studies. Design and construction considerations for the major tunnel sections (i.e., inlet, anechoic chamber, diffuser, muffler, driver) are described. Aerodynamic and acoustic calibration of the tunnel is discussed in relation to design criteria. Problems applicable to other acoustic tunnels such as background noise, edge tone suppression, deflected jet noise and distortion of noise directivity patterns by shear layer refraction are discussed. (Author)

A72-41590 * # Installation caused flow distortion and its effect on noise from a fan designed for turbofan engines. F. P. Povinelli and J. H. Dittmar (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1006.* 11 p. 12 refs. Members, $1.50; nonmembers, $2.00.

Use of a ground test stand 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. Differences in blade passage sound pressure levels of more than 10 dB were measured between the rear-drive and front-drive versions, with the rear-drive installation producing less noise. Perceived noise levels were computed and the influence of the distortion on these levels was determined. (Author)

A72-41591 # Application of wall corrections to transonic wind tunnel data. T. W. Binion, Jr. and C. F. Lo (ARO, Inc., Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1009.* 8 p. Members, $1.50; nonmembers, $2.00. USAF-sponsored research.

The wind tunnel wall interference exhibited in two test programs for which interference free data were available is discussed. It is shown, for a model which can be well represented mathematically and which is tested in a flow field without wave reflections, that data corrections can be quite good up to Mach number 0.98 with blockages as large as 1.5 percent. However, even with small models if the wall characteristics are not close to those required by the model, the flow field can be so distorted that data corrections are improbable. Directions to proceed toward improving data quality are indicated. (Author)

A72-41602 # A theoretical and experimental study of a jet stretcher system. R. C. Bauer, E. H. Matkins, R. L. Barebo, and W. C. Armstrong (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1024.* 17 p. 7 refs. Members, $1.50; nonmembers, $2.00. USAF-sponsored research.

Analytical techniques were developed for estimating diffuser performance, and for evaluating the feasibility of using an axisymmetric jet stretcher for angle-of-attack testing. The diffuser analysis estimates the starting conditions limited by either the nozzle exit boundary layer or the jet stretcher ambient pressure level. Experimental results show the analysis for diffuser starting conditions to be conservative and accurate to within 10% for engine-off operation. The feasibility of using an axisymmetric jet stretcher for angle-of-attack testing was determined by establishing a criteria for acceptable jet stretcher performance based on maintaining the static pressure distribution on the test body to within plus or minus 10% of the interference-free pressure distribution. A local application of linearized theory was used to determine the proper position of the jet stretcher and to indicate the regions that require bleed flow. (Author)

A72-41603 # Theoretical effects of porosity and angle of attack on jet-stretcher performance. B. R. Eppright, Jr. (Tracor, Inc., Austin, Tex.) and J. C. Westkaemper (Texas, University, Austin, Tex.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1025.* 5 p. Members, $1.50; nonmembers, $2.00.

The jet-stretcher concept employs a shroud having the contour of a streamline to extend the usable flow region of free jets when testing body models with mid- or aft-mounted engine inlets. Theoretically, each Mach number and angle of attack requires a different shroud because of streamline changes. Using a computer, a study was made of the flow over a shrouded, modified von Karman body at M = 3, employing a three-dimensional, inviscid method of characteristics. Angles of attack up to 4 deg were included. A fixed-position, perforated shroud was found inadequate to produce proper flow conditions at such angles. A shroud based on a streamline of the body at zero angle of attack showed promising results when it was rotated at an angle of attack of about half that of the body. (Author)

A72-41604 # Full-scale inlet/engine testing at high maneuvering angles at transonic velocities. R. L. Palko (ARO, Inc., Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1026.* 9 p. Members, $1.50; nonmembers, $2.00. USAF-supported research.

Results of a study conducted to determine modifications and new testing techniques required to provide an increased angle of attack and yaw capability to test full-scale inlet/engine configurations (with forebody effects) in a 16-ft transonic propulsion wind tunnel. These modifications and techniques will provide simulation of the inlet flowfield for angles of attack up to 20 deg and for angles of yaw up to 5 deg. The method used to obtain the flow simulation for high maneuvering angles utilized auxiliary flow shaping and geometric pitch. An analytical potential flow method was used to determine the configuration of the devices necessary to produce the required flowfields, and these devices were then tested to experimentally verify the analytical results. Experimental results compare favorably with the predicted flowfield, and the use of flow-shaping devices for simulation of the inlet flowfield is promising. (Author)

A72-41607 # Characteristics of an ejector-type engine simulator for STOL model testing. G. B. Nicoloff and H. A. Weber (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper*

72-1028. 9 p. Members, $1.50; nonmembers, $2.00. Contract No. F33615-71-C-1754.

Description of the design and calibration testing of a propulsion engine simulator used in investigating the performance characteristics of externally blown, internally blown, and mechanical-flap configurations with a 1/20 scale STOL aircraft model. The simulator in question is a rotating ejector simulator, in which the nozzle geometry can be modified to simulate various possible exhaust nozzle conditions. The rotating simulator is particularly applicable to high bypass ratio turbofan simulation and characteristically demonstrates induced flow ratios of over 0.75. A.B.K.

A72-41608 # **National aeronautical facilities program /NAFP/.** J. S. Kamchi and J. D. Johnston (USAF, Development and Acquisition Directorate, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1033*. 5 p. 11 refs. Members, $1.50; nonmembers, $2.00.

The program is reviewed from its inception to the present time. It began when the problem of using or modifying the existing engine test facility to test the engine for the C-5A aircraft arose. The initial action taken by the Air Force was to program a large engine test facility. Three ad hoc working groups of the Aeronautics Panel examined the facilities needed for subsonic and V/STOL aircraft, transonic and supersonic aircraft, and hypersonic aircraft. From the Working Group studies, a first approximation of national facility requirements was provided. The importance of aeronautics on national preeminence, on foreign competition, and the economic impact on the U.S. economy was considered. F.R.L.

A72-41609 # **The high Reynolds number transonic wind tunnel HIRT proposed as part of the National Aeronautical Facilities Program.** R. G. Roepke (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics, Aerodynamics Testing Conference, 7th, Palo Alto, Calif., Sept. 13-15, 1972, Paper 72-1035*. 10 p. 9 refs. Members, $1.50; nonmembers, $2.00.

A national need for improved aerodynamic simulation in transonic wind tunnels has been declared. This paper describes a proposed test facility which will satisfy most of the existing test deficiencies. The Ludwieg tube tunnel is compared with other proposed methods of high Reynolds number simulation. Performance advantages and disadvantages of the various approaches to high Reynolds number tunnels are discussed and compared with projected test needs. Reynolds number effects on various aircraft performance parameters are illustrated with examples. The deficiencies in simulation capability of existing transonic wind tunnels and consequences of these deficiencies are briefly explored. (Author)

A72-41641 **Spectral gust alleviation factors for pitching aircraft.** E. Huntley and P. G. Littlewood (Sheffield, University, Sheffield, England). *Aeronautical Journal*, vol. 76, July 1972, p. 433-442. 7 refs.

The longitudinal responses of a rigid aircraft, free to heave and pitch, flying through random turbulence are analyzed. Gust alleviation factors for the basic response variables (normal acceleration, rate of pitch, incidence, attitude, and flight path angle) are defined. Using the short period mode equations, explicit equations are derived for them in terms of the mass scale parameter, the damping ratio, and a ratio of damping parameters. Attention is given to the distribution of accelerations along the aircraft fuselage. F.R.L.

A72-41642 **A new method for the evaluation of slotted wind tunnel interference parameters applicable to subsonic oscillatory tests.** R. A. Streather (Lanchester Polytechnic, Coventry, England). *Aeronautical Journal*, vol. 76, July 1972, p. 443-447. 9 refs.

A72-41700 # **Elements of the theory of gas-turbine-unit designs (Elementy teorii skhem gazoturbinnykh ustanovok).** A. A. Smal'ko. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, May-June 1972, p. 135-140. In Russian.

The aspects of selecting the characteristic parameter of gas-turbine designs, which makes it possible to classify possible designs, are examined. Four basic gas-turbine designs are identified. It is shown that all existing gas-turbine designs are essentially combinations of the four basic designs. Equations describing the behavior of the economy and reliability of gas-turbine operation at fractional loads are derived. The range of cycle parameters which corresponds to maximal operational efficiency of a specific gas turbine is established. V.P.

A72-41805 # **Choice of optimal geometrical relationships in a transformer-type angle converter (K vyboru optimal'nykh geometricheskikh sootnoshenii v transformatornom preobrazovatele ugla).** L. A. Kondrashova (Dal'nevostochnyi Politekhnicheskii Institut, Vladivostok, USSR). *Priborostroenie*, vol. 15, no. 5, 1972, p. 47-51. In Russian.

A72-41846 **The INAS device of Ferranti as integrated weapon system for the HS Harrier (INAS-Gerät von Ferranti als integriertes Waffensystem der HS Harrier).** P. Küng. *Flug Revue/Flugwelt International*, Sept. 1972, p. 37-40, 45-47. In German.

A72-41851 # **Economic and social aspects of commercial aviation at supersonic speeds.** B. K. O. Lundberg. *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-51*. 26 p. 58 refs. Research supported by the Styrelsen for Teknisk Utveckling.

Neither current nor greatly improved SST projects conceivable in the future will be able to compete with subsonic jets in the economy-class market without enormous losses or subsidies, even if no restrictions are imposed on overland flights. Operation at about first-class fares will also be grossly uneconomic, and at such fares SSTs, operating mainly over the oceans, can only take over at most half of the small long-haul oversea first-class market and a quite insignificant portion of the economy-class market. The main reason for the deficient economics is the much higher purchase price per seat. The exceedingly high cost/benefit ratio appears to make the SSTs unjustified even if they had no adverse environmental effects. Minimum requirements for their introduction are (1) that they are forbidden to fly supersonically over land, (2) that they comply with airport noise standards for subsonic aircraft, and (3) that it has been proved that no adverse effects result from sonic booms over sea, cosmic radiation or exhaust emission in the stratosphere. (Author)

A72-41852 # **Some recent developments in the understanding of jet noise.** J. D. Voce and J. Simson (Rolls-Royce, Ltd., Bristol Engine Div., Bristol, England). *International Council of the Aeronautical Sciences, Congress, 8th, Amsterdam, Netherlands, Aug. 28-Sept. 2, 1972, Paper 72-55*. 42 p. 14 refs.

Model tests tend to confirm Ffowcs-Williams' (1960, 1963) theory that the intensity of sound radiated in the direction of the Mach wave is dependent on the third power of the velocity, although significant discrepancies occur at both high and low speeds, increasing with angle to the jet. The discrepancy at high speeds is associated with the shock structure of the supercritical jet. Pure jet

and shock cell noise, and the two-dimensional or 'fish tail' class of silencers are discussed. The object of these devices is to induce a very rapid spread of the jet, in the quiet plane, with minimum thrust reduction. Rapid spreading with the associated high eddy diffusivity induces a noise reduction in the plane of the fish tail. 'Internal' or 'tailpipe' noise sources, and the effect of forward speed are considered. Tests have shown the effectiveness of acoustic absorbers and screens placed at the nozzle exit. F.R.L.

A72-41944 # **Researches on the two-dimensional retarded cascade. I, II.** T. Ikui, M. Inoue, and M. Kuromaru (Kyushu University, Fukuoka, Japan). *JSME, Bulletin,* vol. 15, June 1972, p. 705-720. 27 refs.

The test facility used in the investigation is equipped for the conduction of cascade tests involving high inlet flow angles. A schematic diagram of the facility is provided together with details concerning the test apparatus. The axial velocity ratio in the solid wall cascade is considered together with a comparison between solid and porous wall cascades. A method for conducting a two-dimensional cascade test involving a wide range of inlet angles is established. In the range of high inlet angles, the admissible value of the axial velocity ratio, which is required to ensure an aerodynamically two-dimensional flow, is found to approach unity. Graphs are presented showing the effects of axial velocity ratio on the static pressure rise and turning angle, and the critical axial velocity ratio for two-dimensional flow. G.R.

A72-42024 **Aviation meteorology (Aviatsionnaia meteorologiia).** A. M. Iakovlev. Moscow, Izdatel'stvo Transport, 1971. 248 p. In Russian.

A simplified account is presented of the techniques used in weather prediction for civil aviation. The composition and structure of the atmosphere are considered, as well as meteorological elements and their effect on aircraft flights. A study is made of synoptic processes, atmospheric fronts, pressure systems, and meteorological conditions of flight at various altitudes. A complex analysis and a forecast of meteorological conditions from surface and high-altitude maps are presented, and problems in ensuring weather information for aircraft flights and in organizing a civil-aviation weather service are discussed. A.B.K.

A72-42074 **Design principles in aircraft construction (Osnovy konstruirovaniia v samoletostroenii).** A. L. Gimmel'farb. Moscow, Izdatel'stvo Mashinostroenie, 1971. 313 p. 20 refs. In Russian.

Stress analysis method and methods of designing aircraft structural components and units are outlined and are demonstrated by applying them to frame girders, wing and spar attachments, welded joints, riveted joints, glued joints, butt joints, and hinged joints. The fundamentals of designing for minimum weight, appropriate safety margins, and adaptability for industrial production are examined. Much attention is given to the selection of suitable materials. A special chapter is devoted to the design of monocoque structures. V.P.

A72-42247 # **Nonstationary processes in the intervane apertures of turbomachines (Nestatsionarnye protsessy v mezhlopatochnykh kanalakh turbomashin).** I. I. Kirillov and A. S. Laskin. *Energomashinostroenie,* vol. 18, May 1972, p. 12-14. 14 refs. In Russian.

The relationship between the kinematic parameters of nonstationary flow through turbine bladings and the variable aerodynamic forces acting on the blades is examined. The principal parameters which characterize nonstationary processes arising in the interaction between two absolutely rigid blade cascades are determined. V.P.

A72-42250 # **A pressure transmitter for measuring the parameters of a relative flow (Peredatchik davleniia dlia izmereniia parametrov otnositel'nogo potoka).** B. L. Gunbin. *Energomashinostroenie,* vol. 18, June 1972, p. 44-46. In Russian.

Description of the design of a pressure transmitter for transmitting readings from aerodynamic nozzles and static pressure taps rotating on turbine rotor blades to a stationary manometer. The proposed device has the form of a somewhat elongated nose cone located in an axial-flow suction nozzle. The transmitter has an outer diameter of 75 mm, 64 working points, and is capable of operation at rotational speeds up to 8700 rpm. A.B.K.

A72-42271 # **Problem of uniform-jet flow around an airfoil (K zadache obtekaniia profilia ravnomernoi sverkhzvukovoi struei).** E. G. Shifrin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug. 1972, p. 162-165. 10 refs. In Russian.

A uniform jet flowing around an airfoil with a separated shock wave is examined for a case of low supersonic velocities of the incident flow where entropy changes at the shock wave may be neglected. Shapes of minimal regions of influence of the mixed flow are examined for both convex and concave profiles. T.M.

A72-42294 **Advanced hydraulic system designed for maintainability.** E. H. Owens (Boeing Co., Seattle, Wash.). *Hydraulics and Pneumatics,* vol. 25, Sept. 1972, p. 131-133.

Requirements of efficient maintenance make it necessary that during routine between-flight maintenance hydraulic system components be replaced easily and quickly. Shut-off devices had to be designed into the interfaces between the system hydraulic lines and the components in order to achieve the design goals for hydraulic components which would be removed most frequently during routine maintenance periods. The design concepts are discussed, giving attention also to disconnect methods to be used for disconnecting the hydraulic pump. G.R.

A72-42322 # **Gradient compensation.** C. D. Hardwick (National Aeronautical Establishment, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin,* no. 2, 1972, p. 1-14.

It is pointed out that for an ASW aircraft with a highly tuned Magnetic Anomaly Detecting (MAD) system the residual maneuver noise becomes the limiting factor in terms of detection range. An approach for providing real time compensation for the residual maneuver noise is discussed. The magnitude and the direction of the gradient vector of the earth's magnetic field in three-dimensional space has to be determined together with the amount of sensor motion taking place in the gradient direction. The gradient interference signal must be synthesized and subtracted from the MAD signal. G.R.

A72-42323 # **Flow distortion and performance measurements on a 12-inch fan-in-wing model for a range of forward speeds and angle of attack settings.** U. W. Schaub and R. W. Bassett (National Research Council, Div. of Mechanical Engineering, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin,* no. 2, 1972, p. 15-32. 10 refs.

A72-42324 # **Flying experience with the SC1 research aircraft and the P1127 prototype at the Royal Aircraft Establishement, Bedford, England.** D. M. McGregor (National Aeronautical Establish-

ment, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin*, no. 2, 1972, p. 43-66. 5 refs.

A72-42326 * # **Prediction of far flow field in trailing vortices.** B. S. Baldwin, N. A. Chigier (NASA, Ames Research Center, Moffett Field, Calif.), and Y. S. Sheaffer (Sheffield, University, Sheffield, England). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-989*. 12 p. 16 refs. Members, $1.50; nonmembers, $2.00.

A finite-difference machine code is brought to bear on the wake-vortex problem in the quasi-cylindrical boundary-layer approximation. A turbulent-energy model containing new features is developed. Parameters of the model are evaluated by comparison of calculated velocities and turbulent intensities with measurements in an axisymmetric wake. Comparisons are made with a previous calculation of the decay of an isolated vortex and with wind tunnel and flight measurements in trailing vortices. A self-similar solution develops at large axial distance that decays with the square root of distance. A slower decay occurs in the preceding transition region. (Author)

A72-42327 # **Flight test studies of the formation of trailing vortices and a method to accelerate vortex dissipation.** H. Chevalier (Texas A & M University, College Station, Tex.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-988*. 7 p. Members, $1.50; nonmembers, $2.00. Army-supported research.

A72-42328 # **Dynamics of towed bodies using a single-point suspension system.** C. Poli and D. Cromack (Massachusetts, University, Amherst, Mass.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-986*. 9 p. 17 refs. Members, $1.50; nonmembers, $2.00. Army-supported research.

A stability analysis of towed bodies of current, practical interest, and the identification of the towing system parameters which affect stability is presented. The analysis is accomplished by first determining the aerodynamic characteristics of two nonstreamlined bodies; an 8 foot by 8 foot by 20 foot cargo container, and a 20 foot long, 5.4 foot diameter right circular cylinder. These results are then used in a linearized small perturbation stability analysis of the towed system. For the single-point system, it is shown that long cables, high speeds, and light loads are required for stability. The drag-to-weight ratio of the towed body, and the length of the cable are shown to be the most important stability parameters. (Author)

A72-42329 * # **Analytic prediction of aircraft spin characteristics and analysis of spin recovery.** J. W. Young and W. M. Adams, Jr. (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-985*. 14 p. 11 refs. Members, $1.50; nonmembers, $2.00.

A72-42330 # **Development of design criteria for predicting departure characteristics and spin susceptibility of fighter-type aircraft.** R. Weissman (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-984*. 7 p. 11 refs. Members, $1.50; nonmembers, $2.00.

A72-42340 # **The application of non-planar lifting surface theory to the calculation of external-store loads.** W. R. Chadwick (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-971*. 10 p. 10 refs. Members, $1.50; nonmembers, $2.00.

A72-42346 * # **Evaluation of flight instrumentation for the identification of stability and control derivatives.** J. A. Sorensen, J. S. Tyler, Jr. (Systems Control, Inc; Palo Alto, Calif.), and J. D. Powell (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-963*. 11 p. 14 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10791.

A72-42347 * # **An analysis of aircraft lateral-directional handling qualities using pilot models.** J. J. Adams (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-962*. 14 p. 13 refs. Members, $1.50; nonmembers, $2.00.

An analytical study of the combined pilot-aircraft system to develop a procedure for computing pilot ratings for the lateral-directional response. In the analytical procedure the pilot is represented by a linear, second-order pilot model, and the aircraft by linear equations of motion. Two levels of pilot response were described by the pilot model. The first level contains a static gain and a second-order lag function with a time constant of 0.2 second. The second level added a 1-sec lead time constant. The second level is assumed to represent a greater effort on the part of the pilot. If the system response characteristics can be achieved with the first-level pilot model, it is concluded that the aircraft will be given a pilot rating of satisfactory. If the aircraft characteristics are such that the second-level pilot model is required to achieve the prescribed system response, it is concluded that the aircraft will be rated tolerable. (Author)

A72-42348 * # **Analysis of a lateral-directional airframe/propulsion system interaction of a Mach 3 cruise aircraft.** G. B. Gilyard, D. T. Berry, and D. Belte (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-961*. 9 p. Members, $1.50; nonmembers, $2.00.

A72-42349 * # **Unsteady rotor aerodynamics at low inflow and its effect on flutter.** G. A. Pierce (Georgia Institute of Technology, Atlanta, Ga.) and W. F. White, Jr. (U.S. Army, Air Mobility Research and Development Laboratory, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-959*. 8 p. 14 refs. Members, $1.50; nonmembers, $2.00. Grant No. DAHC04-68-C-0004.

A comprehensive flutter analysis has been developed utilizing compressible unsteady aerodynamics for a helicopter rotor at a low inflow condition. The rotor is treated as a nonuniform rotating beam with finite bending and torsional stiffness. The unsteady aerodynamic representation incorporates the effects of spanwise variations in Mach number and reduced frequency by applying available two-dimensional theories in a strip theory fashion. The results are characterized by an oscillation of the apparent aerodynamic damping with decreasing frequency ratio (oscillation frequency/rotational

frequency) which suggests a new flutter criteria for rotors. These results are correlated with available experimental data. (Author)

A72-42350 * # Unsteady wake effects on progressing/regressing forced rotor flapping modes. K. H. Hohenemser and S. T. Crews (Washington University, St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-957.* 10 p. 11 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS2-4151.

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 excentric 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)

A72-42351 # A perturbation solution of rotor flapping stability. W. Johnson (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-955.* 16 p. 5 refs. Members, $1.50; nonmembers, $2.00.

Examination of the stability of the flapping motion of a single blade of a helicopter rotor, using the techniques of perturbation theory. The equation of motion studied is linear, with periodic aerodynamic coefficients due to the forward speed of the rotor. Blade pitch feedback proportional to both flapping displacement and flapping rate is included. Four cases are considered: small and large advance ratio, and small and large Lock number. The solution of this problem demonstrates the information which may be obtained by using perturbation techniques. It is concluded that perturbation theory is a powerful mathematical technique which should prove very useful in analyzing some of the problems of helicopter dynamics. (Author)

A72-42353 # Equations of motion appropriate to the analysis of control configured vehicles. R. C. Schwanz (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-952.* 17 p. 21 refs. Members, $1.50; nonmembers, $2.00.

Development of general criteria to permit the flight control analyst to select the appropriate formulation of the equations of motion describing the dynamics of elastic flight vehicles whose control laws may be characterized as a control configured vehicle (CCV) concept. In this development of general criteria, emphasis is placed upon the comparison of the linearized, mathematical models of the dynamics currently used by flight control analysts to unite the aerodynamic, structural, and geometric data sets supplied by other engineering disciplines. It is shown that the a priori selection of the quasi-static and modal-truncation formulations may lead to a poorly designed flight control system for some types of elastic aircraft. In addition, it is shown that the analysis of control systems for the highly elastic, CCV-type aircraft will require the selection of the more accurate residual-flexibility, residual-stiffness, modal-substitution, or exact formulations. (Author)

A72-42354 # Development and evaluation of an energy-oriented guidance logic for air combat models. R. J. Wenham and A. H. Lusty, Jr. (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-949.* 12 p. Members, $1.50; nonmembers, $2.00.

Development of a guidance logic for digital air combat simulation that is referenced to, and essentially retains, the basic maneuvering characteristics of the pure pursuit. The pursuit guidance commands for angle of attack, angle of bank, and throttle setting are modified according to the emphasis to be placed on energy conservation. The degree of emphasis is in turn controlled through tactical considerations. Direct comparison is made between the conservative guidance and pure pursuit, which demonstrates the characteristics of the conservative guidance and its effect on combat results. The application of the energy-oriented model in aircraft design is demonstrated in a brief study of two advanced fighter designs. (Author)

A72-42355 # Integration of aerospace vehicle performance and design optimization. D. S. Hague, C. R. Glatt, and R. T. Jones (Aerophysics Research Corp., Bellevue, Wash.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-948.* 19 p. 39 refs. Members, $1.50; nonmembers, $2.00.

Discussion of automated aerospace vehicle performance and design optimization techniques. Performance optimization areas covered include boosters, reentry vehicles, and aircraft (including the air-to-air combative encounter). Design situations considered are appropriate to high-performance transports and launch systems. The impact of very-large-scale vehicle design optimization codes on computer program design and computer operating system requirements is discussed briefly. (Author)

A72-42356 * # Nonlinear instability of a helicopter blade. P. Tong (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-956.* 14 p. 8 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS2-6175.

The nonlinear equations of flap-lag coupled with oscillation of a torsionally rigid blade are derived. The solution is established by a simplified asymptotic expansion procedure of multiple time scales. The region of stability and limit cycle oscillation and its comparison with numerical results are presented. (Author)

A72-42357 * # Surface temperature effect on subsonic stall. J. M. Macha, D. J. Norton (Texas A & M University, College Station, Tex.), and J. C. Young (NASA, Manned Spacecraft Center, Aerodynamics and Entry Section, Houston, Tex.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-960.* 10 p. 17 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS9-9766.

