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A Continuing Bibliography with Indexes

NASA SP-7037 (120)
March 1980

National Aeronautics and Space Administration

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 120

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 February 1980 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 297 reports, journal articles, and other documents originally announced in February 1980 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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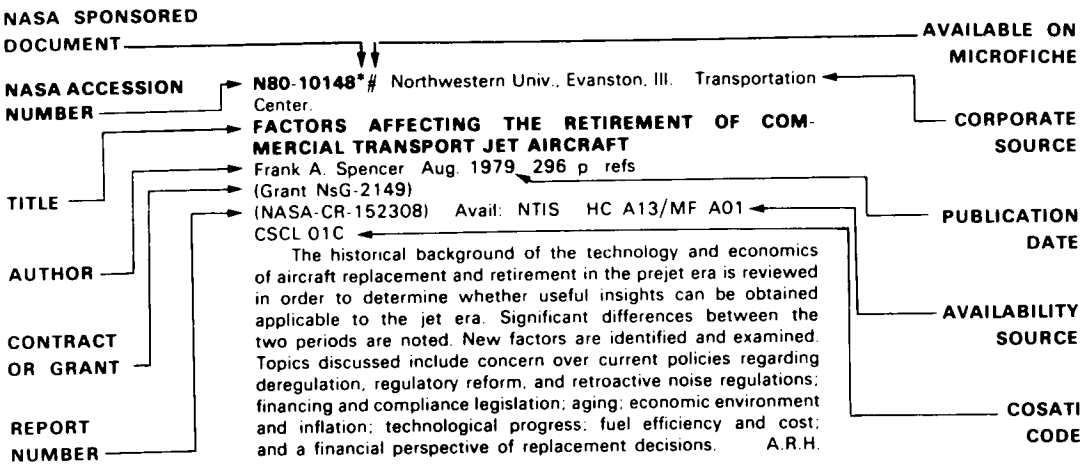

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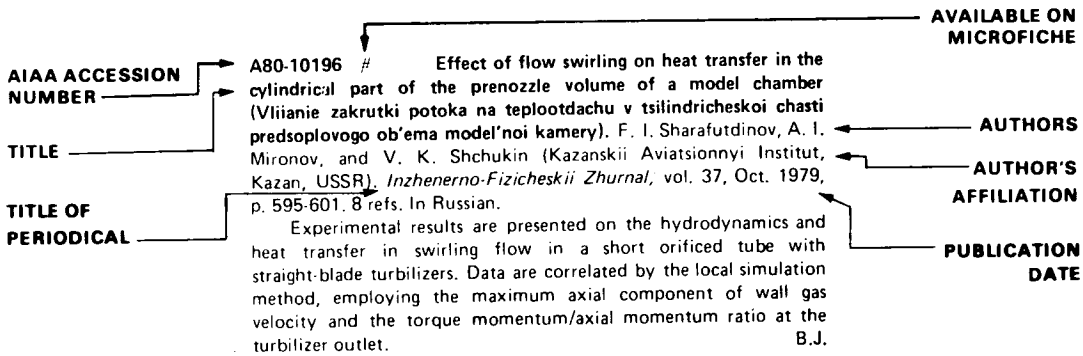

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 120)

MARCH 1980

IAA ENTRIES

A80-13178 **The influence of colors on the visibility of aircraft and ground obstacles (Der Einfluss von Farben auf die Sichtbarkeit von Luftfahrzeugen und Bodenhindernissen).** H.-E. Hoffmann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, West Germany). *DFVLR-Nachrichten,* Nov. 1979, p. 9-11. 5 refs. In German.

The paper reports on studies made to investigate the gray contrast threshold. Attention is given to how the following parameters affected the threshold value: object size, object form, type of background, luminous density, observation time, and location of the image on the retina. Also discussed are studies comparing the results obtained in the laboratory with those from more realistic observation conditions, such as a pilot would encounter. Finally, data are presented which were gathered from observation of identical aircraft painted dark green and white/yellow. M.E.P.