Results of an analytical and experimental study of boundary layer flow over an aerodynamic surface rejecting heat to a cool environment. This occurs following reentry of a Space Shuttle vehicle. Analytical studies revealed that a surface to freestream temperature ratio, greater than unity tended to destabilize the boundary layer, hastening transition and separation. Therefore, heat transfer accentuated the effect of an adverse pressure gradient. Wind tunnel tests of a 0012-64 NACA airfoil showed that the stall angle was significantly reduced while drag tended to increase for free-stream temperature ratios up to 2.2. (Author)

A72-42358 * # Stability criteria for accelerating and decelerating aircraft. E. V. Laitone and W.-F. Lin (California, University, Berkeley, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto,*

Calif., Sept. 11-13, 1972, Paper 72-951. 10 p. 11 refs. Members, $1.50; nonmembers, $2.00. Grant No. NGR-05-003-451.

Derivation of the linearized differential equation for the longitudinal oscillations of an aircraft for the general case when the atmospheric density, thrust force, and velocity are varying. Exact solutions and stability criteria are presented for several different conditions. For the zero thrust coasting aircraft that is being decelerated by its drag force, new stability criteria are derived for both ascending and descending flight. A critical altitude is found for ascending aircraft that are attempting to coast out of the atmosphere. Above this critical altitude the oscillations cease, and there is a monotonic increase in the angle of attack. Exact solutions for the oscillations of coasting aircraft are presented in terms of the confluent hypergeometric functions. It is shown that previous attempts to predict a critical altitude for ascending vehicles were in error because they did not include the second type, or logarithmic solution, of the confluent hypergeometric function. (Author)

A72-42359 # **Differential turns.** H. J. Kelley and L. Lefton (Analytical Mechanics Associates, Inc., Jericho, N.Y.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-950.* 6 p. 7 refs. Members, $1.50; nonmembers, $2.00. Contract No. F44620-71-C-0123.

Turning competition between two aircraft represented in energy approximation is formulated as a differential game. The structure of the family of solutions is discussed and two limiting cases examined; that of very long duration, emphasizing steadily sustainable turn rates, and that of very short duration, dominated by instantaneously available rates. (Author)

A72-42360 * # **Applications of a technique for estimating aircraft states from recorded flight test data.** R. C. Wingrove (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, 2nd, Palo Alto, Calif., Sept. 11-13, 1972, Paper 72-965.* 6 p. 15 refs. Members, $1.50; nonmembers, $2.00.

A72-42519 # **Anti-fog and frost coatings.** G. D. Herbage (Aircraft and Instrument Demisting, Ltd., London, England). *Aircraft Engineering,* vol. 44, Sept. 1972, p. 49, 50.

The hydrophilic antifog coating for aviation instrument windows consists basically of a chemical formula which is applied to the glass surface, which is in turn held permanently in position by a thin layer of transparent film. It requires no sealing or electrical supply, and protects against fogging for ten years or more. It has the added advantage of being able to collect most of the moisture in its immediate vicinity. Problems of light transmission, reflection, and environment are discussed. F.R.L.

A72-42520 # **Emergency evacuation systems.** *Aircraft Engineering,* vol. 44, Sept. 1972, p. 52-54.

Following a review of legislation governing emergency evacuation of aircraft, door design variations are discussed. The basic shape of any stowage box for an emergency escape system must be designed to clear the door motion in normal and emergency use, to give unobstructed working action of the door's activation, and to provide an unhindered operating area for cabin staff. There should be a certain degree of standardization for escape slide arming systems and firing modes when a slide is engaged for emergency operation. Some of the slide systems for specific aircraft are briefly described. F.R.L.

A72-42521 # **Electrical components in gas turbine control systems.** J. K. Barugh (Vactric Control Equipment, Ltd., Morden, Surrey, England). *Aircraft Engineering,* vol. 44, Sept. 1972, p. 56, 58.

The engine control system for the Olympus 593 is described, demonstrating how sophisticated the modern electric control system has become. The demand signal from the pilot's lever can be modified by combining it with other signals or otherwise process it in such a way that the throttle valve position can be changed in accordance with auxiliary parameters in addition to the throttle lever demand itself. Motor tachogenerators and pickoffs are discussed. Alternating current motors are preferable because of the absence of sliding contacts and for reasons of reliability and simplicity. A solution to the problem of meeting the demands on gas-turbine control systems will be to use a digital computer as a central processor. F.R.L.

A72-42578 Calculation of laminar boundary layers by means of a differential-difference method. N. A. Jaffe and A. M. O. Smith (Douglas Aircraft Co., Long Beach, Calif.). In: Progress in aerospace sciences. Volume 12. Oxford and New York, Pergamon Press, 1972, p. 49-212. 92 refs.

An overall description is provided of a method for solving the laminar-boundary-layer equations with arbitrary boundary conditions. The method can be used for analyzing arbitrary two-dimensional or axisymmetric flows and certain types of three-dimensional flows. These three-dimensional flows include those over infinite yawed wings at an arbitrary Mach number and over supersonic cones at an angle of attack. The method is not dependent on any simplifying assumptions regarding fluid properties, and any arbitrary variation of properties as a function of local conditions, in principle, is permissible. In practice, the only restrictions are the accuracy limitations of existing formulas that relate fluid properties to the thermodynamic state of the fluid. G.R.

A72-42639 New results concerning the numerical calculation of the sonic flow around a given airfoil section (Nouveaux résultats concernant le calcul numérique de l'écoulement sonique autour d'un profil d'aile donné). D. Euvrard and G. Tournemine (Rennes, Université, Rennes, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques,* vol. 275, no. 4, July 24, 1972, p. 303-305. In French. Research supported by the Direction des Recherches et Moyens d'Essais.

A72-42676 International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Symposium sponsored by the Instrument Society of America. Edited by R. R. Roberts (McDonnell Douglas Corp., St. Louis, Mo.). Pittsburgh, Instrument Society of America (Instrumentation in the Aerospace Industry. Volume 18), 1972. 326 p. Members, $15.; nonmembers, $18.

Applications of laser velocimeters for flow field investigations, a large-viewfield photographic system for in-flight model contour measurements in an aeroballistic range, and design considerations for particulate instrumentation based on laser light scattering systems are among the topics covered in papers concerned with optical measurement techniques. Other areas covered include new devices and advances in measurement techniques, propulsion system testing, and in-flight instrumentation. M.V.E.

A72-42678 # **Applications of laser velocimeters for flow field investigations.** F. H. Smith and A. E. Lennert (ARO, Inc., Arnold Air Force Station, Tenn.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 9-16. 8 refs. USAF-sponsored research.

The dual-scatter laser Doppler velocimeter (LDV), operating in both the forward- and back-scatter modes, and a signal conditioning and processing data system are briefly described. The dual-scatter system characteristics are such that no artificial seeding of the flow is required to make measurements. With minor modifications and improvements, the dual-scatter LDV system will supplement conventional wind tunnel velocity measuring instrumentation as an operational instrument. In support of this conclusion, the application of the LDV to actual wind tunnel measurements in the subsonic, transonic, and supersonic regimes is presented. (Author)

A72-42682 Supervisory computer control of jet engine dual compressor tests. W. Goodwin, F. G. Selleck, and A. Waterman (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 37-47.

Digital computer controlled testing of separately driven coaxial gas turbine low pressure and high pressure compressors, referred to as dual compressor testing, has been implemented successfully. The supervisory control system measures, computes, and controls dual compressor operating parameters, maintaining desired aerodynamic conditions during tests. This is achieved by computer control of two gas turbine drive engines of 18,000 hp and 35,000 hp, and six fast-acting control valves, ranging up to six feet in diameter. Reliability and flexibility were emphasized in the system design. (Author)

A72-42683 Steady and time variant inlet distortion measurements. M. J. Ford (United Aircraft Florida Research and Development Center, West Palm Beach, Fla.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 49-53.

High response pressure measurements (0-1000 Hz) are being made to evaluate the effects of nonuniform and unsteady inlet airflow conditions on the stability and performance of supersonic jet engines. No single pressure transducer has been found which satisfies the requirements of small size, high frequency response, stability and vibration insensitivity. Therefore, it was necessary to incorporate filtering and signal merging to combine the outputs of two transducers for each probe location to obtain the required 0 to 1000 Hz pressure data. An analog data screening device is used to identify peak distortion levels for later analysis. A high-speed digitizer with a high degree of channel-to-channel time correlation is used for the detailed data analysis. (Author)

A72-42686 Engine compressor face rake for flight test instrumentation F-14A/TF-30. H. Weiss and C. R. Scally (Grumman Aerospace Corp., Calverton, N.Y.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 73-91. 17 refs.

This report describes the instrumentation approach to the F-14A engine compressor face rake. Included is the theoretical pneumatic analysis which was performed and correlated to actual test results. Thermal tests, both static and transient, were also conducted. Accounts of operational experience with the rake in the flight environment are included. Through this experience it was determined that changes in some techniques were required. The use of real-time data processing proved to be a significant tool, not only in actual displays of computed data but also in immediately determining hardware anomalies. (Author)

A72-42688 An advanced strain level counter for monitoring aircraft fatigue. D. E. Weiss (U.S. Navy, Naval Air Development Center, Warminster, Pa.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 105-108.

This paper describes an advanced version of a strain level monitoring system which records on a 3.5-in. magnetic disk the number of times that each of seven strain levels (positive and negative) has been exceeded. The two major components of the system are: (1) an inductive strain sensor and (2) an autologger or recorder which contains the signal conditioning equipment and records strain exceedances on a magnetic disk. The total weight of the system is less than three pounds. (Author)

A72-42689 Altitude alerting systems. P. Holman-Smith (Boeing Co., Renton, Wash.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 109-117. 6 refs.

This paper describes the development and design of the altitude alerting systems for Boeing 707/727/737/747 airplanes to meet the requirements of FAR 91-51. It also describes the retrofit systems designed by Boeing to meet airline requests for altitude alerting on delivered airplanes and other systems that have been installed independently by some airlines. The relationships between altitude alerting and other systems such as altitude reporting and altimetry are discussed. (Author)

A72-42690 In-flight and flight-line monitor system to detect foreign object damage in jet engines. H. R. Hegner (IIT Research Institute, Chicago, Ill.) and J. E. Bridges. In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 119-130.

A72-42696 Myti-Acq/1 - Real time multiprocessing structural test data system. R. E. Romaneck (Grumman Aerospace Corp., Bethpage, N.Y.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 173-181.

Discussion of the alternatives considered at Grumman in developing its new F-14A Structural Test Digital Data System (Myti-Acq) which was designed to provide more accurate real-time displays, a multi-test capability and operational manpower reductions. The to-date performance of the system is assessed as complying with original design objectives. V.Z.

A72-42697 Computer control of the General Dynamics High Speed Wind Tunnel. A. J. Somerville (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 183-187.

This paper discusses the operation of the General Dynamics High Speed Wind Tunnel with a digital computer filling the role of the prime supervisory and control element. A general description of the wind tunnel and computer system is followed by a discussion of the major systems of the wind tunnel and the specialized software and hardware associated with each system. Also included is a report of the improvement in tunnel operation, from both an economic and performance standpoint, as well as anticipated improvements. (Author)

A72-42699 A near real time data acquisition/reduction facility for the Boeing wind tunnels. H. R. Gelbach, H. D. Willsie,

and R. E. Luick (Boeing Co., Seattle, Wash.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 199-203.

Outline of the design considerations and operating experience with a data acquisition/reduction facility supporting two major aerodynamic wind tunnel facilities. The system includes two 100-input-channel subsystems sharing a single XDS 9300 computer. The subsystems are treated by the computer as peripherals; therefore, the computing system is free to service all peripherals in a time-sharing manner. Quick-look (fully computed, but edited) data are returned to the aerodynamic engineer via lamp-bank displays, symbol printing X-Y plotters, and/or oscillograph, as well as the standard output peripherals. The system also includes control of the model attitude and, in some cases, the transonic wind tunnel Mach number. Specific system performance goals included 0.1% maximum total data system error (excluding transducers), traceable computer controlled self-calibration and return of quick-look data in aerodynamic coefficients within one minute. (Author)

A72-42709 **Wake vortex sensing.** R. D. Kodis (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). In: *International Aerospace Instrumentation* Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 281-283.

Experimental studies and tests are reported on two wake vortex sensing techniques designed to sense the presence and track the motions of low altitude aircraft wake vortices endangering operations around terminal areas. The techniques studied are based on acoustic pulse deflection and velocity field measurements. M.V.E.

A72-42711 **Measuring instruments for extreme environments.** J. C. Schneider (Kaman Sciences Corp., Colorado Springs, Colo.). In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 289-293.

A variable-impedance transduction technique was utilized to develop instruments for use in thermal extremes. These instruments are being used for in-flight measurements in high-performance test aircraft, as well as in several nonaerospace applications. The design of these instruments is such that thermal effects are minimal, and thus accurate measurements over temperature ranges of 1000 F can be made without cooling or data compensation. The systems are useful for static as well as dynamic measurements of pressure, displacement, and acceleration. (Author)

A72-42715 **Development of a clamp-on flowmeter.** H. G. Tobin (ITT Research Institute, Chicago, Ill.). *(Instrument Society of America, International Aerospace Instrumentation Symposium, 17th, Las Vegas, Nev., May 10-12, 1971.)* In: International Aerospace Instrumentation Symposium, 18th, Miami, Fla., May 15-17, 1972, Proceedings. Pittsburgh, Instrument Society of America, 1972, p. 337-340.

Description of a recently developed instrument for measuring flow rates in hydraulic lines without requiring the opening of the line. The instrument clamps on to the hydraulic line even if it is against the bulkhead of an aircraft. The current version utilizes an infrared heat source in a thermistor bridge to monitor the flow rate. Flow can be measured on a variety of line sizes and with flow in either direction. The current unit is usable over flow rates ranging from 10 cu cm/min to greater than 400 cu cm/min. (Author)

A72-42755 **Dynamic response of structures; Proceedings of the Symposium, Stanford University, Stanford, Calif., June 28, 29, 1971.** Symposium supported by the National Science Foundation, U.S. Navy, U.S. Army, and U.S. Air Force. Edited by G. Herrmann (Stanford University, Stanford, Calif.) and N. Perrone (U.S. Navy, Office of Naval Research, Washington, D.C.). New York, Pergamon Press, Inc., 1972. 367 p. $24.

The dynamic behavior and response of structural elements and systems are examined in papers dealing with aerospace structural design requirements and crashworthiness criteria. Topics considered include dynamic plastic behavior of shells, characterization of critical pulse loads, plate vibrations, flutter prevention in SST design, space shuttle structures, full-scale testing, crashworthiness design of rotary-wing aircraft, energy-absorbing devices for aircraft impact conditions, passenger seat and restraint systems, applications of photoelasticity to elastodynamics, stress-wave propagation, and dynamic response of dislocations in solids.

T.M.

A72-42760 **Flutter prevention in design of the SST.** M. J. Turner and J. B. Bartley (Boeing Co., Commercial Airplane Group, Seattle, Wash.). In: Dynamic response of structures; Proceedings of the Symposium, Stanford, Calif., June 28, 29, 1971. New York, Pergamon Press, Inc., 1972, p. 95-113. 8 refs.

The general characteristics of flutter problems affecting the structural design of the SST are discussed in relation to configuration constraints resulting from mission performance requirements. Combined analytical and experimental methods that have been used in solving these problems are outlined in detail. Because of structural complications resulting from a long and slender body, thin low aspect ratio wing, and aft location of wing mounted engines, a very detailed finite element representation is employed in deriving the analytical model of the complete aircraft structure. Applications of subsonic lifting surface theory and supersonic Mach box methods in the treatment of oscillatory airloads are described. (Author)

A72-42763 **A survey of rotary-wing aircraft crashworthiness.** G. T. Singley, III (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). In: Dynamic response of structures; Proceedings of the Symposium, Stanford, Calif., June 28, 29, 1971. New York, Pergamon Press, Inc., 1972, p. 179-223. 51 refs.

The necessity of improved crashworthiness design requirements for rotary-wing aircraft is demonstrated by a review and analysis of both U.S. Army operational experience and an 11-year crash survival research and development program. Aircraft accident investigation, crash testing of full-scale aircraft, and the testing of selected components and subassemblies are outlined. The aircraft crash environment is described along with consequent hazards and injuries. Recent advances in rotary-wing aircraft crashworthiness design are explained with reference to airframes, seat/restraint systems, occupant environment, ancillary equipment stowage, post-crash emergency escape, and fire prevention. T.M.

A72-42764 **An assessment of energy absorbing devices for prospective use in aircraft impact situations.** A. A. Ezra and R. J. Fay (Denver, University, Denver, Colo.). In: Dynamic response of structures; Proceedings of the Symposium, Stanford, Calif., June 28, 29, 1971. New York, Pergamon Press, Inc., 1972, p. 225-246. 27 refs.

This paper presents a survey of energy absorbing devices and systems for absorbing the kinetic energy of a moving body at impact, discusses their characteristics, and explores the use of these devices in aircraft crashworthiness design. The important characteristics of energy absorbers are the specific energy absorption capacity per unit weight of device or system, the efficiency of the stroke, the stroke to length ratio, the reliability, the repeatability, the ability to sustain rebound loads, and the cost. In specific applications it is desirable to optimize the design in the sense that some desired combination of

low cost, low weight, small size, and high performance is achieved. Energy absorbers have an important role to play in the improvement of aircraft crashworthiness. Areas in which these devices may be applied include the landing gear, the bottom of the fuselage, the seats, and the mountings for massive structures such as helicopter transmissions. (Author)

A72-42826 Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972. 444 p. $29.95.

An appraisal of Van der Neut's scientific work is presented together with papers on the design of optimum aircraft structures. Subjects considered include a mission analysis criterion for the definition of structural design loads, the structural safety of aircraft, developments in structural airworthiness requirements, dynamic aspects of Fokker F-28 aircraft design, and the application of the finite element displacement method to problems of elastoplastic deformation. Aspects of stress concentration around holes in plates and shells are discussed along with the bursting speed of a symmetrical conical disk with radial holes, the theory of multilayer shells, the buckling of circular cylindrical shells under axial compression, and the optimum design of circular sandwich plates. G.R.

A72-42827 Compression panels - An alternative language. J. G. ten Asbroek (Fokker-VFW, Amsterdam, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 11-26.

A structural deficiency found in the wing of a transport aircraft had been connected with the installation of a number of fuel system brackets. The history of the wing compression panel is described. The technical reasoning by which the cause of the deficiency was first identified is briefly considered. A description of the phenomenon is then provided in a language which makes use of terms and considerations employed by the 'average' aircraft stress engineer. The alternative approach initially neglects all aspects of column and local buckling. The support loads are calculated by determining the minimum of the bending energy in the redundant beam. G.R.

A72-42828 Discussion of the mission analysis criterion for the definition of structural design loads. J. B. de Jonge (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 27-38.

In designing aircraft structures, it has been the aim to provide a strength that would make the chances of structural failure under normal operational conditions very remote. The design strength of the aircraft is defined by the most severe conditions, the 'envelope' of the design-loading conditions. The 'envelope procedure' does not take into account the specific type of aircraft usage. In the last few years, a large effort has been made to develop new techniques for the calculation of gust loads, on the basis of the so-called 'power spectral density method.' As a result, a new method for the definition of design loads was proposed, which was indicated as the 'mission analysis concept.' The basic difference between the mission analysis concept and an envelope concept is that the first one takes into direct consideration the specific aircraft usage. G.R.

A72-42829 Structural safety of aircrafts. J. Taub (Delft, Technische Hogeschool, Delft, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 39-50.

A criterion for the acceptable probability of failure is discussed together with load levels consistent with the acceptable failure rate and the use of critical stresses as safety criterion. A number of problems arises in the design of a structure with an acceptable safety level. A method dealing with questions of distribution among various load conditions is proposed. According to this method, individualized load levels are obtained for each type of aircraft. G.R.

A72-42830 Some developments in structural airworthiness requirements. H. N. Wolleswinkel (Rijksluchtvaartdienst, Amsterdam, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 51-69. 16 refs.

The development of airworthiness regulations is considered, taking into account the draft requirements of 1954, the appointment of the ICAO-Airworthiness Committee in 1956, improvements in the efficiency of the Airworthiness Committee in 1970, and the development of the Joint Airworthiness Code. Questions of the maneuvering loads are examined together with aspects of gust loads and the limit load concept. The relation between gust loads and operational usage is discussed along with the problem of dynamic gust loads. It is found that the safety of air transportation improved considerably during the last 20 years. G.R.

A72-42831 Dynamic aspects of Fokker F-28 aircraft design. J. IJff (Fokker-VFW, Amsterdam, Netherlands) and R. J. Zwaan (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 71-97. 9 refs.

Questions of dynamic schematization are discussed together with aspects of experimental unsteady T-tail aerodynamics, theoretical unsteady T-tail aerodynamics, and relations between a flutter model and flight flutter tests. Flutter calculations including degrees of freedom for control surfaces are required when motions of these surfaces occur directly in a control mode, or after a single failure. Gust loads are critical for the design of large parts of the structure of a subsonic jet transport. As a result, calculations of the vertical gust loads on the wing have been performed from the very start of the preliminary design. Approaches used in the determination of landing impact loads are also considered. G.R.

A72-42845 Steady state equations of motion, equilibrium shape and stability derivatives of elastic airplanes evaluated with finite element methods. J. Roskam (Kansas, University, Lawrence, Kan.). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 305-323. 9 refs.

It is shown how the steady-state equations of longitudinal motion of an elastic airplane can be derived from the general theory. Use is made of finite element methods in representing the structural and aerodynamic characteristics of the airplane. The functional dependence of aerodynamic and thrust forces and moments is discussed, and equations are presented for steady-state rectilinear flight. An important problem that arises in stability and control calculations for a completely elastic airplane is that of the jig shape. In this problem, the task is to find the unloaded shape that when loaded in a known manner results in a known shape. F.R.L.

A72-42849 Calculation of potential flow about aerofoils using approximation by splines. E. F. F. Botta and A. I. van de Vooren (Groningen, Rijksuniversiteit, Groningen, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 399-412. 6 refs.

The calculation of incompressible and inviscid flows past

airplane wings is studied, attacking the exact problem instead of using the linearized approximation. The method is based on the replacement of the airfoil by a doublet distribution representing the discontinuity in velocity potential behind the airfoil. An integral equation is derived for the determination of the doublet distribution. In the numerical solution the airfoil contour and the doublet distribution are represented by splines, taking into account the behavior near the leading and trailing edges. In principle, the method can be extended to nonsymmetrical airfoils and to three-dimensional bodies. F.R.L.

A72-42851 **Fatigue of lugs.** J. Schijve (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Contributions to the theory of aircraft structures. Rotterdam, Nijgh-Wolters-Noordhoff Universitaire Uitgevers (Delft University Press), 1972, p. 423-440. 22 refs.

The fatigue strength of a lug joint, where the load is transmitted from a fork end through a single joint or bolt to the lug, is studied. Attention is given to the behavior of lugs during load reversal from tension to compression, fretting corrosion, clearance between pin and hole, prestressing by interference fits, residual stresses by hole expansion, and use of slotted holes and flattened pins to avoid fretting. Prediction of the fatigue strength of a lug and fail-safe aspects are considered. F.R.L.

A72-42868 # **Two-dimensional model for thermal compression.** F. S. Billig (Johns Hopkins University, Silver Spring, Md.). *Journal of Spacecraft and Rockets,* vol. 9, Sept. 1972, p. 702, 703.

Consideration of methods used in obtaining performance estimates for airbreathing propulsion devices. A two-dimensional model is introduced to demonstrate that the essential compatibility conditions of balanced pressure and aligned velocity vectors on a streamline dividing two flows required in one-dimensional modeling can be maintained in two-dimensional flow. Simple oblique shocks are used to depict the inlet compression process, whereas the concept of an oblique planar heater is used to provide a two-dimensional model of the heat addition process. M.V.E.

A72-42909 **A look at the duration correction for computing EPNL.** G. Banerian (U.S. Department of Transportation, Office of Noise Abatement, Washington, D.C.). *Journal of Sound and Vibration,* vol. 23, Aug. 22, 1972, p. 415-421. 6 refs.

This paper is concerned with the problem of computing the noise duration correction as the effective duration time tends to zero, a condition that results when the peak pressure level approaches a noise floor. The present method for computing the duration correction leads to extremely large negative values as the effective duration time approaches zero. A modification is suggested to avoid this anomaly. (Author)

A72-42912 **Vibration measurements of an airplane fuselage structure. I - Turbulent boundary layer excitation. II - Jet noise excitation.** J. F. Wilby and F. L. Gloyna (Boeing Co., Commercial Airplane Group, Seattle, Wash.). *Journal of Sound and Vibration,* vol. 23, Aug. 22, 1972, p. 443-486. 36 refs.

A72-42913 **Measurement, in a duct, of the space-structure of the discrete-frequency noise generated by an axial compressor.** P. Harel and M. Perulli (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(British Acoustical Society and American Society of Heating, Refrigeration and Air Conditioning Engineers, Symposium on the Acoustics of Flow Ducts, University of Southampton, Southampton, England, Jan. 10-14, 1972.) Journal of Sound and Vibration,* vol. 23, Aug. 22, 1972, p. 487-506. 5 refs. Research sponsored by the Société Nationale d'Etude et de Construction de Moteurs d'Aviation.