A80-13181 **Wing profile design of the world championship sailplane SB 11 (Tragflügelprofilentwurf für das Weltmeisterschafts-Segelflugzeug SB 11).** K.-H. Horstmann and A. Quast (Deutsche Forschungs- und Versuchsanstalt für Lüft- und Raumfahrt, Institut für Entwurfs-Aerodynamik, Braunschweig, West Germany). *DFVLR-Nachrichten,* Nov. 1979, p. 18-20. In German.

Attention is given to the conflicting performance demands which glider wings must meet. It is noted that a glider should be capable of climbing while circling in an updraft at low speed with a great amount of lift, while it should be able to glide to the next updraft at high speed and with minimal altitude loss. It is shown how the featured design alleviates several problems and leaves no gap between wing and flap as in the commonly used Fowler flap configuration. The use of a constant thickness flap eliminates the need for a flexible contour section which in turn, reduces control effort. In addition, the conventional method of banking with ailerons is retained. Finally, test results are presented demonstrating the improved performance. M.E.P.

A80-13182 **How effective can sound barriers be (Wie wirkungsvoll können Schallschutzwände sein).** D. Lohmann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Braunschweig, West Germany). *DFVLR-Nachrichten,* Nov. 1979, p. 20-23. In German.

The paper investigates the factors involved in the shielding of aircraft noise from surrounding areas. Attention is given to research undertaken with Lufthansa Airlines, noting that sound barriers are most effective when placed near the source of the noise or near the observer who is to be protected. Discussion covers the Huygens-Fresnel principle and theoretical considerations. It is found sound waves passing over the top edge of a barrier can cause an increase rather than a reduction in the noise level, thus a double wall arrangement is described. Finally, model results with single and double wall barriers are covered. It is concluded that placement and shape of the barriers are important prerequisites for their effectiveness. M.E.P.

A80-13212 **Stochastic response secondary surveillance radar (Radar secondaire de surveillance à réponses stochastiques).** L. Milosevic (Thomson-CSF, Divisions Systèmes Electroniques, Arcueil, Val-de-Marne, France). *L'Onde Electrique,* vol. 59, Oct. 1979, p. 84-90. 6 refs. In French.

Garbling (response alteration caused by overlapping) limits the use of secondary surveillance radars. A new so-called stochastic procedure, compatible with current operations is suggested to solve this problem: the procedure consists in using a random process in response to interrogations. After describing the new procedure, we will state the modifications to be carried out on current interrogators, transponders and extractors. The results of theoretical computation are explained by means of curves. The first flight tests carried out at the Bretigny test center (CEV) demonstrate an effective increase of the response probability in a garbling configuration, because of the stochastic procedure. (Author)

A80-13321 **Full-scale flammability tests with experiments on animals in the Aeronautical Test Center of Toulouse.** M. Favand and D. Deviller (Toulouse, Centre d'Essais Aéronautique, Toulouse, France). *Journal of Combustion Toxicology,* vol. 6, Aug. 1979, p. 162-176.

In order to find a correlation between the physico-chemical measurements of toxic gases and smoke emitted during the pyrolysis of aircraft cabin materials and the incapacitation and intoxication of laboratory animals, experiments were carried out at the Aeronautical Test Center at Toulouse, France. A fire was started in a mock-up section of an airplane cabin, from which gas and smoke then traveled to the exposure chamber, where rats were put inside individual, freely rotating tumble cages, and a rabbit in a nose exposure cage. During the experiments, analyses of gases (oxygen, carbon monoxide, carbon dioxide and hydrocarbons), using infrared absorption and gas chromatography techniques, were made. Temperature, smoke density, and heat flux also were measured. The exact moment of the rats' incapacitation was determined by testing their reaction to electric shocks; later, autopsies were performed with cervical and pulmonary tissue samples analyzed. The intoxication of the rabbit was determined by electrodes which measured its breathing, cardiac and cerebral rhythms. Details of the installations are given. J.B.

A80-13343 **Structural fatigue experiments (Trabajos de fatiga structural).** *Inta/Conie,* July-Sept. 1979, p. 12-16. In Spanish.

Fatigue testing on the horizontal stabilizer of the C-101 gave highly satisfactory results (actual damage 100.2% of the theoretical), but tests had been delayed by broken bolts, iron plates and dynamometers. Part of the solution lay in the very strict tolerances necessary between orifices and bolts, as well as maintaining their lubrication. In addition, after modifying the system of counterbalances, load variation will be above the principal drophammer, with servovalves providing a constant load to the other two drophammers. For greater technological capacity, the future Fatigue

Laboratory, requiring highly skilled personnel and designed for aeronautical and any other type of fatigue testing, is described.
J.P.B.

A80-13369 **Effect of the surface state of gas turbine blading on the blading's aerodynamic characteristics when operating on products of combustion of high-sulphur oil.** I. I. Degtiar, K. V. Olesevich, A. P. Kururuzniak (Odesskii Politekhnicheskii Institut, Odessa, Ukrainian SSR). *(Teploenergetika,* vol. 26, Mar. 1979, p. 67-70.) *Thermal Engineering,* vol. 26, Mar. 1979, p. 190-194. 7 refs. Translation.

A80-13455 # **On behavior of axial compressor blades with variable geometry when using blade cascade measurement data (Betriebsverhalten von Axialverdichterstufen mit Verstellgeometrie unter Verwendung von Schaufelgittermessdaten).** P. Maderitsch. Darmstadt, Technische Hochschule, Fachbereich Maschinenbau, Dr.-Ing. Dissertation, 1977. 127 p. 20 refs. In German.

A method is developed, based on the NACA-65 profile and the design approach used by the Japanese, that calculates the cascade measurement for any design point of a given flow angle, a directional change and an attenuation ratio. Attention is given to the calculation of the design incidence angle and the linear curvature used in determining a necessary directional change. It is determined that this method is suitable for calculating the flow at the partial load and for correcting the nozzle and turbine blade, thus optimizing the compressor blades and fans that minimize the loss of a specific working range.
C.F.W.

A80-13456 # **Calculations of inviscid supercritical subsonic flow past a lifting profile of arbitrary thickness (Berechnung der reibungsfreien überkritischen Unterschallströmung um beliebige Dicke auftriebsbehaftete Profile).** G. Löbert. Darmstadt, Technische Hochschule, Fachbereich Maschinenbau, Dr.-Ing. Dissertation, 1979. 129 p. 37 refs. In German.

The form that a continuous source-sink distribution takes in the vicinity of a compression shock when decelerating from supersonic to subsonic speeds is examined. It is shown that the change of speed in sink layers is equally as large as the change due to the compression shock, verifying that along the current plane an even sink distribution must be taken into consideration when calculating the effects on the lifting profile. Attention is given to calculations of the above-mentioned factors using Prandtl-Glauert transformations, as well as to the conformal representation of a transformed profile on a circle using Theodersen's methods, and to 'parceling' of the flow field.
C.F.W.

A80-13482 **Airfield packages - A help for developing countries.** B. Leigh (Plessey Radar, Ltd., Weybridge, Surrey, England). *Airport Forum,* vol. 9, Oct. 1979, p. 35-38, 40. In English and German.

Airport development is discussed involving a wide range of factors that include project financing for developing countries. Attention is given to the financial arranging of programs into a total airfield package and six advantages of this concept are cited, including credit financing and customer demands. Two examples of such airport packages are the major development programs currently being undertaken for new international airports at Abidjan, Cote d'Ivoire and Garoua, Cameroon; these are discussed in detail giving master plans and other construction data.
C.F.W.

A80-13483 **Easy maintenance improves airfield lighting economy.** R. Erni (Erni und Co., Zurich, Switzerland). *Airport Forum,* vol. 9, Oct. 1979, p. 45, 47-52. In English and German.