A72-42920 # **Procedures for simple resonance testing of sailplanes (Metodyka prostych rezonansowych badan szybowcow).** M. Bossak, J. Pietrucha, and W. Potkanski. *Instytut Lotnictwa, Prace,* no. 49, 1972, p. 55-64. 10 refs. In Polish.

A72-42922 # **Principles of modelling studies of fuel systems and hydraulic systems by electronic analog computers (Zasady badan modelowych ukladow paliwowych i hydraulicznych na elektronicznych maszynach analogowych).** S. Bramski, M. Czerkas, and M. Rybak. *Instytut Lotnictwa, Prace,* no. 49, 1972, p. 73-87. 7 refs. In Polish.

A72-42927 **Variable pitch fans - Successors to the aircraft propeller.** K. T. Fulton. *Chartered Mechanical Engineer,* vol. 19, Sept. 1972, p. 94-96.

The propulsion and operational advantages offered by variable pitch (vp) fans are significant. Engines equipped with such fans have lower noise output, and their performance characteristics are especially appropriate to the performance needs of aircraft with STOL capabilities. With a vp fan and fixed-area nozzle, not only can surge margin and matching be assured, but by operating the fan in fine pitch, thrust modulation in flight is available, as well as thrust reversal on the ground. Tests performed on the Turbomeca Astazou fitted with a vp fan are described. F.R.L.

A72-42928 # **Simulator test center.** J. Baradat (Matériel Téléphonique, Paris, France). *Electrical Communication,* vol. 47, no. 3, 1972, p. 175-179.

Description of a digital computer based experimental study center for testing the ability of a simulator to reproduce accurately a crew environment and the performance of the simulated aircraft and for evaluating the efficiency of the simulator's instructional methods. The computer used is a small general-purpose computer used singly for medium-size simulators, or in a dual system for large simulators such as those of the A 300 B Airbus or the Mercury aircraft. The interface between the simulator and the computer provides all the conversions and adaptations required and controls data transfers between the computer and a variable environment. The logic unit is designed around simple basic printed boards grouped in subracks and produces the complex logic functions by appropriate wiring. The test center consists of two crew compartments, one for aircraft simulators, and the other for military tank simulators. The use of graphic CRT displays in this test center to facilitate the work of the instructor is discussed, emphasizing the playback feature. A.B.K.

A72-42946 **Tactical aircraft positioning.** E. W. Bush (Cubic Corp., San Diego, Calif.). *Navigation,* vol. 19, Summer 1972, p. 120-127.

It is shown that a CW radar system patterned after the AN/USQ-28 SHIRAN system can provide a satisfactory solution to the problem of achieving near real-time aircraft position information required for selective target missions. The use of a combination of frequency and time multiplexing in range measurement is demonstrated. V.P.

A72-42949 **Great circle waypoints for inertial equipped aircraft.** R. J. Holm (Litton Industries, Inc., Woodland Hills, Calif.). *Navigation,* vol. 19, Summer 1972, p. 191-194.

A procedure for determining reporting points on a great circle passing intermediate VORTAC stations by aircraft equipped with inertial navigation is described. It is shown that, using the procedure, 24 nautical miles can be saved by flying the great circle as compared

to the Jet Airway 134 (Washington to Los Angeles). The procedure eliminates all reference to great-circle vertices as well as the usual lengthy log table, haversine computations. V.P.

A72-42966 International Conference on Structural Safety and Reliability, Washington, D.C., April 9-11, 1969, Proceedings. Conference sponsored by the U.S. Air Force, U.S. Navy, and Advanced Research Projects Agency. Edited by A. M. Freudenthal (*George Washington University, Washington, D.C.*). Oxford and New York, Pergamon Press, 1972. 348 p. $45.

The behavior of structures subject to stochastic loads is treated in papers dealing with the role of statistics in the conceptual formulation of safety and reliability. Bayesian statistical decision theory, extreme value theory, estimation of the parameters of Gumbel and Fréchet distributions, and linear invariant estimation of Weibull parameters are examined in the context of reliability-based design applications. The estimation of aircraft fatigue performance and the prediction of aircraft lifetime are treated extensively. T.M.

A72-42971 Reliability analysis in the estimation of transport-type aircraft fatigue performance. J. P. Butler (Boeing Co., Seattle, Wash.). In: International Conference on Structural Safety and Reliability, Washington, D.C., April 9-11, 1969, Proceedings. Oxford and New York, Pergamon Press, 1972, p. 181-210; Discussion, p. 210, 211. 10 refs. Contract No. F33615-68-C-1232.

The application of reliability analysis methods to the estimation of probable fatigue performance is investigated. Consideration is given to the use of order statistics to define the probable reliability of a fleet of aircraft or a number of fatigue-exposed details. A reliability analysis plan is presented and compared with the current, fixed-scatter-factor procedure for determining the fatigue crack-free service period of a structural detail. Both the two-parameter Weibull distribution and the log-normal distribution with empirically defined shape parameters are utilized to investigate the application of order statistics to fatigue reliability analysis. Maximum-likelihood estimators, including one which considers only the first two ordered fatigue failures, are described and used to assess fatigue data, and to establish distribution shape parameter values that are representative of structural fatigue scatter. (Author)

A72-42972 Life estimation and prediction of fighter aircraft. J. Branger (Eidgenössisches Flugzeugwerk, Emmen, Switzerland). In: International Conference on Structural Safety and Reliability, Washington, D.C., April 9-11, 1969, Proceedings. Oxford and New York, Pergamon Press, 1972, p. 213-237, 341-349. 9 refs.

In view of the present requirements for longer operational lives of aircraft, it is necessary to find means of extending the service life not only by proper structural modifications but also by eliminating excessive safety margins on life and reducing them to a minimum that ensures adequate safety. The paper indicates how this problem was approached in Switzerland in the case of the D. H. Venom. A high degree of human reliability, the systematic concern with the assumptions of design and operation as well as comprehensive procedures of quality control helped to eliminate the avoidable margin of the safety factor with respect to life. Organized systematic rotation of all aircraft provides the justification for consideration of the fleet as a single statistical population. The most important outcome of the full-scale tests proved to be the identification of critical components. (Author)

A72-42973 Safety, reliability and airworthiness. H. C. Black (Air Registration Board, London, England). In: International Conference on Structural Safety and Reliability, Washington, D.C., April 9-11, 1969, Proceedings. Oxford and New York, Pergamon Press, 1972, p. 239-264. 15 refs.

The constraints under which aviation operates have led to the development of a vehicle in which nearly all parts are at least duplicated; multiple redundancy is present to a very large degree in both systems and structures design. Statistical methods of reliability analysis for development of safety requirements and for their application started in the performance and systems field and spread to structures. Many of the possible systems failures can influence flying qualities or crew workload, and this has led to development of an analysis of acceptable flying qualities related to the probability of the situation arising. The principle use of the application of statistical methods to failure analysis is in aiding the decision between various forms of redundancy. (Author)

A72-42974 Testing procedures for the design and life estimation of fatigue-sensitive structures. E. Gassner and E. Haibach (Laboratorium für Betriebsfestigkeit, Darmstadt, West Germany). In: International Conference on Structural Safety and Reliability, Washington, D.C., April 9-11, 1969, Proceedings. Oxford and New York, Pergamon Press, 1972, p. 299-321. 12 refs.

Upon a critical examination of the existing techniques, it is realized that the allowable stresses can be estimated with satisfactory reliability only in rather infrequent cases, where the stress-time history can be described by a stationary random process. Satisfactory results can also be obtained for similar stress-time histories with constant mean stress and for those resulting from individual events of random or nonrandom nature. The situation is quite different in the case of stress-time histories where incremental stresses of a purely random nature are superimposed on a basic stress which is varying quasi-statically. The numerous parameters of such stress-time histories are the primary reasons that have made it impossible up to now to establish a technique yielding design data that can be generalized. (Author)

A72-43054 # *A search procedure for electronic radar (Eine Suchprozedur für elektronisches Radar).* H. Dannemann. Berlin, Technische Universität, Dr.-Ing. Dissertation, 1971. 113 p. 19 refs. In German.

A search procedure is developed for an electronic radar for which the scanning sequence and the transmitter power required per element of volume can be arbitrarily chosen. After a few introductory remarks concerning the problems connected with a search, a mathematical method is outlined by means of which the effectiveness of a two-stage search for a previously unknown number of targets can be described exactly and approximately. These considerations lead to the suggested search procedure, which is first checked in the case of a less complicated search at the boundary of the acquisition region under the assumption of a quasi-steady air space. Important results are obtained from this preliminary study which are then shown to be valid for a search in the total volume of the monitoring space. A detailed investigation is then made of this more realistic total volume search, with special attention being devoted to the choice of a favorable parameter range and to the problem of reducing the escape probability of targets resulting from their high speed. A.B.K.

A72-43060 # Studies of the ground effect on the noise levels and their frequency distribution in the near field of an engine jet directed vertically against the ground (Untersuchungen über den Bodeneinfluss auf die Schallpegel und deren Frequenzverteilung im Nahfeld eines senkrecht gegen den Boden gerichteten Triebwerksstrahles). R. Scholten. Berlin, Technische Universität, Dr.-Ing. Dissertation, 1971. 125 p. 13 refs. In German.

A procedure is developed for determining the stresses on the airframes of jet-powered V/STOLs due to high noise levels in the near field of the jet engine. It is shown that Lighthill's method for

calculating the radiated noise power of an engine jet in the far field can be extended to the near field by introducing a position-dependent velocity exponent. With this modified Lighthill theory a semiempirical calculation procedure is derived the bases of which are the measured sonic field and velocity exponent field of a reference jet engine. A.B.K.

A72-43068 # Model-analytical investigation of short-haul air traffic with VTOL aircraft in the Federal Republic of Germany (Modellanalytische Untersuchung eines Kurzstreckenluftverkehrs mit VTOL-Flugzeugen in der Bundesrepublik Deutschland). W. Hamma. Berlin, Technische Universität, Dr.-Ing. Dissertation, 1971. 172 p. 174 refs. In German.

It is pointed out that the investigation is limited to the territory of West Germany and does not include Berlin. The year 1980 and the years following it are taken into consideration in the study because it is assumed that economically operating VTOL aircraft will be available at that time. The magnitude of the traffic to be expected is derived together with the necessary conditions for the VTOL traffic. A procedure for a complete systematic evaluation of the capacity and the economic costs of the VTOL traffic system is also developed. The results of the analysis provide a basis for an objective comparison of the VTOL system considered with other competing traffic systems. Questions concerning the required airports are discussed together with problems of safety, aspects of operational organization, and the characteristics of the future VTOL aircraft. G.R.

A72-43091 # Analysis by hydraulic analogy of rotating separation in compressors (Analyse par analogie hydraulique du décollement tournant dans les compresseurs). Y. Le Bot and P. Bernard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* July-Aug. 1972, p. 187-198. 6 refs. In French.

Tests carried out with a water wheel to determine the influence of the distributor, the diffuser, and ultimately of upstream obstacles such as support arms on rotating separation in a turbine stage are described, especially with reference to the rotation constant of the separated zones. The influence of a reduced number of blades in the absence of a diffuser, and the influence of the diffuser on the characteristics of rotating separation are outlined. Attention is given to unsteady flows in a stage with a distribution cascade. F.R.L.

A72-43094 # Experimental verification of the theory of the lifting surface in the high subsonic range (Vérification expérimentale de la théorie de la surface portante en subsonique élevé). R. Destuynder (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(AGARD, Structures and Materials Panel Meeting, 34th, Copenhagen, Denmark, Apr. 9-14, 1972.) La Recherche Aérospatiale,* July-Aug. 1972, p. 217-224. In French.

Comparison is made between theory and experiment, at different Mach numbers and different reduced frequencies, of unsteady pressure fields induced by pitching motions of a wall-mounted sweptback wing. A study is also made of the development and analysis of a flutter obtained on a wing of the same plan form, in the same range of reduced frequencies and Mach numbers as that used for the pressure measurements. This second phase makes it possible to experimentally obtain the evolutions of frequency and damping of modes susceptible of coupling themselves as a function of test parameters (Mach number and generating pressure). Correspondence of theory with experiment is excellent in both cases. F.R.L.

A72-43095 # Method of measuring modal characteristics of a structure subjected to a random excitation (Méthode de mesure des caractéristiques modales d'une structure soumise à une excitation aléatoire). A. Bourgine (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale,* July-Aug. 1972, p. 225-229. In French.

A method of measurement of proper frequencies and damping of proper modes of a structure vibrating linearly around a reference state assumed to be slowly variable in time and subjected to a random excitation is developed. A system with one degree of freedom and continuous mechanical systems are studied. Exploitation of the method requires powerful methods of analysis. The method has been verified experimentally on a system with one degree of freedom (active electric filter), and on a real structure excited by the natural turbulence of a wind tunnel. F.R.L.

A72-43130 Parallel runway spacing. A. Kullstam (Computer Sciences Corp., Falls Church, Va.). *(Institute of Navigation, Annual Meeting, 27th, Pasadena, Calif., June 29-July 1, 1971.) Navigation,* vol. 19, Spring 1972, p. 19-28. 5 refs.

In connection with continuously increasing air traffic, it is necessary to increase the capacity of the airport by independently operated runways. Aspects of minimum runway spacing compatible with prevailing safety standards are investigated. A sensitivity analysis is conducted in order to obtain information about the system parameters that have the greatest influence on the runway spacing. The most critical parameter is the total command delay time. Another significant parameter is the bank angle. The penetration probability, on the other hand, has little influence on the intervention zone width. It is found that an increase in the data acquisition rate is more effective than aspects of accuracy. G.R.

A72-43139 # New materials in modern technology (Novye materialy v sovremennoi tekhnike). A. T. Tumanov and K. I. Portnoi. *Akademiia Nauk SSSR, Doklady,* vol. 205, July 11, 1972, p. 336-338. 5 refs. In Russian.

The mechanical properties and production technology of two composite materials are examined. The first is an aluminum-base material strengthened (50 vol %) by continuous high-strength high-modulus boron fibers. Substitution of this alloy (VKA-1) for aluminum wing spars leads to substantial decreases in weight and increases in rigidity. The other alloy, termed VKN-1, is designed to operate at temperatures on the order of 1200 C. It is a nickel-base alloy strengthened (40 to 50 vol %) by tungsten or molybdenum fibers. V.P.

A72-43151 DABS is a four letter word. K. A. Wise (FAA, Systems Research and Development Service, Washington, D.C.). *Journal of Air Traffic Control,* vol. 14, Sept. 1972, p. 9-11.

DABS is an acronym for Discrete Address Beacon System. Such a system is to provide surveillance and ground-air communications in support of air traffic control automation for the years after 1980. It is pointed out that the present ATC system is primarily a manual system with regard to the control and separation of air traffic. The manual system is in process of transition to the semiautomatic Third Generation System recommended by the Project Beacon Task Force in 1961. The development of the DABS was recommended in order to obtain garble-free replies, superior data quality, and the means for implementing a digital data-link. G.R.

A72-43152 * NASA's quiet engine programs. R. P. Jackson (NASA, Washington, D.C.). *Journal of Air Traffic Control,* vol. 14, Sept. 1972, p. 16-18.

It is the goal of NASA to provide the technology that will make the aircraft unobtrusive in its environment. The primary work in propulsion source noise reduction centers around the technology to modify existing engines and the technology to design new propulsion systems for CTOL, STOL, and VTOL that operate at significantly lower noise levels than present systems. It is recommended that noise standards should also be established for new engines. Another recommendation is concerned with the incorporation of noise and pollution technology in military aircraft propulsion developments. G.R.

STAR ENTRIES

N72-29992# Aeronautical Research Committee, Bangalore (India).
CONICALLY CAMBERED TRIANGULAR WINGS OPTIMISED FOR LEAST DRAG WITHOUT LEADING EDGE SUCTION
V. S. Holla, T. N. Krishnaswamy, and S. M. Ramachandra Oct. 1971 30 p refs
(ARC-TR-2) Avail: NTIS HC $3.50

A method of designing optimized conically cambered triangular wings with subsonic leading edges and supersonic trailing edges, is given using load distributions vanishing at the leading edge. The characteristics of these wings are compared with plane triangular wing (with suction) which has the minimum lift dependent drag. Lagrange's method is used in the optimization procedure. In general, it is seen that optimized wing shapes obtained from the basic load and twist distribution used in the present case are of practical use. Author

N72-29993*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL STUDY OF EFFECT OF CASING TREATMENT ON PERFORMANCE OF A MULTISTAGE COMPRESSOR
Roger W. Snyder and Robert J. Blade Washington Aug. 1972 26 p refs
(NASA-TN-D-6917; E-6920) Avail: NTIS HC $3.00 CSCL 20D

The simulation was based on individual stage pressure and efficiency maps. These maps were modified to account for casing treatment effects on the individual stage characteristics. The individual stage maps effects on overall compressor performance were observed. The results show that to improve the performance of the compressor in its normal operating range, casing treatment of the rear stages is required. Author

N72-29996# Joint Publications Research Service, Arlington, Va.
SOLUTION OF THE PROBLEM OF AN AIRFOIL OF ARBITRARY PLAN CONFIGURATION MOVING NEAR A GROUND-EFFECT SURFACE
S. D. Yermolenko and A. V. Rovnykh 28 Jul. 1972 15 p refs
Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved. Aviats. Tekhn. (USSR), no. 1, 1971 p 5-14
(JPRS-56629) Avail: NTIS HC $3.00

The problem of an airfoil of arbitrary plan configuration moving near a ground-effect surface is solved employing a non-linear method. The results of computing aerodynamic characteristics of airfoils of varying plan configurations with experimental data pertaining to thin plates are compared.
Author

N72-29998# New York Univ., N.Y. School of Engineering and Science.
AERODYNAMIC STUDIES OF WING BODY Final Report
Antonio Ferri and Lu Ting Feb. 1972 12 p refs
(Grant AF-AFOSR-1062-67; AF Proj. 9782)
(AD-741917; AFOSR-72-1020TR) Avail: NTIS CSCL 20/4

The main objectives of the research were to carry out the theoretical analysis of the flow field near a wing body configuration, to develop the far field solutions and to study their interference effects on another airplane. Analyses have been carried out and definite results are obtained in the following topics: (1) the motion and decay of vortex lines, (2) the connection of near field data to far field solution, (3) turbulent flow and boundary layer separation, and (4) the aerodynamic effects on an airplane by an incident shock. Author (GRA)

N72-29999*# Clemson Univ., S.C.
EVALUATION OF MINIMUM VARIANCE ESTIMATORS FOR SIGNAL DERIVATIVES IN REAL NOISE ENVIRONMENTS
R. W. Snelsire [1972] 37 p refs
(Grant NGR-41-001-024)
(NASA-CR-112146) Avail: NTIS HC $4.00 CSCL 01B

A digital filter has been developed to optimally estimate the rate of descent of an aircraft to permit all-weather operation. The filter was evaluated using recorded rate of descent information from flight instruments. The evaluation showed the filter to be superior to other systems especially when operated in turbulent air. Author

N72-30000*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
FLIGHT VELOCITY INFLUENCE ON JET NOISE OF CONICAL EJECTOR, ANNULAR PLUG AND SEGMENTED SUPPRESSOR NOZZLES
J. F. Brausch Aug. 1972 268 p refs
(Contract NAS3-15773)
(NASA-CR-120961) Avail: NTIS HC $15.50 CSCL 01B

An F106 aircraft with a J85-13 engine was used for static and flight acoustic and aerodynamic tests of a conical ejector, an unsuppressed annular plug, and three segmented suppressor nozzles. Static 100 ft. arc data, corrected for influences other than jet noise, were extrapolated to a 300 ft. sideline for comparison to 300 ft. altitude flyover data at M = 0.4. Data at engine speeds of 80 to 100% (max dry) static and 88 to 100% flight are presented. Flight velocity influence on noise is shown on peak OASPL and PNL, PNL directivity, EPNL and chosen spectra. Peak OASPL and PNL plus EPNL suppression levels are included showing slightly lower flight than static peak PNL suppression but greater EPNL than peak PNL suppression. Aerodynamic performance was as anticipated and closely matched model work for the 32-spoke nozzle. Author

N72-30001*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ANALYSIS OF THE TAKEOFF AND LANDING PERFORMANCE OF A JET-POWERED STOL AUGMENTOR WING DESIGN
Susan E. Post, Bruno J. Gambucci, and Curt A. Holzhauser Aug. 1972 63 p refs
(NASA-TM-X-62176) Avail: NTIS HC $5.25 CSCL 01B

A preliminary study of the takeoff and landing performance characteristics of a swept wing airplane with augmented jet flap, designed for STOL operation and low noise is presented. The study is based on aerodynamic data from wind tunnel tests of a large-scale swept augmentor wing model, scaled up to a 48,000 pound airplane. Engine characteristics are based on a turbo fan with a fan pressure ratio of 2.5 delivering the major portion of the thrust to the augmentor flap. A description of the overall airplane configuration, the propulsion system, and the use of the aerodynamics is presented. To assess the STOL performance of the airplane, takeoff and landing distances and flight path capabilities were computed at various flap deflections and thrust levels. After evaluating these results in terms of desired STOL performance with required margins, basic takeoff and landing configurations were chosen. Author

N72-30002*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

ANALYSIS OF AN ELECTROHYDRAULIC AIRCRAFT CONTROL SURFACE SERVO AND COMPARISON WITH TEST RESULTS

John W. Edwards Washington Aug. 1972 73 p refs

(NASA-TN-D-6928; H-629) Avail: NTIS HC $3.00 CSCL 01B

An analysis of an electrohydraulic aircraft control-surface system is made in which the system is modeled as a lumped, two-mass, spring-coupled system controlled by a servo valve. Both linear and nonlinear models are developed, and the effects of hinge-moment loading are included. Transfer functions of the system and approximate literal factors of the transfer functions for several cases are presented. The damping action of dynamic pressure feedback is analyzed. Comparisons of the model responses with results from tests made on a highly resonant rudder control-surface servo indicate the adequacy of the model. The effects of variations in hinge-moment loading are illustrated. Author

N72-30003*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FLAP-LAG STABILITY OF HINGELESS HELICOPTER ROTOR BLADES

Robert A. Ormiston and William G. Bousman Aug. 1972 28 p refs Sponsored in part by Army Air Mobility R and D Lab.

(NASA-TM-X-62179) Avail: NTIS HC $3.50 CSCL 01B

The stability of hingeless rotor blade oscillations in hover is examined theoretically using a simplified centrally-hinged, spring-restrained, rigid blade to approximate the deflections of actual elastic blades. The aerodynamic and inertial coupling between the flap and lead-lag degrees of freedom is primarily responsible for instability, however elastic coupling and kinematic pitch-lag coupling both exert a powerful influence on hingeless rotor blade stability. Experimental results obtained from a two-bladed 1.81m diameter model rotor designed for minimum elastic coupling have confirmed the results of linear theory. For this model configuration rotor blade stall at high pitch angles was found to counteract the destabilizing flap-lag coupling and increase the damping of lead-lag oscillations. It was possible to account for this effect with the theory by using drag data for stalled airfoils. Author

N72-30004*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT MEASUREMENTS OF BUFFET CHARACTERISTICS OF THE F-104 AIRPLANE FOR SELECTED WING-FLAP DEFLECTIONS

Edward L. Friend and Walter J. Sefic Washington Aug. 1972 48 p refs

(NASA-TN-D-6943; H-666) Avail: NTIS HC $3.00 CSCL 01B

A flight program was conducted on the F-104 airplane to investigate the effects of moderate deflections of wing leading- and trailing-edge flaps on the buffet characteristics at subsonic and transonic Mach numbers. Selected deflections of the wing leadingand trailing-edge flaps, individually and in combination, were used to assess buffet onset, intensity, and frequency; lift curves; and wing-rock characteristics for each configuration. Increased deflection of the trailing-edge flap delayed the buffet onset and buffet intensity rise to a significantly higher airplane normal-force coefficient. Deflection of the leading-edge flap produced some delay in buffet onset and the resulting intensity rise at low subsonic speeds. Increased deflection of the trailing-edge flap provided appreciable lift increments in the angle-of-attack range covered, whereas the leading-edge flap provided lift increments only at high angles-of-attack. The pilots appreciated the increased maneuvering envelope provided by the flaps because of the improved turn capability. Author

N72-30005# National Aviation Facilities Experimental Center, Atlantic City, N.J.

RELATIONSHIP BETWEEN THE SAE SMOKE NUMBER AND JET AIRCRAFT SMOKE VISIBILITY

Gerald R. Slusher Dec. 1971 24 p refs

(FAA Proj. 502-306-02X)

(FAA-RD-71-23; FAA-NA-71-25) Avail: NTIS HC $3.25

A method was developed using the Society of Automotive Engineers (SAE) smoke numbers for calculating the exhaust smoke transmission for turbine engines, number of plume paths, and viewing angles. Criteria were developed relating the SAE smoked number to engine airflow and thus to engine size for conditions of visible and invisible smoke. Transmission of multiple plumes was calculated and presented. Author

N72-30006# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT PRELIMINARY REPORT: AMERICAN AIRLINES, INCORPORATED DC-10-10, N103AA 8 MILES SOUTH OF THE WINDSOR, ONTARIO, CANADA, VORTAC AT 11750 FEET, 12 JUNE 1972

22 Aug. 1972 8 p ref

(SB-72-69/878A) Avail: NTIS HC $3.00

An inflight emergency caused by rapid decompression following accidental opening of a cargo door is discussed. The aircraft was a DC-10 in flight near Windsor, Ontario, Canada on 12 June 1972. Actions taken by the pilot following the emergency are discussed and causes for injury to the passengers following the safe landing are examined. The report is preliminary in nature pending final decision of the National Transportation Safety Board. P.N.F.