The latest state of the art runway lighting is described for specific areas of a runway and some economic aspects are examined. Two types of elevated approach and threshold lights are discussed such as sealed beam and halogen lamps. Attention is given to inset light fitting and cost saving by eliminating unnecessary maintenance and constructing compact light fixtures.
C.F.W.

A80-13484 **Airfield surveillance by radar.** A. G. L. M. Weijts (Hollandse Signaal Apparaten, Hengelo, Netherlands). *Airport Forum,* vol. 9, Oct. 1979, p. 56-58, 60, 61, 63. In English and German.

The chief operational requirements for a surface movement surveillance system are summarized and the resulting minimum technical requirements that need to be employed are discussed. The Airport Surface Detection Equipment (ASDE) that is used at Schiphol Airport, Amsterdam is presented. Attention is given to cost aspects of the ASDE and to an operational approach to the decision of employing an ASDE system.
C.F.W.

A80-13485 **Hydrants or airfield fuellers.** E. Leistner. *Airport Forum,* vol. 9, Oct. 1979, p. 71-74, 76-78, 80-87. In English and German.

An attempt is made to present the advantages and disadvantages of the two fueling systems in normal use today. The mobile method in which the fuel is taken to the aircraft by airfield fuellers and the static, or hydrant system in which aircraft get their fuel from a pipeline system installed below the apron surface via dispensers, acting as metering and hose vehicles, are described in detail. Attention is given to the dispenser for a hydrant system and to a prototype of a mini-dipenser for operation by one person. Similarities between mobile and static systems are discussed and some safety aspects of each system are noted.
C.F.W.

A80-13504 **Forward sweep - Rockwell's new broom.** G. Warwick. *Flight International,* vol. 116, Nov. 17, 1979, p. 1660-1662.

Fighter aircraft with forward swept wings (FSW), which have the advantages of more useable lift and better low speed handling, are being researched and designed, since such aircraft can give F-16-like capabilities to much smaller planes, thus reducing costs. Specific advantages of FSW design include: wing tips that remain active after inner portions have stalled, better lift-to-drag ratio in high 'g' maneuvers, ailerons that remain responsive after the rest of the wing has stalled, canards, shorter takeoffs and landings, higher flutter speeds, simplified active load alleviation, and easier area ruling to lessen supersonic drag. The disadvantage of FSW design is structural instability, requiring heavier wings, but this weight penalty can be reduced using aeroelastically tailored composite structures - varying the direction of the carbon-fiber plies in the wing skins and the thickness of those skins.
J.B.

A80-13571 **Stability derivatives of blunt slender cones at high Mach numbers.** M. Khalid and R. A. East (Southampton, University, Southampton, England). *Aeronautical Quarterly,* vol. 30, Nov. 1979, p. 559-589. 21 refs.

The paper presents a semi-empirical theoretical model for calculating the effect of nose bluntness on the stability derivatives of oscillating slender cones at hypersonic Mach numbers. The model is based on hybrid blast wave analogy/shock-expansion flow model and is used to obtain closed form analytic expressions for certain stability derivatives for oscillating slender cones. In addition, two models based on zero thickness and finite thickness entropy layers are proposed which are seen to be appropriate to the cases of very small and large noise bluntnesses, respectively. Finally, the results are compared with new and existing experimental data and with predictions of previous theoretical methods.
M.E.P.

A80-13573 **Transition in the infinite swept attachment line boundary layer.** D. I. A. Poll (Cranfield Institute of Technology, Cranfield, Beds., England). *Aeronautical Quarterly,* vol. 30, Nov. 1979, p. 607-629. 17 refs. Research supported by the Ministry of Defence (Procurement Executive).