N72-30007*# New York Univ., N.Y.

EXPERIMENTAL VERIFICATION OF LOW SONIC BOOM CONFIGURATION

Antonio Ferri, Huai-Chu Wang, and Hans Sorensen (Aeronautical Inst. of Sweden) Washington NASA Jun. 1972 111 p refs (Grant NGL-33-016-119)

(NASA-CR-2070; NYU-AA-71-19) Avail: NTIS HC $3.00 CSCL 01B

A configuration designed to produce near field signature has been tested at M = 2.71 and the results are analyzed, by taking in account three-dimensional and second order effects. The configuration has an equivalent total area distribution that corresponds to an airplane flying at 60,000 ft. having a weight of 460,000 lbs, and 300 ft. length. A maximum overpressure of 0.95 lb/square foot has been obtained experimentally. The experimental results agree well with the analysis. The investigation indicates that the three-dimensional effects are very important when the measurements in wind tunnels are taken at small distances from the airplane. Author

N72-30008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION AT LOW SPEEDS OF A MODEL OF THE KESTREL (XV-6A) VECTORED-TRUST V/STOL AIRPLANE

Richard J. Margason, Raymond D. Vogler, and Matthew M. Winston Washington Jul. 1972 177 p refs

(NASA-TN-D-6826; L-8193) Avail: NTIS HC $3.00 CSCL 01B

Longitudinal and lateral stability data were obtained with the model out of and in ground effect over a moving ground plane for a range of model angles of attack and sideslip at various thrust coefficients. These data were taken primarily at thrust coefficients which simulate transition speeds on the airplane between hover and 200 knots. Some data, however, represent the effect of thrust deflection at speeds up to 350 knots. Also presented are the effects of control-surface deflections and interference between the jets and free stream. Author

N72-30009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYTICAL STUDY OF AIRPLANE-AUTOPILOT

RESPONSE TO ATMOSPHERIC TURBULENCE
Waldo I. Oehman Washington Sep. 1972 43 p refs
(NASA-TN-D-6869; L-8140) Avail: NTIS HC $3.00 CSCL 01B

An analytical study has shown that, with proper selection of feedback gains, an automatic control system can reduce excursions in altitude of a jet transport flying in turbulence without increasing structural loads. The control system uses feedback of attitude-angle and pitch-rate signals to the elevator and uses feedback of altitude and altitude-rate signals to the throttle.
Author

N72-30010*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF AN IN-FLIGHT THRUST REVERSER ON THE STABILITY AND CONTROL CHARACTERISTICS OF A SINGLE-ENGINE FIGHTER AIRPLANE MODEL
Charles E. Mercer and Donald L. Maiden Washington Sep. 1972 237 p refs
(NASA-TN-D-6886; L-8395) Avail: NTIS HC $3.00 CSCL 01B

The changes in thrust minus drag performance as well as longitudinal and directional stability and control characteristics of a single-engine jet aircraft attributable to an in-flight thrust reverser of the blocker-deflector door type were investigated in a 16-foot transonic wind tunnel. The longitudinal and directional stability data are presented. Test conditions simulated landing approach conditions as well as high speed maneuvering such as may be required for combat or steep descent from high altitude.
Author

N72-30011*# Tracor, Inc., Austin, Tex.
COMMUNITY REACTION TO AIRCRAFT NOISE AROUND SMALLER CITY AIRPORTS
William K. Conner and Harrold P. Patterson Aug. 1972 187 p refs
(Contract NAS1-10216)
(NASA-CR-2104) Avail: NTIS HC $3.00 CSCL 01B

The results are presented of a study of community reaction to jet aircraft noise in the vicinity of airports in Chattanooga, Tennessee, and Reno, Nevada. These cities were surveyed in order to obtain data for comparison with that obtained in larger cities during a previous study. (The cities studied earlier were Boston, Chicago, Dallas, Denver, Los Angeles, Miami, and New York.) The purpose of the present effort was to observe the relative reaction under conditions of lower noise exposure and in less highly urbanized areas, and to test the previously developed predictive equation for annoyance under such circumstances. In Chattanooga and Reno a total of 1960 personal interviews based upon questionnaires were obtained. Aircraft noise measurements were made concurrently and aircraft operations logs were maintained for several weeks in each city to permit computation of noise exposures. The survey respondents were chosen randomly from various exposure zones.
Author

N72-30012# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: PAN AMERICAN WORLD AIRWAYS, INCORPORATED, BOEING 747, N747PA, FLIGHT 845, SAN FRANCISCO, CALIFORNIA, 30 JULY 1971
24 May 1972 58 p
(NTSB-AAR-72-17) Avail: NTIS

An aircraft accident involving a Boeing 747 which struck an approach light support during takeoff from San Francisco International Airport is discussed. The aircraft completed an emergency landing and minor injuries to several passengers were incurred. The cause of the accident was determined as pilot error in using incorrect takeoff reference speeds.
Author

N72-30013*# Bell Helicopter Co., Fort Worth, Tex.
LARGE SCALE WIND TUNNEL INVESTIGATION OF A FOLDING TILT ROTOR Final Report
May 1972 195 p refs
(Contract NAS2-5461)
(NASA-CR-114464; D272-099-002) Avail: NTIS HC $11.75 CSCL 01B

A twenty-five foot diameter folding tilt rotor was tested in a large scale wind tunnel to determine its aerodynamic characteristics in unfolded, partially folded, and fully folded configurations. During the tests, the rotor completed over forty start/stop sequences. After completing the sequences in a stepwise manner, smooth start/stop transitions were made in approximately two seconds. Wind tunnel speeds up through seventy-five knots were used, at which point the rotor mast angle was increased to four degrees, corresponding to a maneuver condition of one and one-half g.
Author

N72-30014# Committee on Commerce (U. S. Senate).
NOISE CONTROL ACT OF 1971 AND AMENDMENTS, PART 1
Washington GPO 1971 626 p refs Hearings on S. 1016 and S. 1566 before Comm. on Com., 92d Congr., 2d Sess., 28, 30 Jun. and 26 Jul. 1971
Avail: Subcomm. on the Environment.

The hearings concerning noise pollution and the Noise Control Act are reported. The comments from the following agencies are included: Department of Interior, Department of State, Comptroller General, Department of Agriculture, Civil Aeronautics Board, National Science Foundation, EPA, and NASA. Additional articles, letters, and statements concerning effects of noise, and sound rating of outdoor equipment are included.
F.O.S.

N72-30015# British Aircraft Corp., Weybridge (England). Commercial Aircraft Div.
THE CORROSION PROPERTIES OF AIRFRAME CONTAMINANTS
R. Kohler and J. Scott London Min. of Defence Dec. 1971 35 p refs
(Contract KS/1/0692/C.B.43(a)2)
(D-Mat-179) Avail: NTIS HC $3.75

The analysis and corrosion testing of a series of fluids collected from the bilge areas of aircraft are described in an attempt to relate the fluids to airframe corrosion. Assessments were also made of the influence of stress, reduced oxygen levels, microbiological action and general environment when relating the corrosion behavior.
ESRO

N72-30016# Bunker-Ramo Corp., Westlake Village, Calif.
CONTROL OF AVIONIC SUBSYSTEMS: THE CREW STATION MANAGEMENT PROBLEM
Richard W. Moss, John M. Reising, and William F. Swartz Wright-Patterson AFB, Ohio AFFDL 15 Mar. 1972 26 p ref
(Contract F33615-69-C-1716; AF Proj. 6190)
(AD-741945; AFFDL-TR-72-25) Avail: NTIS CSCL 01/3

The complexity of the piloting task of controlling on-board avionic subsystems is rapidly getting to the point where mission effectiveness is being degraded. The origin of this problem is evidenced by examining the trend over the past years to increasing numbers of controls and displays in the cockpit. A model is employed to analyze, in an operational context, the control tasks performed by the pilot in terms of mode annunciation, mode selection and fault warning. The conclusion reached is that the proliferation of control/display devices in the cockpit must be reversed if the pilot is to be exploited as the lead element in an advanced command, control and communications network.
Author (GRA)

N72-30017# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
THE STUDY OF DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL Final Scientific Report, 1 Jan. 1969 - 31 Dec. 1971

E. B. Lee 8 May 1972 28 p refs
(Grant AF-AFOSR-1502-68; AF Proj. 9769)
(AD-741920; AFOSR-72-1032TR) Avail: NTIS CSCL 01/3

Control and modeling of systems with distributive parameters and time delays have been considered. Various theoretical topics related to the modeling and control for the distributive system were studied in detail. Among the topic areas considered are modeling and computer simulation for systems with time delays, quadratic optimization and feedback controllers for linear time delay systems, and stability, controllability and observability for generalized dynamical systems. The goal has been to involve techniques which can be readily used in the design of controllers to reduce structural loading during wind gusts and in design of controllers which can be used in configuring the vehicle to reduce appendage size and weight while maintaining satisfactory aircraft handling characteristics. Author (GRA)

N72-30018# American Airlines, Inc., New York.
AIR VIEW OF STOL SYSTEM REQUIREMENTS
Feb. 1972 172 p Sponsored by DOT
(AD-742463; AAL-ER/D-56; DOT-OS-10075) Avail: NTIS CSCL 13/2

Conventional air and rail systems are incapable of providing needed short-haul service for the increased capacity requirements of the near future. Some improvements can be made but a new, integrated short-haul transportation system may be needed to supplement the present system. The complexity and magnitude of the problem require significant leadership and funding by the Federal Government. The airlines: areas of concern include the aircraft, STOLports, ATC, marketing, safety, economics, and acceptance by passengers and STOLport neighbors. This paper addresses reduced takeoff and landing (RTOL), propeller STOL transport (PST), jet STOL transport (JST), ATC, STOLport siting, route analysis, certification and safety, airline service requirements, economics, Metroflight demonstration need, STOLport acceptance, public demand stimulation and STOL development system management. Author (GRA)

N72-30019# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
PARA-FOIL STEERABLE PARACHUTE, EXPLORATORY DEVELOPMENT FOR AIRDROP SYSTEM APPLICATION Final Report, Jan. 1967 - Oct. 1969
Ralph J. Speelman, III, Charles A. Babish, III, Rudi J. Berndt, James H. DeWeese, Solomon R. Metres, William R. Pinnell, and Larry L. Watson Apr. 1972 300 p refs
(AF Proj. 6065)
(AD-742294; AFFDL-TR-71-37) Avail: NTIS CSCL 01/3

An exploratory development program was conducted to demonstrate an advanced aerial delivery concept of using a Para-Foil high glide steerable parachute, mated with ground and airborne electronics homing subsystems for controlled airdrop of 500- and 2000-pound payloads. The Para-Foil is a wing made entirely of fabric and having no rigid members. It has an upper surface and a lower surface and an airfoil cross section. The leading edge is open to permit inflation due to ran air pressure. A series of wind tunnel tests with both rigid and flexible Para-Foil models was conducted to establish the effects on performance of various design parameters, to establish a performance baseline for the full scale Para-Foils, and to evaluate various reefing techniques. The Para-Foil aerodynamic turn control characteristics were evaluated through truck tow tests and a series of free flight tests. Free flight tests were also conducted to verify system performance and to evaluate automatic homing capability. Author (GRA)

N72-30020# Rochester Applied Science Associates, Inc., N.Y.
INVESTIGATION OF THE VORTEX NOISE PRODUCED BY A HELICOPTER ROTOR Final Technical Report
H. Kevin Johnson and Walter M. Katz Feb. 1972 136 p refs
(Contract DAAJ02-70-C-0023; DA Proj. 1F1-62204-AA-41)
(AD-741778; RASA-71-10; USAAMRDL-TR-72-2) Avail: NTIS CSCL 20/1

Karman-street-type vortex shedding from a lifting surface was analyzed as a source of noise from a helicopter rotor in hover and forward flight. Experimental pressure-time histories were analyzed, and high resolution spectra were developed over a frequency range of 0 to 5000 Hz using a 0.7-Hz filter. The results of the investigation indicated that vortex noise is the major source of acoustic radiation from a helicopter rotor in hover or low-speed flight and that it is concentrated in the frequency range of 200 to 500 Hz. Author (GRA)

N72-30021# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LOW MACH NUMBER WIND-TUNNEL STUDY OF AN ADVANCED MANNED INTERCEPTOR M.S. Thesis
Robert M. Foley 13 Mar. 1972 111 p refs
(AD-741745; GAM/AE/72-4) Avail: NTIS CSCL 01/3

The project involved the testing of a model of a projected advanced manned interceptor in the wind tunnel. The model was a blended-body shape designed for Mach 4 cruising flight. The test program was conducted at Mach 0.19. Basic performance parameters were recorded on IBM cards and the reduced data supplied the parameters to determine basic lift, drag, and pitching moment characteristics of the model as well as thirteen of the static stability derivatives. GRA

N72-30022# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ECOLOGICAL ASPECTS OF BIRD-AIRCRAFT STRIKE HAZARDS
Ronald J. Sobieralski Mar. 1972 33 p refs
(AF Proj. 683M)
(AD-742227; AFWL-TR-71-94) Avail: NTIS CSCL 01/5

The U. S. Air Force annually spends millions of dollars for the replacement or repair of aircraft components damaged by bird-aircraft collisions. A large percentage of these strikes occur on or in the immediate vicinity of the airfield. In order to effectively reduce the strike hazard at the airfield those features which serve to attract birds to the field must be identified and altered. The ecological survey is undertaken to identify the attractants. Selective procedures for altering the habitat can then be applied to reduce the problem without unnecessary destruction of the environment or avifauna in the area. The survey procedures established can be used by individual bases to obtain the information necessary for the application of selective corrective action. Willing, intelligent individuals at any base could perform a survey of such limited complexity as the one proposed in the report. Once the field work has been accomplished, it is recommended that a professional be consulted as to what corrective procedures should be used to eliminate or reduce the problem. Author (GRA)

N72-30023# Army Foreign Science and Technology Center, Charlottesville, Va.
BASIC THEORIES OF AIR CUSHION VEHICLES
Yu. Yu. Benya and V. K. Dyachenko Oct. 1971 429 p refs
Transl. into ENGLISH of the publ. "Osnove Teorii Sudov na Vozdushnoy Podushke"
(AD-742425; FSTC-HT-23-496-71) Avail: NTIS CSCL 13/10

The authors have succeeded in blending general information about air cushion vehicles (background information such as history, basic features of designs, and prospects for their development by the major sea powers of the world) with detailed studies of the major hydro-aerodynamic problems encountered by design engineers (concerning theories in the areas of speed, stability, manueverability and seaworthy capabilities of these strange, new craft). The result is a combination formal-informal guide which will enthuse, as well as inform, both students and technical engineers of the shipbuilding industry. Author (GRA)

N72-30025# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
VARIABLE DIAMETER ROTOR STUDY Final Report, Jan. - Jul. 1971
Arthur W. Linden et al Wright-Patterson AFB, Ohio AFFDL Jan. 1972 211 p refs
(Contract F33615-71-C-1186; AF Proj. 1366)
(AD-740911; SER-50718; AFFDL-TR-71-170) Avail: NTIS CSCL 01/3

The report documents the findings of a variable diameter rotor systems concept study which Sikorsky Aircraft performed. The objective of the study was to investigate the various schemes proposed for variable diameter rotors for compound helicopters, to determine the merits of each, and to conclude which is most promising. Three basic types of variable diameter rotors were investigated, classified by the type of rotor blade construction: telescoping rigid blades, folding rigid blades, and flexible blades. Examples of each of these were adapted to a large compound helicopter design. All aircraft were sized to perform the same mission and a quantitative analysis was performed which rated each design on overall system cost effectiveness. GRA

N72-30026# Defense Documentation Center, Alexandria, Va.
HEAVY LIFT HELICOPTERS Report Bibliography, Oct. 1962 - Jan. 1971
Apr. 1972 56 p refs
(AD-740900; DDC-TAS-72-16-1) Avail: NTIS CSCL 01/3

The bibliography contains unclassified references on heavy lift helicopters with a minimum payload of about 9,000 pounds or a minimum gross weight of 17,000 pounds. These references relate to rotor characteristics, rotor systems, rotor loads, lift propulsion, payloads, heavy lift rotors, configurations, design, and performance capabilities of the heavy lift helicopters. Computer-generated indexes of corporate author-monitoring agency, subject, personal author, and title are included. Author (GRA)

N72-30027# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE EFFECTS OF WIND AND TEMPERATURE GRADIENTS ON SONIC BOOM CORRIDORS
R. O. Onyeonwu Oct. 1971 39 p refs
(Grant AF-AFOSR-1885-70; AF Proj. 9781)
(AD-740897; UTIAS-TN-168; AFOSR-71-3087TR) Avail: NTIS CSCL 20/1

Calculation of sonic boom corridor widths based on closed form solutions of ray acoustic equations using piecewise linear atmospheric models of winds and temperatures has been accomplished. Detailed solutions of ray tracing equations are presented for all possible variations of winds and temperatures, within the framework of the assumed model atmosphere. The effects of aircraft flight altitude and Mach number, wind and temperature gradients, and wind direction on sonic boom corridor are investigated in detail, including the effects of non-standard atmospheres such as prevail in winter months. Numerical results are presented and amply discussed. Agreement of the present calculations with published data is excellent. Author (GRA)

N72-30031*# Boeing Co., Seattle, Wash.
AN ADVANCED CONCEPT SECONDARY POWER SYSTEMS STUDY FOR AN ADVANCED TRANSPORT TECHNOLOGY AIRCRAFT Final Report
[1972] 160 p refs
(Contract NAS1-10893)
(NASA-CR-112103) Avail: NTIS HC $10.00 CSCL 10B

The application of advanced technology to the design of an integrated secondary power system for future near-sonic long-range transports was investigated. The study showed that the highest payoff is achieved by utilizing secondary power equipment that contributes to minimum cruise drag. This is best accomplished by the use of the dedicated auxiliary power unit concept (inflight APU) as the prime power source for an airplane with a body-mounted engine or by the use of the internal engine generator concept (electrical power extraction from the propulsion engine) for an airplane with a wing-pod-mounted engine. Author

N72-30168# Mitre Corp., Bedford, Mass.
TACTICAL AWACS MEASURES OF EFFECTIVENESS
C. R. Turner and J. F. Bard Apr. 1972 29 p
(Contract F19628-71-C-0002; AF Proj. 4110)
(AD-742233; MTR-2308; ESD-TR-72-142) Avail: NTIS CSCL 17/2

The purpose of this report is to establish a methodology and criteria for assessing the utility of AWACS when employed in a tactical environment. Prior analyses have often obscured the AWACS contributions to the performance of tactical air missions by directing their thrust at end-game results. The approach proposed herein is primarily directed at AWACS system level performance. Consequently, AWACS system level measures of effectiveness (MOE's) have been formulated. These MOE's have been designed to assess the contributions of AWACS when it is employed as an element of the Tactical Air Control System (TACS). In addition, MOE's have been derived to assess the effectiveness of nine generic tactical air missions which AWACS will be capable of supporting. Author (GRA)

N72-30173# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FEASIBILITY STUDY OF WHOLE AIRCRAFT AS AN APERTURE ANTENNA M.S. Thesis
Samuel R. Weaver Mar. 1972 44 p refs
(AD-742439; GE/EE/72-27) Avail: NTIS CSCL 09/5

A set of assumed conditions that must be met to realize a radar antenna that conforms to a flexible irregular shape such as an aircraft surface are given. The theory and properties of adaptive arrays are reviewed along with the properties of aperiodic arrays. The results of some experimentation is cited to support the theory. An argument is then presented that by use of adaptive array techniques and widely spaced (several wavelengths) array elements it is feasible to realize an airborne radar antenna that will conform to any desired shape. It is argued that it is feasible to determine target position by a combination of pattern computation and interferometer techniques having knowledge of the location of a relatively small number of the antenna elements. Author (GRA)

N72-30245*# Chrysler Corp., Huntsville, Ala.
AERONAUTICAL NOISE SUPPRESSION AT TRANSONIC MACH NUMBERS Final Report
George F. McCanless, Jr. 24 May 1972 34 p refs
(Contract NAS8-27503)
(NASA-CR-123810; HSM-R5-72) Avail: NTIS HC $3.75 CSCL 14B

The measurement of wind tunnel background pressure fluctuations in a Ludwig Tube is discussed. The measurements are to provide improved unsteady aerodynamic data for the design of aeronautical vehicles. The preliminary results of the facility calibration are presented. The noise generation mechanisms are discussed. The ability of conducting short duration acoustic tests is demonstrated, and amplitude and frequency data are given. Techniques of noise reduction are included. Author

N72-30247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCES IN MEASURING TECHNIQUES FOR TURBINE COOLING TEST RIGS Status Report
Frank G. Pollack 1972 20 p refs Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972
(NASA-TM-X-68100; E-7016) Avail: NTIS HC $3.00 CSCL 14B

Surface temperature distribution measurements for turbine vanes and blades were obtained by measuring the infrared energy emitted by the airfoil. The IR distribution can be related to temperature distribution by suitable calibration methods and the data presented in the form of isotherm maps. Both IR photographic and real time electro-optical methods are being investigated. The methods can be adapted to rotating as well as stationary targets, and both methods can utilize computer processing. Pressure measurements on rotating components are made with a rotating system incorporating 10 miniature transducers. A mercury wetted slip ring assembly was used to supply excitation power and as a signal transfer device. The system was successfully tested up to speeds of 9000 rpm and is now being adapted to measure rotating blade airflow quantities in a spin rig and a research engine. Author

N72-30249*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ANECHOIC CHAMBER FACILITY FOR INVESTIGATING AERODYNAMIC NOISE
P. F. Massier and S. P. Parthasarathy 15 Sep. 1972 32 p
(Contract NAS7-100)
(NASA-CR-128038; JPL-TR-32-1564) Avail: NTIS HC $3.75 CSCL 14B

The aerodynamic noise facility was designed to be used primarily for investigating the noise-generating mechanisms of high-temperature supersonic and subsonic jets. The facility consists of an anechoic chamber, an exhaust jet silencer, instrumentation equipment, and an air heater with associated fuel and cooling systems. Compressed air, when needed for jet noise studies, is provided by the wind tunnel compressor facility on a continuous basis. The chamber is 8.1 m long, 5.0 m wide, and 3.0 m high. Provisions have been made for allowing outside air to be drawn into the anechoic chamber in order to replenish the air that is entrained by the jet as it flows through the chamber. Also, openings are provided in the walls and in the ceiling for the purpose of acquiring optical measurements. Calibration of the chamber for noise reflections from the wall was accomplished in octave bands between 31.2 Hz and 32 kHz. Author

N72-30250*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTIMUM RUNWAY ORIENTATION RELATIVE TO CROSSWINDS
L. W. Falls and S. C. Brown Washington Sep. 1972 19 p refs
(NASA-TN-D-6930) Avail: NTIS HC #3.00 CSCL 01E

Specific magnitudes of crosswinds may exist that could be constraints to the success of an aircraft mission such as the landing of the proposed space shuttle. A method is required to determine the orientation or azimuth of the proposed runway which will minimize the probability of certain critical crosswinds. Two procedures for obtaining the optimum runway orientation relative to minimizing a specified crosswind speed are described and illustrated with examples. The empirical procedure requires only hand calculations on an ordinary wind rose. The theoretical method utilizes wind statistics computed after the bivariate normal elliptical distribution is applied to a data sample of component winds. This method requires only the assumption that the wind components are bivariate normally distributed. This assumption seems to be reasonable. Studies are currently in progress for testing wind components for bivariate normality for various stations. The close agreement between the theoretical and empirical results for the example chosen substantiates the bivariate normal assumption. Author

N72-30257# Army Construction Engineering Research Lab., Champaign, Ill.
COEFFICIENT OF LINEAR THERMAL EXPANSION OF EPOXY RESIN MORTARS Final Report
Robert F. Kemphues Apr. 1972 16 p refs
(AF Proj. 5224)
(AD-742212; CERL-TR-M-14) Avail: NTIS CSCL 01/5

Epoxy resin materials have been used since 1959 for the rapid repair of airfield pavements; some have been highly successful, others have failed. Some of the failures may be attributed to internal stress in the epoxy resin material. These stresses could be due to curing shrinkage or to the difference in coefficient of linear thermal expansion (oc sub l) between the epoxy patch and portland cement concrete. This study was undertaken to obtain information about the thermal expansion and curing shrinkage of epoxy resin mortars and concretes.
Author (GRA)

N72-30264*# Scientific Translation Service, Santa Barbara, Calif.
NUMERICAL STUDY OF THE INFLUENCE OF THE WING TIP SHAPE ON THE VORTEX SHEET ROLLING UP
C. Rehback Washington NASA Aug. 1972 6 p refs Transl. into ENGLISH from Rech. Aerosp. (Chatillion-sous-Bayneaux), 1971-1975 p 367-368
(Contract NASw-2035)
(NASA-TT-F-14538) Avail: NTIS $3.00 CSCL 20D

A computer program to analyze the wing tip vortex distribution as a function of wing tip shape is presented. The wing and the sheet are replaced by a vortex surface. The continuous vortex distribution over the surface is replaced by a discrete vortex distribution, which is a horseshoe distribution of finite magnitude and is placed over the wing only. The sheet appears in the form of a series of vortex threads which emanate as moderate incidence angles from the leading edge to the wing tip. Starting with the given initial position, the threads evolve during the course of an iteration calculation and assume equilibrium positions parallel to the average velocity over the sheet. Author