The transition behavior of the boundary layer which is formed along an infinite swept attachment line has been studied experimentally. Circular trip wires and turbulent flat plate boundary layers

have been used as sources of disturbance and the range of parameters covered has been such that the results are directly applicable to full scale flight conditions. Simple criteria have been deduced which allow that state of the boundary layer to be determined for given geometric and free stream properties. Sample calculations for typical swept wing configurations suggest that the majority of civil aircraft will have turbulent attachment lines in the cruise and that subsequent relaminarisation in regions of favourable pressure gradient is unlikely. (Author)

A80-13695 Statistical characteristics of pressure fluctuations in the flow-separation zone on a plate behind a spoiler. E. V. Vlasov, A. S. Ginevskii, R. K. Karavosov, and M. O. Frankfurt. *(Akusticheskii Zhurnal,* vol. 25, May-June 1979, p. 367-372.) *Soviet Physics - Acoustics,* vol. 25, May-June 1979, p. 208-211. 10 refs. Translation.

The experiments described were carried out to study the structure of the flow and the velocity and pressure pulsations in the separated flow region behind a spoiler. Data on the configuration of the separated region, the pressure pulsation intensities, and their spectra and correlation functions are presented. It is seen that the observed periodicity of the pressure pulsation distribution in the boundary layer may be attributed to the periodic nature of the flow in the mixing layer behind a spoiler, beyond the region of reverse flow V.P.

A80-13699 Experimental studies of helicopter flight conditions and noise. B. N. Mel'nikov (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). *(Akusticheskii Zhurnal,* vol. 25, May-June 1979, p. 450-453.) *Soviet Physics - Acoustics,* vol. 25, May-June 1979, p. 255-257. 5 refs. Translation.

The establishment of a theoretical relationship between helicopter flight velocity and noise is highly complicated by the complexity of the mechanism of excitation and propagation of helicopter noise and by the multitude of factors that affect the noise. In the experiments described, an attempt is made to establish the noise characteristics and the relationship of velocity to noise for the Mi-2, Mi-6, Mi-8, and Ka-26 helicopters. V.P.

A80-13775 # Characteristics and operational conditions of aircraft turbojet engines (Kharakteristiki i ekspluatatsionnye svoistva aviatsionnykh turboreaktivnykh dvigatelei). Iu. A. Litvinov and V. O. Borovik. Moscow, Izdatel'stvo Mashinostroenie, 1979. 288 p. 35 refs. In Russian.

The operational conditions of gas turbine engines are reviewed and attention is given to the influence of these conditions on the characteristics of engine components. Mathematical models of turbojet engines are described and compared with experimental determinations of operational characteristics. The various operating modes of gas turbine engines are discussed, along with startup and stability considerations. B.J.

A80-13800 # Corrosion protection in agricultural aircraft technology (Zashchita ot korrozii aviatsionnoi sel'skokhoziaistvennoi tekhniki). G. G. Krymskii and V. A. Stel'mashchuk. Moscow, Izdatel'stvo Transport, 1979. 96 p. 75 refs. In Russian.

The book presents experimental data on metal corrosion, dissolution of plastics, elastomers, and other materials by agricultural chemicals, as well as characteristics of current corrosion protection methods of agricultural aircraft, helicopters, and aircraft equipment. A general analysis is made of the effect of corrosion processes on reliability of agricultural aircraft technology and flight safety. Information is presented on organization of corrosion protection of agricultural aircraft in civil aviation and aircraft industry repair shops. Corrosion tests of metals and plastics in agricultural chemicals and protective coatings are discussed. A.T.

A80-13825 # Turbomeca - The 'Makila' is in production (Turbomeca - Le 'Makila' sort en série). J. Morisset. *Air et Cosmos,* vol. 17, Nov. 10, 1979, p. 26-29. In French.

The Makila gas turbine engine developed by Turbomeca for medium-weight (seven- to eight-ton) helicopters such as the Super Puma is discussed. Steps in the Makila development and testing programs are outlined, and the production schedule and project financial support breakdown are presented. Improvements to the Turmo engine incorporated in the Makila are discussed, noting the effect of Turmo experience in enabling the Makila schedule to be met. An initial engine maintenance interval of 2000 h is pointed out. The components of the Makila engine are described, including the air intake casing, the axial and centrifugal compressors, the annular combustion chamber, the gas generator turbine wheels, the two-stage turbine, the transmission system, the control system and the operational regimes, and the comparative simplicity and low acquisition cost of the Makila in relation to its competitor, the General Electric T 700, are emphasized. A.L.W.