N72-30280# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CALCULATION METHOD OF THE SUPERCRITICAL FLOW OVER AN AIRFOIL IN A NOZZLE [METHODE DE CALCUL DE L'ECOULEMENT SUPERCRITIQUE SUR UN PROFIL PLACE DANS UNE TUYERE]
Pierre Labal 1972 26 p refs In FRENCH; ENGLISH summary
(ONERA-NT-189) Avail: NTIS HC $3.50

A time-dependent method is developed to compute supercritical flow over an airfoil or an axisymmetric body in a nozzle. An explicit second-order accurate difference scheme, similar to a two-step Richtmyer scheme is set up. The artificial viscosity term is made to depend upon a parameter which is a function of time and spatial variables. Transformed spatial variables are used in order to increase the mesh points in the vicinity of the shock wave and to simplify the treatment of the boundary conditions on the airfoil. Results are presented for supercritical flows over a biconvex airfoil for various values of the specific heat ratio and of the upstream Mach number. Good agreement is found with results previously obtained using a time-dependent method, and Spreiter's transonic similarity law is verified with a very good accuracy. Author (ESRO)

N72-30284# Meteorology Research, Inc., Altadena, Calif.
TRANSPORT AND STABILITY OF A VORTEX WAKE Final Report
Ivar H. Tombach 17 Apr. 1972 74 p refs
(Contract F44620-70-C-0032; AF Proj. 9781)
(AD-742305; MRI-72-FR-1010; AFOSR-72-1159TR) Avail: NTIS CSCL 20/4

The influence of the atmospheric environment on the transport and decay of a trailing vortex wake has been studied analytically and experimentally during a two-year long research program. An analytical model describing the descending motion of an entraining wake in a stably stratified atmosphere has been developed. This model was compared with several other recent

theoretical analyses and with limited experimental observations in order to determine the validity. A flight test program was carried out in which the smoke-marked vortices behind a lightplane were observed in an atmosphere of measured turbulence and stratification. The descending motion of the wake was also measured, as was the vortex spacing during the descent. The results of these tests are compared with those of some small-scale model experiments and of some large aircraft flight tests. GRA

N72-30285# Oceanics, Inc., Plainview, N.Y.
THE VORTEX CORE JET NEAR THE POINT OF GENERATION Final Report
Theodore R. Goodman Apr. 1972 25 p refs
(Contract F44620-70-C-0106; AF Proj. 9781)
(AD-742311; Rept-72-91; AFOSR-72-1158TR) Avail: NTIS CSCL 20/4

Near the point of generation of a wing tip vortex the axial velocity in the vortex core can be considerably greater than the free stream velocity. The present analysis describes the velocity field under these circumstances and shows that a self-similar solution exists that satisfies all the boundary conditions. The resulting two-point boundary value problem is solved on a digital computer and shows qualitative agreement with experiments. Author (GRA)

N72-30291# North American Rockwell Corp., Columbus, Ohio. Aircraft Div.
EXPLORATORY INVESTIGATION OF PULSE BLOWING FOR BOUNDARY LAYER CONTROL Technical Report, Apr. 1971 - Jan. 1972
T. E. Oyler and William E. Palmer 15 Jan. 1972 84 p refs
(Contract N00014-71-C-0259; NR Proj. 215-183)
(AD-742085; NR72H-12) Avail: NTIS CSCL 20/4

Results of an experimental investigation is described to determine the feasibility of intermittent jet blowing to achieve reduced air flow rates as compared with steady blowing for prevention or delay of flow separation on a trailing edge flap. The jet was directed tangential to the flap surface in a downstream direction. The results show that significant reductions in mass flow rate could be realized at a given flap lift effectiveness. Author (GRA)

N72-30300# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXPERIMENTAL STUDY OF THE EFFECT OF FLAP SETBACK AND GAS TEMPERATURE ON THE LIFT OF A JET DEFLECTION FLAP M.S. Thesis
Harold M. Stewart Mar. 1972 93 p refs
(AD-741583; GAM/ME/72-6) Avail: NTIS CSCL 20/4

An investigation was conducted on the effect of setback, combined with elevated gas temperatures, on Coanda attachment to a curved plate. The tests used a rectangular convergent nozzle. Chamber temperatures ranged from ambient to 1100 F. Turning efficiency and surface pressure distribution were analyzed. Air flow patterns over a flap on a 1/6th scale propulsive wing model were analyzed. Nonuniform air flow is discussed with regard to flow separation. Author (GRA)

N72-30418# ARO, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC TESTING OF WING SECTIONS USING THE LASER DOPPLER VELOCIMETER Final Report, 19 Aug. 1970 - 30 May 1971
R. L. Parker AEDC Apr. 1972 32 p refs
(Contract F40600-72-C-0003; AF Proj. 8219)
(AD-740901; AEDC-TR-71-264) Avail: NTIS CSCL 14/2

An experimental program was conducted in the wind tunnel to ascertain velocity distribution about a wing section at various angles of attack using a laser Doppler velocimeter (LDV) and conventional pressure measuring techniques. In addition, an analytical method was developed to determine the pressure distribution over an arbitrary airfoil surface given the geometry and coefficient of lift. The results of the different measurement techniques are compared with the analytical computations. Agreement between experimental data and fluid flow theory was obtained. GRA

N72-30419# Ballistic Research Labs., Aberdeen Proving Ground, Md.
LASER DOPPLER SHIFT VELOCIMETER
Faustin N. Weber, Jr. Apr. 1972 25 p refs
(AD-740652; BRL-MR-2178) Avail: NTIS CSCL 14/2

Two different schemes for the laser doppler velocimeter are described and theoretically analyzed, a modified Mach-Zehnder velocimeter, and a modified Rayleigh velocimeter. Preliminary results obtained for the first scheme are shown and rather extensive results for the second scheme are presented. This latter method is shown to be capable under rather controlled conditions of obtaining speeds to well within 1%. Finally some results of a literature study concerning the use of laser doppler velocimetry as applied to the determination of the speed of wind tunnel flows are given. Author (GRA)

N72-30420# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SELECTION OF OPTIMUM EXPOSURE AND ITS AUTOMATIC ADJUSTMENT DURING AIR PHOTOGRAPHY
A. I. Sizov 11 Feb. 1972 13 p refs Transl. into ENGLISH from ZH. Nauchn. i Prikl. Fotogr. i Kinematogr. (Moscow), v. 15, no. 6, 1970 p 401-405
(AF Proj. 6220)
(AD-740196; FTD-MT-24-1598-71) Avail: NTIS CSCL 14/5

Consideration is shown of an approach to light sensitivity criteria from the standpoint of the selection of an exposure which makes it possible to obtain the maximum number of fine details on an aerial photo. A number of methods of programmed and automatic exposure control are considered, and estimates are made of their errors. Among the methods considered are a *method of control according to integral brightness, a method of* control according to minimum brightness, an integral method involving the selection of a video brightness signal according to the signal level, and an integral method involving the selection of a video brightness signal according to the level of the brightness coefficient. Author (GRA)

N72-30438# Mechanical Technology, Inc., Latham, N.Y.
APPLICATION OF NEW AND IMPROVED SOLID LUBRICANT MATERIALS AND PROCESSES TO NAVAL AIRCRAFT. EMPHASIZING REDUCED MAINTENANCE AND IMPROVED RELIABILITY
M. B. Peterson and E. F. Finkin 14 Jul. 1971 145 p refs
(Contract N62269-71-C-0177)
(AD-740825; MTI-71TR48) Avail: NTIS CSCL 11/8

The overall objective of the program was to help to extend the aircraft operating interval between rework and maintenance actions and savings of aircraft rework hours. The program goal was to improve the performance of current solid lubricant materials and processes, via several ways: Substitution of new and improved materials and processes, introduction of solid lubricants to new applications where they could be advantageously used, and simplification or elimination of unneeded processing steps. Formal recommendations were formulated and are contained in this report. Author (GRA)

N72-30471*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVIEW OF STATUS AND POTENTIAL OF TUNGSTEN-WIRE: SUPERALLOY COMPOSITES FOR ADVANCED GAS TURBINE ENGINE BLADES

Robert A. Signorelli Washington Sep. 1972 23 p refs
(NASA-TM-X-2599; E-7020) Avail: NTIS HC $3.00 CSCL 11F

The current status of development of refractory-wire-superalloy composites and the potential for their application to turbine blades in land-based power generation and advanced aircraft engines are reviewed. The data indicate that refractory-wire-superalloy composites have application as turbine blades at temperatures of 2200 F and above. Author

N72-30551*# Techtran Corp., Glen Burnie, Md.
METEOROLOGICAL FLIGHT CONDITIONS FOR SUPERSONIC AIRCRAFT
I. G. Pchelko, N. V. Peterenko, and G. S. Buldovskiy Washington NASA Jul. 1972 184 p refs Transl. into ENGLISH of the publ. "Meteorologicheskiye Usloviya Poletov Sverkhzvukovykh Samoletov" Leningrad, Hydrometeorol. Press, 1970
(Contract NASw-2037)
(NASA-TT-F-693) Avail: NTIS HC $3.00 CSCL 04B

The composition and structure of the atmosphere are described in terms of the flight medium affecting the performance of aircraft. Emphasis is placed on certain important features of meteorological conditions in the troposphere and stratosphere. Seasonal pecularities of atmospheric circulation in the stratosphere are described. Interaction between stratospheric and atmospheric processes is analyzed. Meteorological phenomena and meteorological elements at all stages of supersonic flight are discussed. The information is of interest to aeronautical meteorologists, and useful to pilots and specialists interested in meteorological flight conditions in the stratosphere. Author

N72-30559# Committee on Public Works (U. S. Senate).
REPORT TO THE PRESIDENT AND CONGRESS ON NOISE
Washington GPO Feb. 1972 472 p refs Presented by the Administrator of EPA to Comm. on Public Works, 92d Congr., 2d Sess., 1 Mar. 1972 Prepared by Environ. Protection Agency
(S-Doc-92-63) Avail: SOD $1.75

The effects of noise on living things and property, noise sources and their current environmental impact, and control technology and estimates for the future are considered. The following topics are discussed: auditory, sociological, physiological, and psychological effects; effects of noise on wildlife; effects of sonic boom and other impulsive noise on property; physical effects of noise on structures and property; community noise; transportation systems, devices powered by internal combustion engines; noise from industrial plants; construction equipment and operations; household and building noise; transportation industry programs; noise reduction for industrial plants; construction and appliance industry efforts; laws and regulatory schemes for noise abatement; government, industry, professional, and voluntary association programs; and assessement of noise concern in other nations. K.P.D.

N72-30586*# Stanford Univ., Calif. Dept. of Applied Mechanics.
IMPROVED NAVIGATION BY COMBINING VOR/DME INFORMATION WITH AIR OR INERTIAL DATA
John C. Bobick and Arthur E. Bryson, Jr. May 1972 156 p refs Sponsored in part by NSF
(Grant NGL-05-020-007; Contract F33615-72-C-1297)
(NASA-CR-124826; SUDAAR-442) Avail: NTIS HC $10.00 CSCL 17G

The improvement was determined in navigational accuracy obtainable by combining VOR/DME information (from one or two stations) with air data (airspeed and heading) or with data from an inertial navigation system (INS) by means of a maximum-likelihood filter. It was found that the addition of air data to the information from one VOR/DME station reduces the RMS position error by a factor of about 2, whereas the addition of inertial data from a low-quality INS reduces the RMS position error by a factor of about 3. The use of information from two VOR/DME stations with air or inertial data yields large factors of improvement in RMS position accuracy over the use of a single VOR/DME station, roughly 15 to 20 for the air-data case and 25 to 35 for the inertial-data case. As far as position accuracy is concerned, at most one VOR station need be used. When continuously updating an INS with VOR/DME information, 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. Author

N72-30587# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PARALLEL APPROACH SURVEILLANCE
J. B. Allen and E. J. Denlinger 14 Aug. 1972 57 p refs
(Contract DOT-FA72WAI-261; FAA Proj. 034-241-012)
(ATC-13; FAA-RD-72-77) Avail: NTIS HC $5.00

The requirements imposed on a surveillance system for supporting independent approaches to closely spaced parallel runways are presented. Based on a proposed procedure for monitoring aircraft approach paths and controlling deviations from proper approach paths, the required spacing between runway centerlines is derived as a function of surveillance system characteristics and other parameters. Potential trade-offs between the surveillance system characteristics are then investigated to determine whether the discrete address beacon (DABS) sensor might be utilized for position measurement and/or communication in such a surveillance system. The results indicate that the required runway spacing is more sensitive to delays and data update intervals than to position measurement accuracies, and that, if DABS is to perform the communication function in the system, it should probably be used for position measurement as well. Author

N72-30589# National Aviation Facilities Experimental Center, Atlantic City, N.J.
AN EVALUATION OF POTENTIAL REFLECTION PROBLEMS WHEN USING THE NAS MODEL 3D DISPLAY IN THE VERTICAL POSITION IN AIR ROUTE TRAFFIC CONTROL CENTERS Interim Report, Dec. 1971 - May 1972
Lee E. Paul Sep. 1972 26 p
(FAA-RD-72-60) Avail: NTIS HC $3.50

A production version of a plan view display was taken to traffic control centers and operated in a sector radar position. A typical digital sector display was simulated through the use of a Raytheon 704 computer and tape drive. A total of 166 controllers observed the display and filled out questionnaires on it, 118 seeing the display with the safety shield in place, 48 seeing it with shield removed. Ambient light level measurements were made at each of the centers. A small percentage of the controllers stated that reflections were a serious problem when the safety shield was in place. With the shield removed, a significantly smaller number indicated a reflection problem. There were very large differences in the ambient light levels at the centers. Author

N72-30591# Ohio Univ., Athens. Dept. of Electrical Engineering.
ALL WEATHER, LOW LEVEL NAVIGATION AND IMPLEMENTATION OF A ONE-WAY RANGING, RANGE-RANGE NAVIGATION SYSTEM Semiannual Report, Apr. - Oct. 1971
Feb. 1972 65 p refs
(Contracts DAAB07-68-C-0084; DAAB07-71-c-0156)
(AD-741813; ECOM-0084-4; SAR-4) Avail: NTIS CSCL 17/7

A third-generation RF receiver for navigation uses was designed using digitally-tuned superheterodyne techniques. This approach allows more flexibility and stability in tuning and reduced harmonic and crossmodulation distortion providing greater spectral purity of the output waveform. Four approaches are under investigation leading to an optimized state-of-the-art dedicated digital processor whose architecture is structured specifically for navigation tasks. A rate-gyro stabilized flight director was also designed, simulated, and implemented onboard the DC-3 Flying Laboratory and successfully provided anticipatory command information to the pilot for a stored-route flight plan. Flight experiments with the breadboard system have demonstrated

position location accuracies of better than 200 feet, for one standard deviation, for 11 independent flights. Investigation of autocorrelation signal processing techniques for elimination of the onboard clock requirement shows that delay-line stabilities of the order of plus or minus 100 picoseconds for range errors of plus or minus 10 feet are required and presently not technically feasible. Author (GRA)

N72-30592# Department of Transportation, Washington, D.C.
DEPARTMENT OF TRANSPORTATION NATIONAL PLAN FOR NAVIGATION
Apr. 1972 35 p
(AD-741944) Avail: NTIS CSCL 17/7

A plan for the operation, development and implementation of existing and possible future navigation systems for civil aviation and maritime requirements is presented. Areas of air and marine commonality are discussed with the objective of minimizing the number of radio navigation aids. Specific Federal Aviation Administration and Coast Guard programs for research and development of navigation systems, and an operating plan into the 1980's are described. Special emphasis is placed on long distance air navigation and high seas marine navigation. Typical of navigation systems considered are Inertial, Loran, Omega and Satellite. New statements of policy in regard to long distance navigation aids are proposed to replace the current U. S. policy adopted by the Air Coordinating Committee on 23 December 1958. User charges based on Public Law 91-250 are summarized. Author (GRA)

N72-30593# Avco Corp., Wilmington, Mass. Systems Div.
SKYWAY PATHS BY DOPPLER FREQUENCY ANALYSIS (SKYDOP), PHASE 1
David G. Detert, Alan H. Katz, and Andrew S. Weeks Griffiss AFB, N. Y. RADC Mar. 1972 170 p refs
(Contract F30602-70-C-0123)
(AD-741807; RADC-TR-72-62) Avail: NTIS CSCL 17/3

An evaluation of a new experimental direction finding technique known as Doppler monopulse is described. An evaluation of experimental field data is made concerning the percent of time the technique would be effective with respect to ionospheric propagation. Consideration is given to the effects of signal modulation. Author (GRA)

N72-30596# Coast Guard, Washington, D.C. Applied Sciences Div.
TESTS OF AIRCRAFT NAVIGATION FOR SMALL AREA MAPPING USING MINIMUM LOCAL AIDS TO NAVIGATION Final Report
James A. McIntosh Apr. 1972 34 p refs Tests held at Natl. Aviation Facilities Exptl. Center, Atlantic City, 9 Sep. 1971
(Contract DOT-CG-20738-B; MIPR Z-70099-2-21107; CG Proj. 726417)
(AD-740607) Avail: NTIS CSCL 17/7

A U. S. Coast Guard HC-130B aircraft was flown on a parallel track pattern while within range of a high accuracy tracking radar, and the navigational performance of the aircraft while using only certain specified aids was observed. The aids used were LF and UHF radiobeacons, the aircraft's Doppler radar, a transponder for the aircraft's search radar, and an inertial guidance system. Author (GRA)

N72-30597# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PRECISION AIRCRAFT NAVIGATION BASED ON LORAN-C AND DIGITAL ALTIMETRY
L. F. Fehlner Jan. 1972 72 p refs
(Contract N00017-72-C-4401)
(AD-740894; APL-TG-1184) Avail: NTIS CSCL 17/7

The report describes a system that can provide precision aircraft navigation based on loran-C and digital barometric altimetry. The system is expected to be capable of fulfilling the critical accuracy requirements of the terminal area as well as serving the needs of area navigation. A digital barometric altimetry technique is described, which has sufficient accuracy to provide the third dimension for all phases of aircraft flight. Further, several auxiliary functions are described that are made practicable by high-accuracy positioning. These are: on-board determination of the point to release an object for free fall to the ground, a built-in approach and departure system, and automatic direction finding. Author (GRA)

N72-30604# Wyle Labs., Inc., El Segundo, Calif.
COMMUNITY NOISE
31 Dec. 1971 204 p refs
(Contract EPA-68-04-0046)
(NTID300.3) Avail: SOD $1.75

The overall noise pollution problem which is associated with outdoor noise in a community is considered. Provided is a quantitative framework for understanding the nature of the outdoor noise environment and the reaction of people and community to its various aspects. Author

N72-30607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMISSION OF SOUND FROM AXISYMMETRIC TURBULENCE CONVECTED BY A MEAN FLOW WITH APPLICATION TO JET NOISE
Marvin E. Goldstein and Burt M. Rosenbaum Washington Sep. 1972 42 p refs
(NASA-TN-D-6939; E-6844) Avail: NTIS HC $3.00 CSCL 20A

A model, based on Lighthill's theory, for predicting aerodynamic noise from a turbulent shear flow is developed. This model is a generalization of the one developed by Ribner. Unlike Ribner's model, it does not require that the turbulent correlations factor into space and time-dependent parts. It replaces his assumption of isotropic. turbulence by the more realistic one of axisymmetric turbulence. The implications of the model for jet noise are discussed. Author

N72-30611# Pennsylvania State Univ., University Park. Ordnance Research Lab.
AN ACOUSTIC ARRAY MODEL FOR THE COMPUTATION OF THE ROTATIONAL NOISE OF A LIFTING ROTOR
John A. Macaluso 1 Feb. 1971 37 p refs
(Contract N00017-70-C-1407; NR Proj. 215-015)
(AD-740816; TR-1-71) Avail: NTIS CSCL 20/1

A description is given of the development and corroboration of a simplified computational model for the prediction of the radiated rotational noise of a lifting rotor or propeller. The method is based on a solution of the concentrated force-excited wave equation and the identification of the terms in this solution with annular distributions of monopole sources of specified phase and amplitude. The computational algorithms developed from this mathematical model provide a rapid means for determining the amplitude and phase of the radiated sound field. They are particularly well suited for providing a description of rotor noise characteristics, which can be used as input to computer programs designed to calculate the rotor noise field in the presence of boundaries. Author (GRA)

N72-30769# National Aviation Facilities Experimental Center, Atlantic City, N.J.
PERFORMANCE OF A DC-9 AIRCRAFT LIQUID NITROGEN FUEL TANK INERTING SYSTEM Final Report, Apr. 1971 - Mar. 1972
E. P. Klueg, W. C. McAdoo, and W. F. Neese May 1972 75 p refs
(FAA Proj. 184-733-01X)
(FAA-RD-72-53; FAA-NA-72-38) Avail: NTIS HC $5.75

Nitrogen inerting protection for the fuel systems in commercial aircraft has been proposed to reduce fire and

explosion hazards associated with refueling, electrical and mechanical failures, engine failures, in-flight fires, lightning strikes, and survivable crashes. A liquid nitrogen fuel tank inerting system was developed and installed on a DC-9 aircraft. Instrumentation equipment and measurement techniques for evaluating the installed fuel tank inerting system performance were developed. A flight test program was conducted to demonstrate compliance of the DC-9 inerting system with applicable airworthiness standards, to evaluate oxygen concentration measurement techniques, and to verify that the installed inerting system maintained an explosion safe mixture in the fuel tanks over the entire flight envelope. Oxygen concentrations at various locations of the ullage and vent systems and the operating characteristics of the inerting system were determined during the flight test program. The inerting system was determined to be capable of maintaining a mixture in the fuel system vents and tank vapor spaces having a volumetric oxygen concentration less than 8 percent under all normal and emergency flight conditions. Author

N72-30774*# Pratt and Whitney Aircraft, East Hartford, Conn.
HIGH-LOADING, 1800 FT/SEC TIP SPEED TRANSONIC COMPRESSOR FAN STAGE. 1: AERODYNAMIC AND MECHANICAL DESIGN
A. L. Morris, J. E. Halle, and E. Kennedy Sep. 1972 115 p refs
(Contract NAS3-13493)
(NASA-CR-120907; PWA-4534) Avail: NTIS HC $7.75 CSCL 21E

A single stage fan with a tip speed of 1800 ft/sec (548.6 m/sec) and hub/tip ratio of 0.5 was designed to produce a pressure ratio of 2.285:1 with an adiabatic efficiency of 84.0%. The design flow per inlet annulus area is 38.7 lbm/sq ft-sec (188.9KG/sqm-sec). Rotor blades have modified multiple-circular-arc and precompression airfoil sections. The stator vanes have multiple-circular-arc airfoil sections. Author

N72-30775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA QUIET ENGINES
Carl C. Ciepluch [1972] 18 p refs Presented at INTER-NOISE 72, Washington, D. C., 4-6 Oct. 1972; sponsored by Inst. of Noise Control Eng.
(NASA-TM-X-68121; E-7086) Avail: NTIS HC $3.00 CSCL 21A

Efforts to develop an engine noise reduction technology suitable for use on subsonic and conventional takeoff and landing type aircraft are reported. Two baseline quiet engines were developed and tested. The engines were designed with the following quiet features: (1) high bypass ratio engine, (2) large rotor-stator spacing of rotor chords, (3) reduced rotor tip speeds, (4) sound absorbing liners in inlet-outlet ducts, and (5) an optimum ratio from stator to rotor blades. Test results show that if these features are applied to future aircraft, substantial reduction in aircraft noise levels will be obtained. E.H.W.

N72-30776*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON-THE-SHAFT DATA SYSTEMS FOR ROTATING ENGINE COMPONENTS
Daniel J. Lesco, John C. Sturman, and William C. Nieberding 1972 23 p ref Presented at Symp. on Instrumentation for Airbreathing Propulsion, Monterey, Calif., 19-21 Sep. 1972
(NASA-TM-X-68112; E-7053) Avail: NTIS HC $3.25 CSCL 21A

Two rotating data systems for engine component testing which demonstrate the techniques of on-the-shaft microelectronic signal conditioning and rotary transformer power- and data-transfer are described. (1) A digital data system provides 69 channels of 1100 C maximum thermocouple data with less than 0.5 percent error from a turbine test rig rotating at speeds up to 9000 rpm. (2) An analog data system amplifies and transfers 72 channels of dynamic strain data with less than 5 percent error from a compressor rig at speeds above 14,000 rpm. Author

N72-30777*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEA-LEVEL EVALUATION OF DIGITALLY IMPLEMENTED TURBOJET ENGINE CONTROL FUNCTIONS
Dale J. Arpasi, David S. Cwynar, and Robert E. Wallhagen Washington Sep. 1972 28 p refs
(NASA-TN-D-6936; E-6977) Avail: NTIS HC $3.00 CSCL 21E

The standard hydromechanical control system of a turbojet engine was replaced with a digital control system that implemented the same control laws. A detailed discussion of the digital control system in use with the engine is presented. The engine was operated in a sea-level test stand. The effects of control update interval are defined, and a method for extending this interval by using digital compensation is discussed. Author

N72-30778*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROPULSION TECHNOLOGY FOR AN ADVANCED SUBSONIC TRANSPORT
Milton A. Beheim, Robert J. Antl, and John H. Povolny Washington Sep. 1972 20 p refs
(NASA-TM-X-2625; E-6913) Avail: NTIS HC $3.00 CSCL 21A

Engine design studies for future subsonic commercial transport aircraft were conducted in parallel with airframe studies. These studies surveyed a broad distribution of design variables, including aircraft configuration, payload, range, and speed, with particular emphasis on reducing noise and exhaust emissions without severe economic and performance penalties. The results indicated that an engine for an advanced transport would be similar to the currently emerging turbofan engines. Application of current technology in the areas of noise suppression and combustors imposed severe performance and economic penalties. Author

N72-30779# Joint Publications Research Service, Arlington, Va.
AVIATION GAS-TURBINE ENGINES IN POWER ENGINEERING
S. N. Uvarov 24 Jul. 1972 28 p Transl. into ENGLISH from the Publ. "Aviatsionnye Gazoturbinnyye Dvigateli v Energetike" Leningrad, Energiya, 23 Jul. 1971 p 5-25
(JPRS-56581) Avail: NTIS HC $3.50

A basic design description is presented for gas turbine engines and gas turbogenerators. Their specifications and use in aircraft are also discussed. Author

N72-30783# Naval Air Propulsion Test Center, Trenton, N.J. Aeronautical Turbine Dept.
DERIVATION AND EVALUATION OF A RADIAL INLET PRESSURE DISTORTION INDEX Final Technical Report
Donald F. Brunda and Joseph F. Boytos Apr. 1972 48 p refs
(AD-742446; NAPTC-ATD-216) Avail: NTIS CSCL 21/5

A generalized, steady-state, radial inlet pressure distortion index (Kr) was derived theoretically, and evaluated by full-scale tests on a J52-P-8A turbojet engine. Test data at stall for one-per-span hub-radial and tip-radial distortion was generalized with the derived distortion index Kr as a function of low compressor rotor speed and corrected average radius ratio. At each corrected rotor speed, the Kr defines the distortion tolerance of the compressor, regardless of the radial position, or extent, of the distortion. Author (GRA)

N72-30784# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
RESEARCH ON THE FLUTTER OF AXIAL-TURBOMACHINE BLADING

Fernando Sisto and Ron Ho Ni May 1972 42 p refs
(Contract N00014-67-A-0202-0016; NR Proj. 094-363)
(AD-742458; ME-RT-72005) Avail: NTIS CSCL 10/1

Theoretical and experimental phases of a program to study flutter in turbomachinery blading are summarized. A general analytical method for predicting the aerodynamic characteristics of partly stalled airfoil is introduced and it agrees with experimental results. The effect of location of rotation axis on quasistatic aerodynamic moment is displayed and generalized conclusions are drawn. Author

N72-30946*# North American Rockwell Corp., Downey, Calif. Space Div.
LOW-COST FABRICATION AND DIRECT BOND INSTALLATION OF FLAT, SINGLE-CURVATURE AND COMPOUND-CURVATURE ABLATIVE HEAT SHIELD PANELS
L. B. Norwood Jun. 1972 81 p refs
(Contract NAS1-10708)
(NASA-CR-112109; SD-72-SH-0086) Avail: NTIS HC $6.25 CSCL 20M

Procedures for low cost fabrication and direct bond installation of flat, single curved, and compound curvature ablative heat shields on a DC-3 aircraft are discussed. The panel sizes and attachment locations are identified. In addition to the bonding of the four contoured panels, two flat panels were bonded to the nearly flat, lower surface of the center wing section. The detailed requirements and objectives of the investigation are described. Author

N72-30964# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
MECHANISM OF MIXING OF TWO NONREACTING GASES
Paul James Ortwerth Oct. 1971 134 p refs
(AF Proj. 3012)
(AD-740909; AFAPL-TR-71-18) Avail: NTIS CSCL 21/5

The turbulence phenomena associated with the mixing of fuel and air in a supersonic combustion ramjet are studied. The turbulence generated by coaxial and normal jet fuel injection is studied by analyzing a control volume in which fuel and air are mixed. These two modes of fuel injection are examined for various initial conditions in order to compare their respective characteristics and determine the design advantages of each mode. Experimental results from a compressible turbulent shear flow experiment, the decay of a supersonic free jet, having important theoretical implications and are used in formulating a new theoretical model for turbulent shear flow. GRA

N72-30970# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT PRELIMINARY REPORT: NORTH CENTRAL AIRLINES, INCORPORATED/AIR WISCONSIN, INCORPORATED CV-580, N90858/DHC-6, N4043B MIDAIR COLLISION NEAR APPLETON, WISCONSIN, 29 JUNE 1972
16 Aug. 1972 7 p
(SA-433) Avail: NTIS HC $3.00

The midair collision of a Convair 580 and a DHC-6 over Lake Winnebago, Wisconsin on 29 June 1972 is reported. The wreckage of both aircraft fell into the lake and all persons involved were fatalities. The report is preliminary in nature pending final decision by the National Transportation safety Board. P.N.F.

N72-30978# Civil Aeronautics Board, Washington, D.C.
REMARKS BY THE HONORABLE ROBERT T. MURPHY, MEMBER, CIVIL AERONAUTICS BOARD BEFORE THE INTERNATIONAL AVIATION CLUB, WASHINGTON, D. C., 21 MARCH 1972
Robert T. Murphy 21 Mar. 1972 11 p
Avail: NTIS HC $3.00

The problems encountered by the aviation industry in international air transportation service and methods for solving them are discussed. Particular attention was given to charter regulations and illegal charter services. E.H.W.

N72-30979# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN CIVIL AERONAUTICS BOARD BEFORE THE ROYAL AERONAUTICAL SOCIETY, LONDON, UNITED KINGDOM, 13 MARCH 1972
Secor D. Browne 1972 14 p
Avail: NTIS HC $3.00

Nonscheduled transatlantic air services and their problems are discussed. Data cover (1) types of charter and charter rules, (2) uncertainties of flight approval, (3) influence of charter service on regular scheduled service, and (4) charter abuses. E.H.W.

N72-30981# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[AEROSPACE ACTIVITIES] Annual report, 1971
1972 177 p In FRENCH
Avail: NTIS HC $11.00

Activities carried out during 1971 in the systems, aerodynamics, wind tunnel structures, energetics, physics, materials, and computer departments of ONERA are briefly described. A list is given of ONERA patents applied for during 1971. ESRO

N72-30986# Cubic Corp., San Diego, Calif.
ACMR SYSTEM SIMULATION. VOLUME 1: SIMULATION PROGRAM DESCRIPTION Final Technical Report
20 Dec. 1971 563 p refs 2 Vol.
(Contract N00019-71-C-0429)
(AD-741194; FTR/525-1-Vol-1) Avail: NTIS CSCL 15/7

The two-volume document comprises the final technical report on the ACMR (Air Combat Maneuvering Range) System Simulation, and is submitted in compliance with Attachment 5, Contract N00019-71-C-0429. Volume 1 provides general, technical, and physical descriptions of the system simulation program, and Volume 2 consists primarily of computer output representing the results of the simulation. The simulation program described in this report has been developed to aid in the system performance analysis of the Air Combat Maneuvering Range tracking and display hardware which is presently undergoing development. Author (GRA)

N72-30987# Cubic Corp., San Diego, Calif.
ACMR SYSTEM SIMULATION. VOLUME 2: SIMULATION TEST RESULTS Final Technical Report
7 Mar. 1972 546 p 2 Vol.
(Contract N00019-71-C-0429)
(AD-741195; FTR/525-1-Vol-2) Avail: NTIS CSCL 15/7

The purpose of this volume, the second in the ACMR system simulation series, is to document the quantitative results of the ACMR System Simulation, as introduced and described in Volume I of this report. The results presented herein represent the entire ACMR instrumentation system as defined by the AIS, TIS, and CCS subsystems. Author (GRA)

N72-30992*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC EFFECTS OF LEADING-EDGE SERRATIONS ON A TWO-DIMENSIONAL AIRFOIL
Paul T. Soderman Washington Sep. 1972 39 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-2643; A-3706) Avail: NTIS HC $3.00 CSCL 01A

An investigation was conducted to determine the flow field and aerodynamic effects of leading-edge serrations on a two-dimensional airfoil at a Mach number of 0.13. The model was a NACA 66-012 airfoil section with a 0.76 m (30 in.) chord, 1.02 m (40 in.) span, and floor and end plates. It was mounted in the Ames 7- by 10-Foot Wind Tunnel. Serrated brass strips of various sizes and shapes were attached to the model in the region of the leading edge. Force and moment data, and photographs of tuft patterns and of oil flow patterns are presented. Results indicated that the smaller serrations, when properly placed on the airfoil, created vortices that increased maximum lift and angle of attack for maximum lift. The drag of the airfoil was not increased by these serrations at airfoil angles of attack near zero and was decreased at large angles of attack. Important parameters were serration size, position on the airfoil, and spacing between serrations. Author

N72-30993# Technische Univ., Berlin (West Germany).
CONTRIBUTION TO VIBRATION CALCULATIONS ON POINTED ARROW WINGS Ph.D. Thesis [EIN BEITRAG ZUR SCHWINGUNGSRECHNUNG VON ZUGESPITZEN PFEILFUEGELN]
K. Diethart Collmann 1971 86 p refs In GERMAN
Avail: NTIS HC $6.50

Linear elastic theory is used to calculate eigenforms and oscillating frequencies of pointed arrow wings. Considered are only airfoils with parallel reinforcing ribs. The program develops stability matrices, reduces these matrices to the format of oscillation calculations and integration by the same coding procedures and determines eigenvalues and eigenvectors with the Q-R procedure or iterative deflation. Arrow wing coordinates are used to develop the stability matrix expressing rib direction.
Transl. by G.G.

N72-30994# National Physical Lab., Teddington (England). Aerodynamics Div.
THE THEORETICAL TREATMENT OF SLOWLY OSCILLATING PART-SPAN CONTROL SURFACES IN SUBSONIC FLOW
H. C. Garner and Doris E. Lehrian London Aeron. Res. Council 1971 101 p refs Supersedes NPL-AERO-1303; ARC-31490; (ARC-R/M-3676; NPL-AERO-1303; ARC-31490) Avail: NTIS HC $7.25; HMSO £2.60; PHI $10.20

Chordwise and spanwise equivalent slopes are combined to give smooth equivalent incidences in place of discontinuities at the hinge and part-span boundaries of trailing-edge controls. Wing forces, hinge moments and their spanwise distributions are calculated to first order in frequency for four planforms. Theoretical accuracy is analyzed for ranges of control chord, control span and Mach number. Comparisons with measured hinge moments are made, and a simple empirical correction to damping is suggested. Author (ESRO)

N72-30996# Royal Aircraft Establishment, Bedford (England). Aerodynamics/Flight Dept.
THEORETICAL ASSESSMENT OF THE GENERAL STABILITY AND GUST RESPONSE CHARACTERISTICS OF STOL AIRCRAFT
W. J. G. Pinsker London Aeron. Res. Council Feb. 1971 83 p refs Supersedes RAE-TR-71028; ARC-32844
(ARC-R/M-3686; RAE-TR-71028; ARC-32844) Avail: NTIS HC $6.25; HMSO £2.92; PHI $11.55

Results are presented of theoretical studies into the likely stability and gust response characteristics of four distinct classes of STOL aircraft, namely those using low wing loading and high C sub L max alone, partly jet-borne configurations, aircraft using jet-flap-type wing-lift augmentation, and designs exploiting propeller slipstream. The areas considered are gust sensitivity, cross-wind control, dynamic response to gusts, speed stability, stability in flight under attitude constraint and dynamic longitudinal and lateral stability with fixed controls. Author (ESRO)

N72-30997# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
THE MEASUREMENT OF GROUND EFFECT USING A FIXED GROUND BOARD IN A WIND TUNNEL
L. F. East London Aeron. Res. Council 1972 57 p refs Supersedes RAE-TR-70123; ARC-32633
(ARC-R/M-3689; RAE-TR-70123; ARC-32633) Avail: NTIS HC $5.00; HMSO £2.10; PHI $8.20

An experimental and theoretical investigation is made of the method of determining the effect of ground proximity in a wind tunnel using a fixed board to represent the ground. The influence which the boundary layer on the fixed ground board has on the flow about the model has been determined from overall force measurements on three models of aspect ratios 1.6, 3 and 8 and the two-dimensional configuration has been solved theoretically. These measurements and calculations show that the boundary layer influence is most significant at the lower aspect ratios and for these configurations an experimental procedure is proposed which enables this influence upon the data to be eliminated. The form of the three-dimensional boundary layer which grows on a fixed ground board beneath a low aspect ratio model is discussed and the reason for its influence upon the explained. A brief discussion of the form of the three-dimensional boundary layer which will grow on a runway as an aircraft passes by is given and the case of infinite aspect ratio (two-dimensional flow) has been analyzed theoretically. Author (ESRO)

N72-30998# Royal Aircraft Establishment, Farnborough (England).
A STUDY OF DYNAMIC AEROELASTIC EFFECTS ON THE STABILITY CONTROL AND GUST RESPONSE OF A SLENDER DELTA AIRCRAFT
E. G. Broadbent, J. K. Zbrozek (Sheffield Univ., Engl.), and E. Huntley London Aeron. Res. Council 1972 57 p refs Supersedes ARC-32779
(ARC-R/M-3690; ARC-32779) Avail: NTIS HC $5.00; HMSO £2.10; PHI $8.20

Four theoretical investigations relating to a specific configuration are combined. Instability of the short period mode, as aircraft stiffness is reduced, is investigated from different points of view and implications with regard to aircraft controllability are worked out. Bending responses of the aircraft to discrete gusts are evaluated using the previously established mathematical model. Author (ESRO)

N72-30999# Aeronautical Research Council, London (England).
CALCULATIONS OF THE FLOW OVER THICK, CONICAL, SLENDER WINGS WITH LEADING-EDGE SEPARATION
J. H. B. Smith 1972 69 p refs Supersedes RAE-TR-71057; ARC-33024
(ARC-R/M-3694; RAE-TR-71057; ARC-33024) Avail: NTIS HC $5.50; HMSO £2.40; PHI $9.40

The vortex-sheet model of leading-edge separation previously applied to flat-plate delta wings has been applied to thick delta wings in the form of rhombic cones. The simplifications introduced by the use of slender-body theory and an asymptotic treatment for the core of the vortex have been retained. The results show that the vortex sheet leaves the wing tangentially to the lower surface. The calculations reproduce the observed trends with increasing thickness: the vortex core moves upwards and outwards and the circulation and both the linear and non-linear parts of the lift fall off. The quantitative agreement between theory and experiment worsens somewhat as the thickness increases, probably indicating an increase in the influence of the secondary separation. Author (ESRO)

N72-31001# British Aircraft Corp., Preston (England). Flight Simulation Section.
A FLIGHT SIMULATOR INVESTIGATION OF THE EFFECT OF TURBULENCE ON ROLLING REQUIREMENTS AT LOW SPEED

A. G. Barnes and N. A. Parsons London Aeron. Res. Council 1972 42 p refs Supersedes ARC-33046
(ARC-R/M-3697; ARC-33046) Avail: NTIS HC $4.25; HMSO £1.55; PHI $6.25

A moving base simulator investigation of the rolling requirements in turbulence of an aircraft on the landing approach is described. A typical swept fighter type aircraft was simulated and pilot opinions were obtained for differing values of the maximum rolling acceleration for full aileron and for differing levels of turbulence. Known aircraft were also simulated for comparison with the results of the parametric study.
Author (ESRO)

N72-31002# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
THE EFFECT OF RIDGE EXCRESCENCES AND TRAILING-EDGE CONTROL GAPS ON TWO-DIMENSIONAL AEROFOIL CHARACTERISTICS
T. A. Cook London Aeron. Res. Council 1972 42 p refs Supersedes RAE-TR-71080; ARC-33194
(ARC-R/M-3698; RAE-TR-71080; ARC-33194) Avail: NTIS HC $4.25; HMSO £1.55; PHI $6.25

Wind tunnel measurements of the effects on two-dimensional section characteristics of square ridge excrescences and of some gaps typical of those found around trailing-edge controls have been made at high subsonic Mach number and at Reynolds numbers up to 15.6 million based on section chord length. The incremental drag due to a square ridge was found to be generally underestimated by applying an estimated magnification factor to flat-plate measurements. Trailing-edge control gaps affected lift and pitching moment characteristics of the aerofoil as well as drag. A tentative correlation of the measurements of drag due to spanwise gaps is suggested. Author (ESRO)

N72-31003# Aeronautical Research Council, London (England).
AN INVESTIGATION OF TRANSITION FIXING TECHNIQUE FOR A 10.5% THICK, 28 DEG SWEPTBACK WING AT HIGH SUBSONIC SPEEDS AND R APPROXIMATELY 3 MILLION
P. G. Hutton 1972 58 p refs Supersedes ARC-32220; ARA-16
(ARC-CP-1215; ARC-32220; ARA-16) Avail: NTIS HC $5.00; HMSO 95p; PHI $3.90

Forces and pressures on a wing of modern design with upper surface transition free or fixed by alternative roughness bands are given. Development of separated flow and shock positions were very sensitive to transition conditions. Applicability to full scale is discussed. The care needed in fixing transition with an incipient rear separation (class B flow) and the value of pressure plotting are illustrated. Examples of results are given.
Author (ESRO)

N72-31005# Naval Postgraduate School, Monterey, Calif.
LAMINAR BOUNDARY LAYER DEVELOPMENT DOWNSTREAM OF A SUCTION SLOT M.S. Thesis
Sabri Cigdem Dec. 1971 117 p refs
(AD-742937) Avail: NTIS CSCL 20/4

Laminar boundary layer development downstream of a suction slot was investigated in a low velocity wind tunnel. In order to observe the effect of suction on the boundary layer, detailed boundary layer profiles were measured at various stations upstream and downstream of a suction slot for different suction flow rates. The investigation was carried out for zero suction, 53.33 SCFH/FT. and 133.33 SCFH/FT. suction, by using 1/16 inch suction slot. The velocity profiles were plotted for 22 stations with different suction flow rates with respect to the no suction flow case. At the far upstream and downstream side of the slot, suction was ineffective and velocity profiles had the Blasius velocity profile shape. Suction had the maximum effectiveness a short distance in front of and downstream of the slot. As the distance from the slot increased both upstream and downstream, the velocity profiles tended to approach Blasius velocity profiles asymptotically. Author (GRA)

N72-31006# Naval Postgraduate School, Monterey, Calif.
THE DERIVATION, SOLUTION, AND ANALYSIS OF AIRPLANE SPIN EQUATIONS MODELED IN AN INERTIAL COORDINATE SYSTEM M.S. Thesis
Roy Robert Buehler Mar. 1972 67 p refs
(AD-742929) Avail: NTIS CSCL 01/2

The general equations of motion for a rigid body are derived in cylindrical coordinates by Lagrangian dynamics and used to model the motion of an airplane in a steady spin. After simplification, the equations are cast into a form utilizing conventional aerodynamic derivatives along with other derivatives which may be significant in spins. An iterative numerical solution procedure is outlined which should simplify the problem of solving the nonlinear differential equations, and relationships between the Euler Angles used in the equations and the more familiar ordered set of pitch, roll, and yaw are derived to permit computer input and output of orientation to be more easily visualized. Author (GRA)

N72-31008# General Dynamics/Convair, San Diego, Calif. Aerospace Div.
AERONAUTICAL EXPLORATORY RESEARCH ON ADVANCED JET FLAP SUPERCRITICAL AIRFOILS Interim Technical Report, 1 Mar. 1971 - 29 Feb. 1972
Hideo Yoshihara, Wilbert V. Carter, G. Joseph Fatta, Richard J. Magnus, and Robert T. Murray 29 Feb. 1972 60 p refs
(Contract N00014-71-C-0161; NR Proj. 212-203)
(AD-744036) Avail: NTIS CSCL 20/4

The goal of the study is to seek a supercritical profile shape which has improved transonic performance in the presence of the jet flap effect. Based upon existing experience four profiles have been evolved. The present report describes the results for two of these airfoils, one having a Coanda jet flap configuration. In the tests pressure distributions, schlieren observations, and wake surveys were obtained. The results are reported.
Author (GRA)

N72-31009# ARO, Inc., Arnold Air Force Station, Tenn.
A GENERAL METHOD FOR CALCULATING THREE DIMENSIONAL NONSTATIONARY AEROELASTIC RESPONSE IN SUBSONIC FLOWS Final Report
Alva Darrell Devers AEDC May 1972 167 p refs
(Contract F40600-72-C-0003; AF Proj. 1366)
(AD-742996; ARO-OMD-TR-72-32; AEDC-TR-72-59) Avail: NTIS CSCL 01/3

The study presents a generalized method which couples three dimensional, unsteady aerodynamic forces with elastic deformations and surface deflections for an arbitrarily configured vehicle imbedded in a subsonic flow field. Although the basic theories are well known, the composite formulation and technique of solving the resulting equations are new. Vortex lattice methods are extended to include unsteady motions and these methods are combined with current developments in structural dynamics to establish a unique approach for attacking problems involving dynamic aeroelastic phenomena. Author (GRA)

N72-31010# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT. ALLEGHENY AIRLINES, INCORPORATED, ALLISON PROP JET CONVAIR 340/440, N5832, NEW HAVEN, CONNECTICUT, 7 JUNE 1971
1 Jun. 1972 72 p refs
(NTSB-AAR-72-20; SA-427) Avail: NTIS HC $5.75

A Convair 340 aircraft crashed during an approach to the New Haven, Connecticut airport on 7 June 1971. Twenty-eight passengers and two crewmembers were fatally injured. Two passengers and the first officer survived. The probable cause of

the accident was the captain's intentional descent below the prescribed minimum descent altitude under adverse weather conditions, without adequate forward visibility or sighting of runway environment. Author

N72-31011# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT. NATIONAL AIRLINES, INCORPORATED, BOEING 747-135, N77772, NEAR LAKE CHARLES, LOUISIANA, 4 JANUARY 1972
12 Jul. 1972 13 p
(NTSB-AAR-72-21) Avail: NTIS HC $3.00; Natl. Transp. Safety Board, Office of Gen. Manager, Accident Inquiries and Records Sect., Washington, D. C. 20591

An incident involving a Boeing 747 aircraft during flight is reported. The aircraft encountered a gust of sharp convective turbulence at 31,000 feet, resulting in injuries to several passengers and four stewardesses. The flight continued to its destination. The cause of the incident was attributed to the meteorological conditions encountered and the fact that the passengers had not obeyed the sign to fasten their seat belts. Author

N72-31012# RAND Corp., Santa Monica, Calif.
EUROPEAN AND US AIRCRAFT DEVELOPMENT STRATEGIES
Robert Perry Dec. 1971 18 p refs
(P-4748) Avail: NTIS HC $3.00

The procedures used by United States and European aircraft manufactures in the design, development, and production of high performance aircraft are compared. The relationships between research and development for the different systems are examined. The effects of design complications, initial flight tests, lack of redundancy, and procurement practices on the cost of the final product are analyzed. It is concluded that general adoption of a strategy of incremental acquisition and a policy of austere development should result in lower cost growth and lower acquisition costs. Author

N72-31013*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LATERAL STABILITY AND CONTROL DERIVATIVES OF A JET FIGHTER AIRPLANE EXTRACTED FROM FLIGHT TEST DATA BY UTILIZING MAXIMUM LIKELIHOOD ESTIMATION
Russell V. Parrish and George G. Steinmetz Washington Sep. 1972 52 p refs
(NASA-TN-D-6905; L-8378) Avail: NTIS HC $3.00 CSCL 01B

A method of parameter extraction for stability and control derivatives of aircraft from flight test data, implementing maximum likelihood estimation, has been developed and successfully applied to actual lateral flight test data from a modern sophisticated jet fighter. This application demonstrates the important role played by the analyst in combining engineering judgment and estimator statistics to yield meaningful results. During the analysis, the problems of uniqueness of the extracted set of parameters and of longitudinal coupling effects were encountered and resolved. The results for all flight runs are presented in tabular form and as time history comparisons between the estimated states and the actual flight test data. Author

N72-31015# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
V/STOL COMMUNITY ANNOYANCE DUE TO NOISE PROPOSED INDICES AND LEVELS
G. W. Johnston Mar. 1972 43 p refs
(UTIAS-TN-177) Avail: NTIS HC $4.25

Contrasted with conventional aircraft and airport noise, distinctive features relating to V/STOL systems are noted. Currently popular methods for assessing conventional aircraft noise (CNR and NEF) are shown to be much less appropriate for V/STOL. Both speech interference and perceived noise annoyances have been included in parallel. Perceived noise contours (LNP) calculated adjacent to a hypothetical waterfront STOLport site confirm that when the aircraft noise exceeds the background by 10 db or less, community annoyance grows imperceptibly with the number of similar operations flown. Smaller aircraft operating in larger numbers, to fulfill a given transportation task, therefore offer a substantial annoyance improvement over larger similar technology aircraft. V/STOL noise certification rules permitting a substantial noise increase with size (3 or 4 db per doubling or more) cannot adequately preserve the community amenity. Author

N72-31016# Civil Aeronautics Board, Washington, D.C. Bureau of Operating Rights.
SERVICE TO SMALL COMMUNITIES. PART 1: LOCAL SERVICE CARRIER COSTS AND SUBSIDY NEED REQUIREMENTS TO SERVE MARGINAL ROUTES
Mar. 1972 114 p
Avail: NTIS HC $7.75