A80-13998 A sea-distress signal via satellites (Ein Seenotrufsystem über Satelliten). W. Goebel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, West Germany). *Astronautik,* vol. 16, no. 3, 1979, p. 76. In German.

A sea-distress signal system, operating on the maritime satellite frequency at 1600 MHz, with a maximum transmitting path of 40,000 km (to the satellite) and a sending time of eight minutes, is discussed. Two systems are examined, that consist of a waterproof transportable machine employing preloaded Ni-Cd cells and a sea-distress signal buoy that automatically begins transmitting signals when it becomes immersed in water. C.F.W.

A80-14050 # Radio and optical flight support systems and communications in civil aviation (Radiosvetotekhnicheskie sredstva obespecheniia poletov i organizatsiia sviazi v grazhdanskoi aviatsii). A. P. Bamburkin, I. E. Kudriasov, and G. I. Oliferenko. Moscow, Izdatel'stvo Transport, 1979. 344 p. In Russian.

The work describes such systems as radar air traffic control, air navigation, and aircraft communications. Attention is given to the design and principles of operation of landing systems, beacon systems, optical landing systems, and radio communication systems. B. J.

A80-14100 # Automatic control systems for flight vehicles (Sistemy avtomaticheskogo upravleniia letatel'nymi apparatami). V. I. Kozlov. Moscow, Izdatel'stvo Mashinostroenie, 1979. 216 p. 43 refs. In Russian.

The textbook outlines the principles of construction, block diagrams and functional circuits, and characteristics of various types of control systems in flight vehicles. The operation of gyroscopic devices is described. Attention is given to a discussion of Pontriagin's maximum principle, analytical design of controllers, and Kalman-Bucy discrete and continuous filters. Aspects of controllability, observability, and modal control are discussed. Theoretical foundations of optimal control in game situations are presented. Illustrative examples supplement the text. S.D.

A80-14175 # Instrument flight rules approach (Zakhod na posadku po priboram). S. A. Mikoian and A. G. Korbut. Moscow, Voenizdat, 1979. 72 p. In Russian.

In this work, the IFR approach is discussed, in a popular form, by a test pilot and a flight engineer. The use of autopilots during bad-weather landings of various types is described. Some means of improving training efficiency are suggested. V.P.

A80-14196 # Airborne semiconductor radiometers (Samoletnye radiometry na poluprovodnikovykh priborakh). A. G. Semin, Iu. B. Khapin, and A. N. Sharapov. *Radiotekhnika,* vol. 34, Sept. 1979, p. 42-45. In Russian.

A number of microwave superheterodyne semiconductor radiometers with input mixers have been developed for remote sensing of the atmosphere and underlying surfaces. The radiometers operate at frequencies of 89, 37, and 20 GHz. This paper presents a brief description of radiometer units and subunits. B.J.

A80-14370 # Application of automated system to air traffic control (Primenenie avtomatizirovannykh sistem dlia upravleniia vozdushnym dvizheniem). V. M. Kein, A. I. Krasov, G. A. Kryzhanovskii, S. M. Fedorov, and V. V. Grachev. Moscow, Izdatel'stvo Transport, 1979. 400 p. 45 refs. In Russian.

Emphasis in this book is placed on the elements of the theory of automated control and the principles of designing automated systems for air traffic control. Computer-aided guidance and control techniques are discussed, along with synchronized discrete-address beacon systems, and various displays. The optimal horizontal guidance law for aircraft in terminal areas is examined. V.P.