Cost analyses of several small airlines in the United States were conducted to determine causes for continuing lack of profitable operation. The services provided by the airlines are described. The economic status for 1969 is examined. The factual data developed, and the conclusions derived are useful in evaluating various alternatives related to continuing or changing the type of service provided to the smaller and relatively isolated communities which are incapable of fully supporting, on a self sustaining basis, certificated air service. Author

N72-31017# Civil Aeronautics Board, Washington, D.C. Bureau of Operating Rights.
SERVICE TO SMALL COMMUNITIES. PART 2: SMALL AIRCRAFT AND SMALL COMMUNITIES: A HISTORY AND ECONOMIC ANALYSIS
Mar. 1972 150 p refs
Avail: NTIS HC $9.50

The development of small community air service from the 1930's to the present, with particular emphasis on the aircraft types employed over the years is discussed. The regulatory process which allowed the local service carriers to eliminate their DC-3 fleets in favor of larger aircraft, as well as the failure to find a suitable DC-3 replacement are explored in detail. The rise of the commuter carrier industry, particularly after the development of higher capacity turboprop aircraft in the mid-sixties, is also set forth. A comparative economic analysis of aircraft types, including those currently in use with both the local service carriers and the principal commuter air carriers is presented. The cost levels, direct and indirect, experienced by commuter carriers with those of the local service carriers are compared. Finally, the study shows that existing local service routes can be offered superior service, on a more economical basis, with small aircraft, operated either by local service or commuter air carriers. Author

N72-31018# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: WESTERN AIR LINES, INCORPORATED BOEING 720-047B, N3166 ONTARIO INTERNATIONAL AIRPORT, ONTARIO, CALIFORNIA, 31 MARCH 1971
7 Jun. 1972 42 p
(NTSB-AAR-72-18) Avail: NTIS HC $4.25

A Boeing 720B, on a proficiency check flight, yawed and rolled out of control, and crashed while in the process of executing a 3-engine missed-approach from a simulated engine-out ILS instrument approach. The five crewmembers and only occupants died in the crash. The weather conditions were 600 feet overcast, with 3/4-mile visibility in fog, haze, and smoke. The probable cause of this accident was the failure of the aircraft rudder hydraulic actuator support fitting. The failure of the fitting resulted in the inapparent loss of left rudder control which, under

the conditions of this flight, precluded the pilot's ability to maintain directional control during a simulated engine-out missed-approach. The existing weather conditions degraded external visual cues, thereby hampering rapid assessment of aircraft performance by the flight check captain. Author

N72-31019# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: ALII AIR HAWAII, INCORPORATED, BEECH D18S, N5642V, KALOHI CHANNEL, HAWAIIAN ISLANDS, 22 FEBRUARY 1972
26 Jul. 1972 11 p
(NTSB-AAR-72-23) Avail: NTIS HC $3.00; Natl. Transportation Safety Board, Office of Gen. Manager, Accident Inquiries and Records Sect., Washington, D. C. 20591

A Beech D18S, was a scheduled visual flight rules air taxi passenger and cargo flight operating from Honolulu, Hawaii, to Lanai, Hawaii. The flight departed Honolulu at 0645 H.s.t., and crashed into the Pacific Ocean in the Kalohi Channel area at a point approximately 38 nautical miles southeast of Honolulu Airport. The accident occurred at approximately 0705 H.s.t. The bodies of three of the passengers and the pilot were not recovered. The aircraft was destroyed and sank into the ocean. There were well-developed rain showers and thunderstorms, with associated turbulence, lightning, and hail in the area; however, visual flight could have been maintained by circumnavigation of this activity. The probable cause of this accident was flight into *an area of known instrument meteorological conditions* containing thunderstorm activity, which culminated in a collision with the water for unknown reasons. Author

N72-31020*# Boeing Co., Seattle, Wash. Commercial Airplane Group.
DESIGN EVALUATION CRITERIA FOR COMMERCIAL STOL TRANSPORTS
R. L. Allison, M. Mack, and P. C. Rumsey Jun. 1972 202 p refs
(Contract NAS2-6344)
(NASA-CR-114454; D6-40409) Avail: NTIS HC $12.25 CSCL 01B

Handling qualities criteria and operational performance margins have been determined for the landing phase of commercial short-takeoff-and-landing airplanes. The requirements are the result of a literature survey, analysis of areas found to be inadequately covered by current criteria, and a subsequent piloted simulator investigation of critical criteria requiring substantiation. Three complete simulator models were used, each describing the characteristics of a different high-lift system, the externally blown flap, the augmentor flap, and the internally blown flap. The proposed criteria are presented with substantiating discussions from currently available data or directly from the results of this simulation work where it is applicable. Author

N72-31021*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC-BOOM MEASUREMENTS FOR SR-71 AIRCRAFT OPERATING AT MACH NUMBERS TO 3.0 AND ALTITUDES TO 24384 METERS
Domenic J. Maglieri, Vera Huckel, and Herbert R. Henderson Washington Sep. 1972 59 p refs
(NASA-TN-D-6823; L-8337) Avail: NTIS HC $3.00 CSCL 01B

Sonic-boom pressure signatures produced by the SR-71 aircraft at altitudes from 10,668 to 24,384 meters and Mach numbers 1.35 to 3.0 were obtained as an adjunct to the sonic boom evaluation program relating to structural and subjective response which was conducted in 1966-1967 time period. Approximately 2000 sonic-boom signatures from 33 flights of the SR-71 vehicle and two flights of the F-12 vehicle were recorded. Measured ground-pressure signatures for both on-track and lateral measuring station locations are presented and the statistical variations of the overpressure, positive impulse, wave duration, and shock-wave rise time are illustrated. Author

N72-31022*# National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, Calif.*
AN ENGINEERING OPTIMIZATION METHOD WITH APPLICATION TO STOL-AIRCRAFT APPROACH AND LANDING TRAJECTORIES
Heinrich G. Jacob Washington Sep. 1972 43 p refs
(NASA-TN-D-6978; A-4323) Avail: NTIS HC $3.00 CSCL 01B

An optimization method has been developed that computes the optimal open loop inputs for a dynamical system by observing only its output. The method reduces to static optimization by expressing the inputs as series of functions with parameters to be optimized. Since the method is not concerned with the details of the dynamical system to be optimized, it works for both linear and nonlinear systems. The method and the application to optimizing longitudinal landing paths for a STOL aircraft with an augmented wing are discussed. Noise, fuel, time, and path deviation minimizations are considered with and without angle of attack, acceleration excursion, flight path, endpoint, and other constraints. Author

N72-31024# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
THE EFFECT OF VARIATIONS IN LOCAL GRAVITY AND OF AIRCRAFT SPEED ON THE EFFECTIVE WEIGHT OF AIRCRAFT IN HIGH PERFORMANCE CRUISE
W. J. G. Pinsker London Aeron. Res. Council 1972 16 p refs Supersedes RAE-TR-69274; ARC-32167
(ARC-R/M-3680; RAE-TR-69274; ARC-32167) Avail: NTIS HC $3.00; HMSO 60p; PHI $2.55

Numerical data are given of the changes in effective gravity experienced by aircraft in flight at various heights and speeds. In most flight conditions this results in a reduction in the effective weight experienced by aircraft which is shown to vary considerably with heading and latitude. For Concorde in cruise there is a reduction in effective weight of approximately 0.5% in westbound flight and this increases to more than 2% in eastbound flight.
Author (ESRO)

N72-31025# Royal Aircraft Establishment, Bedford (England). Aerodynamics/Flight Dept.
MEASUREMENT OF THE YAWING MOMENT OF INERTIA OF AN AIRCRAFT (HP115) IN FLIGHT
R. L. Poulter London Aeron. Res. Council 1972 22 p refs Supersedes RAE-TR-70223; ARC-32787
(ARC-R/M-3691; RAE-TR-70223; ARC-32787) Avail: NTIS HC $3.25; HMSO 82p; PHI $3.55

The yawing moment of inertia has been obtained by measuring the acceleration in yaw resulting from the release of a wing-tip parachute. Lateral accelerometers mounted near the fore and aft extremities of the aircraft on a line parallel to the principal axis of inertia were used to measure the yawing acceleration. The principal axis is known in this case from previous ground measurements, but it is shown that 1 deg error in axis inclination would only produce an error of about 3% in the measured inertia. The results obtained from the flight tests are encouraging and are about 3 1/2% lower than earlier measurements on a ground rig and about 2 1/2% greater than the manufacturer's original estimate. Operational problems are discussed and some improvements to the parachute equipment are also suggested. Author (ESRO)

N72-31027# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept. (SI)
EVALUATION OF ADVANCED METHOD FOR STEAM CATAPULT PERFORMANCE PREDICTION WITH SHIP-BOARD TEST DATA Final Report
G. Gaeman, J. Levenson, and W. Goon Apr. 1972 106 p refs
(AD-742804; NAEC-ENG-7741) Avail: NTIS CSCL 01/5

An advanced method which is phenomena-based has been developed in an endeavor to predict steam catapult performance with minimized test correlation effort. This report presents the

evaluation of this method by use of present day available shipboard test data. Special techniques are developed to handle these data. The capability of the method is substantiated herein and means to achieve its full potential are also included.
Author (GRA)

N72-31029# RAND Corp., Santa Monica, Calif.
A SIMPLE ADAPTIVE SCHEDULING MECHANISM FOR PLANNING BASE LEVEL INSPECTIONS
Louis Miller Feb. 1972 48 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-743284; R-938-PR) Avail: NTIS CSCL 01/3

The report describes a simple and promising improvement over the two systems now used for scheduling aircraft into base-level inspections. Both the periodic concept (hours flown between inspections are held constant) and the isochronal concept (calendar time held constant) have undesirable traits because aircraft accrue flying hours irregularly over time. The solution presented here comprises two steps: over a long period (perhaps a fiscal quarter), fix the dates on which inspections will begin (perhaps weekly); divide the period into smaller intervals (perhaps two weeks) and before each interval, schedule those aircraft that have flown the most since their last inspections. Step 1 smooths the flow of work into the docks. Step 2 controls the variability of flying hours between inspections. Author (GRA)

N72-31030# Dynamic Science Engineering Operations, Phoenix, Ariz.
THE DESIGN, FABRICATION, AND TESTING OF AN INTEGRALLY ARMORED CRASHWORTHY CREW SEAT Final Report
Stanley P. Desjardins and Harold D. Harrison Jan. 1972 319 p refs
(Contract DAAJ02-69-C-0030)
(AD-742733; USAAMRDL-TR-71-54; Rept-1680-71-24) Avail: NTIS CSCL 01/3

A program was conducted to develop design technology for integrally armored crashworthy crew seats. The effort included theoretical analysis, design, fabrication, and testing. Dynamic analysis of an occupant seated in an integrally armored crew seat was conducted. Then a seat concept trade-off was performed, a concept was selected and designed, and prototype seats were fabricated. The seats were subjected to a combined static loading test including simultaneous longitudinal, lateral, and vertical components while mounted in a test fixture simulating warped floor conditions typical of crashing aircraft. The seats were then subjected to a series of 10 dynamic tests.
Author (GRA)

N72-31031# Mechanical Technology, Inc., Latham, N.Y.
INVESTIGATION OF GEARBOX DESIGN MODIFICATIONS FOR REDUCING HELICOPTER GEARBOX NOISE Final Technical Report
Robert H. Badgley and Thomas Chiang Mar. 1972 173 p refs
(Contract DAAJ02-70-C-0035; DA Proj. 1G1-62207-AA-72)
(AD-742735; MTI-71TR50; USAAMRDL-TR-72-6) Avail: NTIS CSCL 20/1

Results presented were obtained in a continuing effort to control, through development of vibration and acoustics technology, noise produced by helicopter geared power trains. The results achieved, while not all inclusive, represent a significant step in understanding the generation of gearbox noise. Efforts undertaken, directed at both the UH-1D main and CH-47 forward rotor-drive gearboxes, included predictions of lateral natural frequency and forced response vibration characteristics of the spiral bevel gear shafts, thin-shell predictions of natural frequency and forced-response vibration characteristics of the planetary ring gear casing, general and analytical modeling of gearbox mounts and adjoining airframe structure, and collection and evaluation of existing helicopter internal noise and vibration data from helicopter manufacturers and users. Author (GRA)

N72-31032# Connecticut Dept. of Transportation, Wethersfield. Bureau of Planning and Research.
STATE HELIPORT SYSTEM, FEASIBILITY STUDY
Jan. 1972 24 p
(SA-173-1971)
(PB-208395) Avail: NTIS HC $3.00 CSCL 01E

The report takes a statewide look at existing heliports and forecasts additional heliports needed to support short haul and commuter requirements. It also considers the feasibility of establishing an emergency heliport system. Consideration is given to population density and area requirements for V/STOL operations. In conclusion, the report states that there is an immediate demand for coordination with local governments for compatibility and application. Author (GRA)

N72-31033# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF EFFECTS OF BLADE SECTION CAMBER AND PLANFORM TAPER ON ROTOR HOVER PERFORMANCE Final Report, Oct. 1970 - Oct. 1971
E. Dean Bellinger Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Mar. 1972 82 p refs
(Contract DAAJ02-71-C-0012; DA Proj. 1F1-62204-AA-42)
(AD-743232; UARL-K911076-14; USAAMRDL-TR-72-4) Avail: NTIS CSCL 01/3

An experimental and analytical investigation was conducted to determine the effects of blade section camber and blade planform taper on helicopter rotor hover performance and to assess the accuracy of several theoretical methods in predicting such performance. The tests were conducted using small scale model rotors (nominally 4 feet in diameter) operating in and out of ground effect at full-scale tip speeds. The NACA 23112 airfoil, which is a section specifically designed to produce very low pitching moments such as required for helicopter blade applications, was selected for the cambered blade. A nominal taper ratio of 2:1 was selected for the tapered blade tests.
Author (GRA)

N72-31034# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPUTER ANALYSIS OF WINDSHIELD MULTIPLE IMAGING M.S. Thesis
Ralph H. Reed Jun. 1972 69 p refs
(AD-744044; GEP/PH/72-18) Avail: NTIS CSCL 01/3

A study was conducted to develop a computer technique to analyse aircraft windshields for multiple imaging. Two types of multiple imaging were considered: internal reflection, or flare, and secondary reflection. Emphasis was placed on secondary reflection multiple imaging. A CDC 6600 computer and FORTRAN were used throughout the study. A program was developed to evaluate multiple imaging in any windshield configuration reducible to a set of defining mathematical equations. The program is based on a set of general subroutines which allow the performance of related computations, such as pilot field of view or reflection/refraction analysis. Since the visual properties of the windshield may be dependent on pilot position as well as windshield configuration, means are provided to easily change the pilot position. A sample analysis of the effect of pilot position on multiple imaging is given. Author (GRA)

N72-31035# Naval Postgraduate School, Monterey, Calif.
***A LITERATURE SURVEY OF THE PROBLEM OF AIRCRAFT SPINS* M.S. Thesis**
Arne Edward Johnson Sep. 1971 105 p refs
(AD-734976) Avail: NTIS CSCL 01/2

The prediction of aircraft spin characteristics has defied complete scientific analysis. There are, however, a number of research techniques which have been utilized in attempts to understand the mechanism of spin. A survey of the literature dealing with spin research and its application to a wide variety of aircraft designs over the period 1916 to 1971 is presented.
Author (GRA)

N72-31036# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT FROM 1 JANUARY 1962 TO 1 JANUARY 1972 Semiannual Summary Report
Thomas A. DeFiore 1 May 1972 19 p
(AD-743067; NADC-13920-2) Avail: NTIS CSCL 14/2

The report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. Author (GRA)

N72-31037# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
TEST PLAN FOR A STRUCTURAL INTEGRITY INVESTIGATION FOR THE CH-46 AFT TRANSMISSION PLANETARY CARRIER BEARING NUT IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM Final Report
Ronald P. Swartz 29 Mar. 1972 12 p refs
(AD-743073; NADC-72049-VT) Avail: NTIS CSCL 13/5

The CH-46D mishaps in 1967 and 1971 precipitated a contractor designed fix of the aft transmission planetary carrier bearing nut. This test plan proposes tests to determine if a mode of failure other than that assumed by the contractor could be present. Static and fatigue tests are proposed on both the original and modified versions. Author (GRA)

N72-31038# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT. MONMOUTH AIRLINES, INCORPORATED, SCHEDULED AIR TAXI, BEECH 99, N-986MA, ALLENTOWN-BETHLEHEM-EASTON AIRPORT, ALLENTOWN, PENNSYLVANIA, 24 OCTOBER 1971
29 Dec. 1971 17 p
(PB-208198; NTSB-AAR-72-3) Avail: NTIS HC $3.00 CSCL 01B

At approximately 2314 e.d.t., October 24, 1971, a Beech Model 99, crashed at approximately the 1,540-foot level of Blue Mountain during an instrument approach to the Allentown-Bethlehem-Easton Airport, Allentown, Pennsylvania. The captain, copilot, and two passengers were fatally injured. The four remaining passengers were seriously injured. The aircraft caught fire shortly after impact. The cockpit and cabin area were destroyed. However, the surviving passengers were able to evacuate from the aircraft before fire reached the cabin area. The probable cause of this accident was the pilot's nonadherence to approved approach procedures for executing a nonprecision instrument approach in instrument flight conditions.
Author (GRA)

N72-31144*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL RESEARCH PROJECTS OFFICE: FUNCTIONS, ACCOMPLISHMENTS, AND PROGRAMS
D. A. Kourtides and J. A. Parker Sep. 1972 15 p refs
(NASA-TM-X-62186) Avail: NTIS HC $3.00 CSCL 07D

The purpose, technical accomplishments, and related activities of the Chemical Research Project Group are outlined. Data cover efforts made to: (1) identify chemical research and technology required for solutions to problems of national urgency, synchronous with aeronautics and space effort; (2) conduct basic and applied interdisciplinary research on chemical problems in the areas of macromolecular science and fire research, and (3) provide productive liaison with the engineering community and effective transfer of technology to other agencies and industry.
Author

N72-31174# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
REMOVAL OF BAKED ON ALUMINIZED SILICONE PAINT, PHASE 1
Gabriel Pilla 1 Mar. 1972 11 p
(AD-742795; NADC-72048-VT) Avail: NTIS CSCL 11/11

A safe and practical procedure for the removal of baked-on aluminized silicone paint used for coating R1820 engines is described. Factors affecting the removability rate of this paint system, such as the metal surface finishes and heat-cycle conditions are also included. Author (GRA)

N72-31279*# Missouri Univ., Rolla. Dept. of Electrical Engineering.
OPTIMAL BRAKING STUDIES Final Summary Report, 1 Feb. - 15 Aug. 1972
John S. Pazdera 15 Aug. 1972 50 p refs
(Contract NAS8-28230)
(NASA-CR-123817) Avail: NTIS HC $4.50 CSCL 13I

To brake in minimum distance, the tire slip must be controlled to ride the peak of the mu-slip curve so that maximum ground force is developed between tire and pavement. The resulting control system differs from antiskid systems which react to impending wheel lockup. A simplified model is presented to permit development of a sound control strategy. Liapunov techniques are used to derive a peak riding adaptive controller applicable to each wheel of a breaking vehicle. The controller is applied to a more sophisticated model of a braking airplane with strut bending dynamics included. Simulation results verify the peak riding property of the controller and the rapid adaption of the controller to extreme runway conditions. The effect of actuator dynamics, perturbation frequency, type and location of sensors, absence of a free wheel, and a method in which the pilot's braking commands can be interfaced with the peak riding system are also considered. Author

N72-31286*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE STEADY-STATE FLOW QUALITY IN A MODEL OF A NON-RETURN WIND TUNNEL
Kenneth W. Mort, William T. Eckert, and Mark W. Kelly Aug. 1972 28 p refs Prepared in cooperation with US Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62170) Avail: NTIS HC $3.50 CSCL 14B

The structural cost of non-return wind tunnels is significantly less than that of the more conventional closed-circuit wind tunnels. However, because of the effects of external winds, the flow quality of non-return wind tunnels is an area of concern at the low test speeds required for V/STOL testing. The flow quality required at these low speeds is discussed and alternatives to the traditional manner of specifying the flow quality requirements in terms of dynamic pressure and angularity are suggested. The development of a non-return wind tunnel configuration which has good flow quality at low as well as at high test speeds is described. Author

N72-31287# Committee on the Judiciary (U. S. House).
NEW JERSEY-NEW YORK AIRPORT COMMISSION COMPACT
Washington GPO 1972 618 p refs Hearings before Comm. on the Judiciary on H.J. Res. 1305 and related bills, 91st Congr., 19, 25 Nov. 1970 and on H.J. Res. 375, H.J. Res. 404, and H.J. Res. 433, 92d Congr., 14-15 Oct. 1971 and 24 Feb. 1972
Avail: Comm. on the Judiciary.

The hearings are reported concerning the compact to authorize the Waterfront and Airport Commission of New York and New Jersey to exercise regulatory powers at airports in New York and New Jersey. The articles of the bill are included along with reports from interested governmental agencies such as the Transportation and Commerce Department. F.O.S.

N72-31292# Institut Franco-Allemand de Recherches, St. Louis (France).
SURVEY OF THE ACTIVITIES OF THE INSTITUT FRANCO-ALLEMAND DE RECHERCHES IN THE FIELD OF

AERONAUTICS [APERCU DES ACTIVITES DE L'ISL INTERESSANT L'AERONAUTIQUE]
A. Auriol 15 Nov. 1971 26 p refs In FRENCH Presented at the 8th Assoc. Franc. des Ingr. et Techniciens de l'Aeron. et de l'Espace Colloq. on Aerodynamique Appl., St. Louis, France, 8-10 Nov., 1971
(ISL-32/71) Avail: NTIS HC $3.50

Different ISL test facilities for aeronautical applications are described including launch range light gas guns, blast simulators, sonic bang generators and shock tubes. The role of ISL in the Franco-German cooperation program is mentioned. ESRO

N72-31297# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
EVALUATION OF ANCILLARY ITEMS FOR XM18 AND XM19 LANDING MATS Final Report
Gordon L. Carr May 1972 128 p refs
(DA Proj. 1T0-62103-A-046)
(AD-743161; AEWES-Misc-Paper-S-72-16) Avail: NTIS CSCL 01/5

An investigation was conducted to evaluate ancillary items for use with XM18 and XM19 landing mats. Traffic and field tests were conducted to obtain information for use in comparing the performance life of the ancillary items with the performance life requirement for landing mat. Various turn adapters, access adapters, starting connectors, half panels, repair panels, closure panels, edge anchors, anchor attachments, and turndown adapters were tested. Engineer design tests were conducted on matsurfaced prepared subgrades, with a rolling wheel load simulating actual aircraft operations. Author (GRA)

N72-31303*# General Applied Science Labs., Inc., Westbury, N.Y.
NONUNIFORM FLOW FIELD GENERATION FOR SUPERSONIC COMPRESSOR STATOR DEVELOPMENT: DESIGN AND PRELIMINARY RESULTS Final Report
Frederick W. Lipfert and Irving Fruchtman May 1972 73 p refs
(Contract NAS1-10004)
(NASA-CR-112097; GASL-TR-759) Avail: NTIS HC $5.75 CSCL 20D

Design and preliminary results are given for a technique which can generate a nonuniform flow similar to the discharge of an impulse supersonic compressor rotor. The technique utilizes a carefully contoured, two-dimensional blunt body in a conventional hypersonic wind tunnel to generate the required flow field. To show the effects of the flow vorticity, a cascade of impulse-type blades was tested in this test stream. Some preliminary performance data are given along with comparison with previously determined uniform flow results. Author

N72-31306# National Gas Turbine Establishment, Farnborough (England).
A STREAMLINE CURVATURE THROUGH-FLOW COMPUTER PROGRAM FOR ANALYSING THE FLOW THROUGH AXIAL-FLOW TURBOMACHINES
D. H. Frost London Aeron. Res. Council 1972 37 p refs Supersedes NGTE-R-312; ARC-32776
(ARC-R/M-3687; NGTE-R-312; ARC-32776) Avail: NTIS HC $4.00; HMSO £1.30; PHI $5.30

A computer program for the analysis of the fluid motion in the meridional plane of axial flow turbomachines is described. The method uses a streamline curvature approach and the program allows calculations within blade rows. Comparisons with experiment and various other methods of analysis are presented. Author (ESRO)

N72-31311# Naval Ship Research and Development Center, Bethesda, Md.
CORRELATION OF RESISTANCE TEST RESULTS FROM FIXED-AND FREE-TO-TRIM METHODS FOR A DYNAMIC LIFT CRAFT MODEL 4667
Nadine Hubble Apr. 1972 96 p refs
(SS Proj. 4606)
(AD-742752; NSRDC-3544) Avail: NTIS CSCL 20/4

Customary methods are discussed for determining the resistance characteristics in smooth water of hulls of planing and hydrofoil craft. Results are presented and compared for a hull, with possible application to either type of craft, which has been tested by both the fixed-trim method, generally used for hydrofoil craft, and the free-to-trim method, generally used for planing craft. Recommendations are made for conducting future resistance tests of dynamic-lift craft, i.e., both planing and hydrofoil hulls, in the fixed-trim mode as well as for converting the data to the form of free-to-trim test data to facilitate general design studies for both types of craft. Author (GRA)

N72-31316# Rochester Applied Science Associates, Inc., N.Y.
AN INVESTIGATION OF THE MIXING OF LINEAR AND SWIRLING FLOWS Final Technical Report, 15 Feb. 1971 - 14 Feb. 1972
Richard P. White, Jr. and John C. Balcerak Feb. 1972 86 p refs
(Contract N00014-71-C-0226; NR Proj. 215-170)
(AD-742854; RASA-72-04) Avail: NTIS CSCL 20/4

A research program was conducted to study in detail the importance of various aerodynamic and geometric parameters on the dissipation of a concentrated trailed vortex in which the dissipation is greatly enhanced by the continuous injection of a mass of air into its core. The basic results of the research program demonstrated that the efficiency of vortex dissipation would be maximized by designing the injection system so that the vortex was injected at its center and parallel to the axis of the trailed vortex core with a linearly-directed mass of air at sonic speeds. The efficiency of the optimum system was shown to be almost an order of magnitude better than had been demonstrated previously. Author (GRA)

N72-31376# Canada Centre for Remote Sensing, Ottawa (Ontario).
A REVIEW OF SATELLITE AND AIRCRAFT REMOTE SENSING INSTRUMENTATION
J. MacDowall 7 Feb. 1972 67 p Presented at the Can. Symp. on Remote Sensing, Ottawa, 7 Feb. 1972
Avail: NTIS HC $5.50

A review is presented of earth resource sensors which are available or under development. Information on sensor characteristics is given so that the user can select the most appropriate available system for use. Developments in Canada are introduced indicating fruitful areas for instrumentation development and techniques with particular promise. Author

N72-31447# Forest Management Inst., Ottawa (Ontario).
LARGE SCALE AERIAL PHOTOGRAPHY AND RADAR ALTIMETRY: THE STATE OF THE ART
L. Sayn-Wittgenstein [1972] 10 p refs Presented at 15th IUFRO Congr., Florida, Mar. 1971
Avail: NTIS HC $3.00

The feasibility of using large scale aerial photography coupled with specially designed radar altimeters for forest inventories is investigated. Test results show that technically such a system can be employed. E.H.W.

N72-31451# National Aerospace Lab., Tokyo (Japan).
HEIGHT CONTROL TEST EQUIPMENT FOR VTOL AIRCRAFT
Masakatsu Matsuki, Tadao Torisaki, Kenji Nishio, Masanori Endo, Akira Yoshida, Susumu Nakayama, Tadasuke Iwabe, Katsumi Takeda, Shizuo Sekine, and Takeshi Koshinuma 1972 42 p refs In JAPANESE; ENGLISH summary
(NAL-TR-275) Avail: NTIS HC $4.25

The theoretical and experimental investigation of height control systems for VTOL aircraft by means of height control test equipment is presented. The installations and instruments in height control test equipment were deliberately designed and constructed to meet the requirements for the safe and accident-proof operation as well as for the execution of new and fresh experiments. A 40-meter-height iron tower, one of the installations, was equipped on its side with rails along which a lorry freely runs up and down by means of the thrust generated by two lift jet engines (JR100H) mounted on it. The thrust of two engines were remotely controlled from the ground to reach the predetermined height. The maximum velocity and acceleration permitted were 10 m/s and 0.3 g respectively.
Author

N72-31452# Joint Publications Research Service, Arlington, Va.
AERONAUTICAL INSTRUMENTS
L. I. Tkachev 27 Jul. 1972 76 p refs Transl. into ENGLISH from Avtomat. Telemekh. (Moscow), 1948 p 223-254; from Dokl. Nauch.-Tekh. Konf. Itogam Nauch.-Issledovatel. Rabot 1966-1967 Gody, Mosk. Energ. Inst., Sekts. automat., Vychisl. Izmer. Tekh., Podsekts. Automat. Telemekh., part 2 (Moscow), 1967 p 108-121; and from Dokl. Nauch.-Tekh. Konf. Itogam Nauch.-Issledovatel. Rabot 1966-1967 Gody, Mosk. Energ. Inst., Sekts. automat., Vychisl. Izmer. Tekh., Podsekts. Sistemotekh. (Moscow), Apr. 1970 p 99-127
(JPRS-56624) Avail: NTIS HC $6.00

Articles on the aircraft vertical indicator, spatial orientation and guidance, and inertial guidance information systems are presented.

N72-31453 Joint Publications Research Service, Arlington, Va.
CONDITIONS OF ADJUSTMENT OF AN AIRCRAFT VERTICAL INDICATOR
L. I. Tkachev *In its* Aeron. Instr. 27 Jul. 1972 p 1-35 refs

The application of a gyropendulum to the construction of a precision vertical indicator was investigated considering all velocities and accelerations during arbitrary displacements in the earth's gravitational field. The coordinate system, movements, and accelerations of gyropendulums are discussed. The expressions for the velocity deviation of an ideal pendulum, ballistic deviation, deviation from vertical movements, and instrument errors are derived from the equations of motion for the gyropendulum. It is concluded that the application of the gyropendulum as an exact vertical indicator is possible only with additional devices. F.O.S.

N72-31454 Joint Publications Research Service, Arlington, Va.
SPATIAL ORIENTATION THEORY
L. I. Tkachev *In its* Aeron. Instr. 27 Jul. 1972 p 36-49 refs

The theoretical possibility of spatial orientation using mechanical devices during the movement of any given gravitational field is proved. The schematic diagram of the instrument is discussed along with the coordinate system, angular velocities of the platform, and platform accelerations. F.O.S.

N72-31460*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A CAPACITIVE ACCELEROMETER SUITABLE FOR TELEMETRY
Grant W. Coon Washington Sep. 1972 20 p refs
(NASA-TM-X-2644; A-4439) Avail: NTIS HC $3.00 CSCL 14B

The design and development of a miniature 0.635 cm (0.25 in.) diameter capacitive accelerometer for use in free flight wind tunnel telemetry are presented. Instruments with full scale ranges from + or - 1 to + or - 200 g were constructed, calibrated, and used in several wind tunnel telemetry projects. Flat, high frequency response from 0 to 1000 Hz or more was obtained by employing the inherent damping and stiffness in the air film surrounding the diaphragm-type spring that supports the inertial mass of the accelerometer. Design features to achieve minimum off-axis sensitivity and temperature stability are discussed, and the design requirements for use of the transducer with telemetry systems are derived. A transducer capacitance change of 0.16 pF full scale gave excellent resolution and provided a frequency deviation of 0.75 MHz for a 100 MHz FM oscillator. Although the present design of the capacitive accelerometer was optimized by using units of 0.635 cm diameter, construction of experimental accelerometers as small as 0.36 cm (0.14 in.) diameter has demonstrated the feasibility of further miniaturization.
Author

N72-31480# ARO, Inc., Arnold Air Force Station, Tenn.
WIND TUNNEL TEST RESULTS ON A FLIGHT PATH ACCELEROMETER AT SUBSONIC AND SUPERSONIC SPEED Final Report, 6 Dec. 1971 - 24 Jan. 1972
James C. Uselton AEDC Jun. 1972 17 p refs
(Contract F40600-72-C-0003; AF Proj. 6903)
(AD-742994; ARO-VKF-TR-72-14; AEDC-TR-72-45) Avail: NTIS CSCL 14/2

A test program was conducted to obtain the damping characteristics of the vanes and to provide a flow calibration of a newly developed flight path accelerometer (FPA). After earlier calibration results identified an interference problem from the sideslip vane strut on the angle-of-attack vanes, the sideslip vane was moved rearward, necessitating additional calibration tests. Results are reported.
Author (GRA)

N72-31632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODERN METHODS FOR THE ARTIFICIAL DISSIPATION OF FOG AND LOW CLOUDS AND EXPERIENCE IN USING THESE METHODS FOR AVIATION PURPOSES
I. I. Gaivoronskii, L. I. Drasnovskaya, and A. D. Solovev 28 May 1972 15 p refs Transl. into ENGLISH from the book "Tr. Konf. po Problemam Aviats. Meteorol," 1969 p 158-167
(AD-743026; FTD-HT-23-415-72) Avail: NTIS CSCL 04/2

The report contains review methods for the artificial dissipation of low-level clouds and fogs. A classification of dissipation methods is given. The classification was made on the basis of the physical processes capable of leading to an improvement of visibility in a fog. The classification makes it possible to analyze any modification methods by comparing them with the most characteristic methods listed in the table. It is proposed that the specific expenditures on energy (reagent) during a definite period be regarded as the principal criterion of method efficiency.
Author (GRA)

N72-31639# Joint Publications Research Service, Arlington, Va.
AERONAUTIC NAVIGATION EQUIPMENT
26 Aug. 1970 80 p refs Transl. into ENGLISH from various issues of Izv. Vyssh. Ucheb. Zaved., Priborostr. (Moscow)
(JPRS-51241) Avail: NTIS HC $6.00

The design, development, and performance of components of air navigation systems are examined. Subjects discussed are: (1) instrumental errors in gyroscopes, (2) error influence of accelerometer on measuring angular velocity, (3) magnetic moment of magnetized gyroscope, (4) drift of a gyroscope on a rotating base, and (5) inertial navigation system errors due to integration inaccuracy.

N72-31652# Committee on Post Office and Civil Service (U. S. Senate).
AIR TRAFFIC CONTROL CAREERS
Washington GPO 1972 99 p refs Hearing on H.R. 8083 before Comm. on Post Office and Civil Serv., 92d Congr., 2d Sess., 13 Mar. 1972

Avail: Comm. on Post Office and Civil Serv.

The development of a career program and greater flexibility in management of air traffic controller careers is discussed at this hearing. G.G.

N72-31653# National Aviation Facilities Experimental Center, Atlantic City, N.J.

VISUAL APPROACH PATH INDICATOR (VAPI) EVALUATION Final Report, Jul. 1971 - Jul. 1972

Robert F. Gates and Thomas H. Paprocki Sep. 1972 16 p refs (FAA Proj. 071-312-12x)

(FAA-ARD-72-49; FAA-NA-72-64) Avail: NTIS HC $3.00

The Tri-color Visual Approach Path Indicator (VAPI), as modified for improved indentification, was evaluated for suitability as part of a two-segment visual approach slope indicator system, and for possible incorporation into the National Airspace System. The unit was tested, using the standard Simple Abbreviated Visual Approach Slope Indicator (SAVASI) system as a control for comparison, to determine effectiveness, environmental suitability and dependability of operation. The test results lead to the conclusion that, for a number of valid reasons, the VAPI unit was markedly inferior to the SAVASI system, and should not be considered either for use in the two-segment VASI, or for inclusion within the National Airspace System. Author

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N72-31654# National Aviation Facilities Experimental Center, Atlantic City, N.J.

VASIS SIGNAL TRANSITION ZONE AND COLOR MODIFICATIONS Interim Report, Jul. 1971 - Jul. 1972

Robert F. Gates and Thomas H. Paprocki Sep. 1972 25 p (FAA Proj. 071-312-11X)

(FAA-ARD-72-91; FAA-NA-72-73) Avail: NTIS HC $3.25

The results of a portion of the overall project effort to develop an improved Visual Approach Slope Indicator System (VASIS) are presented. A method of decreasing the VASI signal pink transition zone was evaluated and the effect of substituting different color density and hue red filters was studied. As a result of the testing, it was concluded that the standard VASI signal can be significantly improved by a slight modification to the geometry of the transition bar and by substitution of different filters. Author

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N72-31680# Air Force Academy, Colo. Frank J. Seiler Research Lab.

BASE MOTION ISOLATION OF A TWO AXIS BEAM DEFLECTOR

Gary C. Comfort May 1972 21 p refs

(AF Proj. 7904)

(AD-743002; SRL-TR-72-0008) Avail: NTIS CSCL 17/8

The base motion isolation characteristics of an optical deflector with a two-axis gimbal support are investigated. The particular configuration of the beam deflector system considered utilizes rate integrating gyros to provide a rate inner control loop with an optical tracker providing an outer position control loop. Base motion isolation is partially achieved by the gimbal support assumed to be frictionless. However, input beam motion relative to the optical surface of the beam deflector is shown to produce large excursions of the output beam. As a result, a feed-forward control loop is added to measure and compensate for input beam motion, i.e., base motion. Author (GRA)

N72-31777*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FACTORS AFFECTING ALTITUDE RELIGHT PERFORMANCE OF A DOUBLE-ANNULAR RAM-INDUCTION COMBUSTOR

Donald F. Schultz and Edward J. Mularz Washington Sep. 1972 28 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland, Ohio

(NASA-TM-X-2630; E-6788) Avail: NTIS HC $3.00 CSCL 21H

A test program was conducted to evaluate the altitude relight capabilities of a short-length, double-annular, ram-induction combustor which was designed for Mach 3 cruise operation. The use of distorted inlet-air flow profiles was tried to evaluate their effect on the relight performance. No significant improvement in altitude relight performance was obtained with this approach. A study was also made to determine the effects of the reference Mach number, the fuel temperature, and the fuel volatility (ASTM-A1 against JP-4) on the altitude relight performance. Decreasing the reference Mach number, increasing the fuel temperature, and using more volatile fuel all decrease the combustor pressure necessary for relight. Author

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N72-31780*# Avco Corp., Lowell, Mass. Systems Div.

HIGH TEMPERATURE COMPOUNDS FOR TURBINE VANES

W. H. Rhodes and R. M. Cannon, Jr. Sep. 1972 70 p refs (Contract NAS3-14333)

(NASA-CR-120966; AVSD-0336-72-CR) Avail: NTIS HC $5.50 CSCL 21E

Fabrication and microstructure control studies were conducted on SiC, Si3N4, and composites based on these compounds. Charpy mode impact testing to 2400 F established that beta-spodumene, lithium aluminum silicate, coated Si3N4, Si3N4 derived from alpha-Si3N4 powder, and SiC containing 5-25 v/o chopped C fibers had the most promising strengths. Several other composite systems had excellent microstructures and could prove interesting materials in the future. Stress-rupture testing on Si3N4 established that increasing 2000 F - 100 hour strengths were obtained for increasing grain size to at least 5 micrometers, increasing density and possibly increasing phase purity. These parameters became less important at 2400 F where it is thought a grain boundary phase controls strength. Author

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N72-31781# Smithsonian Institution, Washington, D.C. Air and Space Museum.

THE CURTISS D-12 AERO ENGINE Annals of Flight, No. 7

Hugo T. Byttebier 1972 115 p refs

Avail: SOD $0.75

The history of the Curtis D-12 aircraft engine is presented. The design, engineering, and manufacturing of various types of the D-12 engine are discussed. The application of the engine in a series of aircraft is described. Line drawings, illustrations, and photographs are included to clarify text. P.N.F.

N72-31783*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR INVESTIGATION OF A TURBINE FOR HIGH-TEMPERATURE-ENGINE APPLICATION. 4: TWO-STAGE TURBINE PERFORMANCE

Warren J. Whitney, Harold J. Schum, and Frank P. Behning Washington Sep. 1972 27 p refs

(NASA-TN-D-6960; E-6912) Avail: NTIS HC $3.00 CSCL 21E

The efficiency of a two-stage turbine is discussed. The turbine efficiency was 0.932 for equivalent design operating conditions (speed) and specific work, which compares closely to the value of 0.929 that would be estimated using the first-stage efficiency. The mass flow obtained with the two-stage configuration indicated that the mass flow characteristics of the two stages were closely matched at design operating conditions. The stage work split at these conditions was 0.505-0.495, which was close to the design work split of 0.515-0.485. Author

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N72-31785*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FLIGHT INVESTIGATION OF AN AIR-COOLED PLUG NOZZLE WITH AFTERBURNING TURBOJET

Nick E. Samanich Washington Sep. 1972 56 p refs
(NASA-TM-X-2607; E-6676) Avail: NTIS HC $3.00 CSCL 21E

A convectively cooled plug nozzle, using 4 percent of the engine air as the coolant, was tested in 1967 K (3540 R) temperature exhaust gas. No significant differences in cooling characteristics existed between flight and static results. At flight speeds above Mach 1.1, nozzle performance was improved by extending the outer shroud. Increasing engine power improved nozzle efficiency considerably more at Mach 1.2 than at 0.9. The effect of nozzle pressure ratio and secondary weight flow on nozzle performance are also presented. Author

N72-31786# General American Transportation Corp., Niles, Ill. Research Div.

EDDY CURRENT INSPECTION OF TURBINE BLADES Technical Report, Aug. 1969 - Mar. 1971

I. R. Kraska and H. W. Kamm Wright-Patterson AFB, Ohio AFML Oct. 1971 41 p
(Contract F33615-68-C-1429; AF Proj. 7351)
(AD-743105; AFML-TR-70-266) Avail: NTIS CSCL 21/5

The report presents the results of a program to find a nondestructive field inspection technique which will detect cracks in the leading and trailing edges of jet engine turbine blades. Such an inspection is required because the presence of cracks causes blade failures and can cause the loss of an engine or entire aircraft. Various nondestructive inspection methods were considered and experimentally evaluated in the laboratory. One was found suitable for field testing. This method, which uses eddy currents, is described in detail. Field and lab test data are presented. They include response characteristics, speeds of inspection, and micrographs of typical cracks detected in the turbine blades of built up rotors from various engines. The system is capable of detecting cracks down to 0.020 in. in length, 0.0005 in. wide, and 0.005 in. deep. On built up rotors of an engine having 108 cleaned blades per stage cracks could be detected at an inspection rate of one stage in 15 minutes. The penetrant system could detect cracks at an inspection rate of one stage in 1 hour and 50 minutes. Author (GRA)

N72-31787# Naval Air Propulsion Test Center, Philadelphia, Pa. Aeronautical Engine Dept.

A TEST METHOD FOR NONDESTRUCTIVE TESTING OF FUEL FILTRATION EQUIPMENT USING THERMOGRAPHY

Anthony P. Pontello Dec. 1971 26 p refs
(AD-743081; NAPTC-AED-1963) Avail: NTIS CSCL 14/2

A method for nondestructive testing of fuel filters and other turbine parts has been developed using thermography. Thermography detects temperature differences on an object in the form of a thermal picture (thermogram) through use of the natural infrared radiation which varies with the surface temperature of the object. Thermal changes resulting from material defects are detected by the thermogram through the various colors displayed when the temperature differences are converted electronically to a color television picture. Experimental results also showed thermography to be successful as a nondestructive test device for determining defects in fuel handling equipment. Author (GRA)

N72-31788# Naval Postgraduate School, Monterey, Calif.

VIBRATIONAL AND CHEMICAL NONEQUILIBRIUM IN A STOICHIOMETRIC TURBOJET ENGINE USING KEROSINE-TYPE FUEL M.S. Thesis

Wiley Paul DeCarli Mar. 1972 74 p refs
(AD-742948) Avail: NTIS CSCL 21/5

The effects of vibrational and chemical nonequilibrium on turbine performance were investigated separately. The vibrational model was taken as a pure nitrogen expansion, and the chemical model was taken as the combustion products of a stoichiometric mixture of kerosene and air. The loss of performance of fully frozen flow with respect to the equilibrium flow for each model was determined. The extent to which nonequilibrium will occur was investigated within limited ranges of pressure and temperature. Vibrational nonequilibrium can result in losses up to seven percent with respect to equilibrium flow. Vibrational freezing will be virtually complete a short distance after the throat of the first stator assembly. The losses due to chemical nonequilibrium are insignificant compared to the vibrational nonequilibrium losses. Author (GRA)

N72-31789# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A PROGRAM FOR THE EQUIVALENT TESTING OF GAS TURBINE ENGINES

N. D. Kuznetsov and V. I. Tseitlin 27 Mar. 1972 18 p Transl. into ENGLISH from Probl. Proch. Mashinostr. (Moscow), no. 10, 1970 p 14-19
(FTD Proj. G101)
(AD-743145; FTD-MT-24-2121-71) Avail: NTIS CSCL 21/5

Verifying the reliability of engines for prolonged service life by conducting protracted tests for a given service life does not assure rapid rates of growth of service life. To accelerate the rate of growth of service life and check on the capabilities of engines for prolonged service life it is necessary to conduct accelerated tests according to a program which will assure equivalence of the loading of units and parts for a given service life. In the report the basis for a program of accelerated equivalent tests of engines, compiled from analysis of the factors that exhaust the service life of units and parts is given. Author (GRA)

N72-31790# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A DISCUSSION AND COMPARISON OF JET ENGINE OVERHAUL COSTS M.S. Thesis

Charles I. Boyer 28 Jan. 1972 52 p refs
(AD-743417; SLSR-30-72A) Avail: NTIS CSCL 15/5

An attempt to compare the cost of overhauling a jet engine at alternative overhaul facilities must consider the various costing concepts and methods involved. Stated costs which are presented without a reference to included and excluded cost elements are often misleading and unrealistic. Major differences between a government facility and a private facility in regards to operating costs must be identified and included in any cost comparison. The report presents the basic costing methods pursued by two overhaul facilities and discusses the various cost effects which the two methods are likely to produce. A final cost comparison is presented after consideration of these effects. Author (GRA)

N72-31791# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN APPLICATION OF SPECTRAL ANALYSIS TO TF33-3 ENGINE REMOVAL DATA M.S. Thesis

William D. Arnold and James C. Wendt 28 Jan. 1972 120 p refs
(AD-743401; SLSR-7-72A) Avail: NTIS CSCL 21/5

The thesis investigated two areas relative to removals of TF33-3 engines number of engine removals over time follow some kind of regular pattern. That is, is there cycling present in daily, weekly, monthly or quarterly engine removal data, and, if so, at what frequencies? The second area investigated was the relationship between program activities and TF33-3 engine removals. The program activities used were sorties, flying hours and engine operating hours. Relationships were examined at various time delays between the activities and the engine removals (up to 7-1/2 years). The mathematical tools used in analysis of the engine removal data were autocovariance, spectral analysis, and cross-covariance functions. Author (GRA)

N72-31792# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A STUDY OF FLYING HOURS AND SORTIES AS PREDICTORS OF B-52H ENGINE FAILURES M.S. Thesis

Charles L. Dow and Walter L. Schnee Jan. 1972 88 p refs
(AD-743400; SLSR-6-72A) Avail: NTIS CSCL 21/5

The report attempts to show that engine failures are dependent upon some combination of historical flying hour and sortie data. A method of arrangement was undertaken which transformed the collected data into specific historical groupings. These specific groups of data were then statistically analyzed and a forecasting model developed. The statistical analysis was performed by application of multiple correlation and regression techniques to the data. The Biomedical Series, BMDO2R, Stepwise Multiple Regression package was chosen for use. The predictive power of the model was evaluated, the statistical assumptions tested, research conclusions drawn, and recommendations made for further studies. Author (GRA)

N72-31954# McDonnell-Douglas Co., St. Louis, Mo.
ADVANCED FLAME ARRESTOR MATERIALS AND TECHNIQUES FOR FUEL TANK PROTECTION — Final Technical Report, 28 Dec. 1970 - 26 Nov. 1971
Quentin C. Malmberg and Edwin W. Wiggins Mar. 1972 160 p refs
(Contract F33615-71-C-1191)
(AD-743016; AFAPL-TR-72-12) Avail: NTIS CSCL 13/12

Fuel tank fires and explosions are a major cause of aircraft losses in combat. Considerable research and development has been devoted to exploring fuel tank explosion protection concepts. Nitrogen dilution, chemical quenching and polyurethane foam void filler material emerge as the primary candidate systems. Of these the passive, logistics free polyurethane foam systems appears ideal. Research was conducted to improve and optimize installation concepts and techniques for foam fire and explosion suppression in simulated aircraft fuselage and wing fuel tanks. Configurations designed to accomplish these program objectives were established to provide data that would optimize the system operation from a foam void standpoint. Next material flame arrestor effectiveness was investigated with respect to combustion over-pressure and fuel flow resistance. Thermophysical properties determinations of candidate arrestor materials were conducted. Data of the program were reduced and collated. GRA

N72-31962# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[AEROSPACE RESEARCH AND ENGINEERING ACTIVITIES, 1971]
Jun. 1972 176 p refs In FRENCH; partly in ENGLISH
Avail: NTIS HC $11.00

The activities of ONERA are reported for 1971. Developments in the following areas are included; contract financing, aerodynamics, wind tunnels, flow measurement, materials, patents, and space technology. F.O.S.

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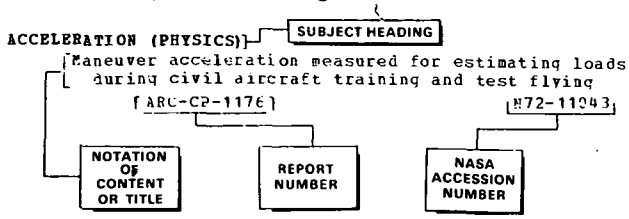

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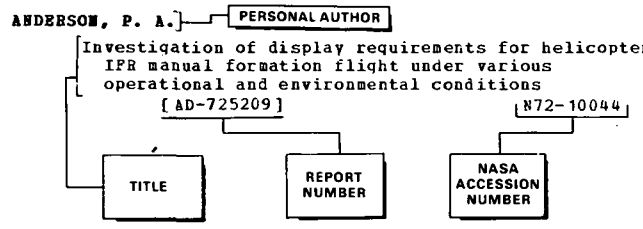

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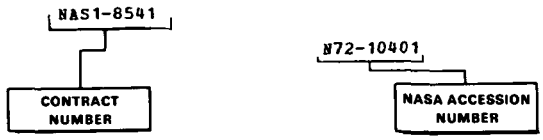

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	6. Performing Organization Code
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