A80-14412 MRCA Tornado - Achievement by international collaboration. B. O. Heath (British Aerospace, Aircraft Group, Preston, Lancs., England). *(European Pioneers' Day, Paris, France, Apr. 26, 1979.) Aeronautical Journal,* vol. 83, Sept. 1979, p. 329-343.

The fighter aircraft Tornado, developed jointly by the United Kingdom, Germany and Italy, is powered by two Turbo-Union RB.199 engines, is 55 ft. long, and has variable-sweep wings (span: 46 ft. at 25-degree sweep, 28 ft. at 68-degree sweep) and a Doppler-monitored inertia-navigation system with displays, including moving map. The Tornado's basic structural material is light alloy, and in comparison with other fighters it shows excellent handling and maneuverability, adequate thrust-to-weight ratio, and high density; it replaces the Phantom, F104, Lightning, Buccaneer, Vulcan and Canberra aircraft. The international collaboration involved in terms of management and division-of-work decisions, as well as its benefits, some political, some pragmatic (NATO interoperability) are briefly reviewed. J.P.B.

A80-14414 Some measurements of gun blast on a lightning aircraft. D. G. Mabey (Royal Aircraft Establishment, Dynamics Laboratory, Bedford, Hants., England). *Aeronautical Journal,* vol. 83, Sept. 1979, p. 350-354. 13 refs.

Gun blast loads on the fuselage of a Lightning fighter aircraft (XP693) near the muzzle of an Aden aircraft cannon were measured in flight at subsonic, transonic and supersonic speeds, and a detailed comparison with wind tunnel measurements is presented. Results show general agreement with the predictions of Smith's (1974) blast-load theory with regard to variations of speed and altitude, but detailed development of the blast wave is modified by the particular installation. Specifically, blast wave arrival times are in excellent agreement with the theory for muzzle-transducer distance/transformed calibre ratios greater than 20, but the level of the pressure ratios is lowered, apparently by the initial confining of the blast wave; the influence of the length of gun barrel/calibre ratio is well represented by the theory, and independently confirmed by Westine's (1969) correlation of gun blast pressures; gun blast is independent of calibre of the gun; and there are no large transonic effects in blast wave development. J.P.B.

A80-14415 Propulsion characteristics of flapping wings. R. D. Archer, J. Sapuppo, and D. S. Betteridge (New South Wales, University, Kensington, Australia). *Aeronautical Journal,* vol. 83, Sept. 1979, p. 355-371. 8 refs. Research supported by the Australian Research Grants Committee.

A theory to establish the dominant dimensionless parameters describing the thrust performance of wings with sinusoidal time dependent flapping motion and in phase twist response is analyzed in rigorous mathematical fashion, covering circulation, incidence, downwash, gross thrust, induced drag, profile drag, useful thrust, input power for profile drag, total power input, and efficiency. The theory was then tested experimentally, and thrust and efficiency were found to depend on advance ratio (in the range 1-3) and wing twist, with maximum propulsive efficiency being about 83%. J.P.B.

A80-14462 # Luminescence of a supersonic air stream with fuel combustion before the critical nozzle section (Svechenie sverkhzvukovogo potoka vozdukha pri szhiganii v nem topliva pered kriticheskim secheniem sopla). L. A. Zakliaz'minskii, R. S. Rozhtov, and L. A. Safronov. *Fizika Goreniia i Vzryva,* vol. 15, July-Aug. 1979, p. 140, 141. In Russian.

A80-14483 Boresight errors induced by missile radomes. K. Siwiak (Motorola Portable Systems Research Laboratory, Ft. Lauderdale, Fla.), T. B. Dowling, and L. R. Lewis (Raytheon Co., Missile Systems Div., Bedford, Mass.). *IEEE Transactions on Antennas and Propagation,* vol. AP-27, Nov. 1979, p. 832-841. 8 refs.

Radome induced boresight errors are defined in terms of antenna difference port to sum port voltage ratios. The antenna port voltages are derived using the reaction integral for the case of a planar waveguide slot array in the presence of a dielectric radome. Radome transmission uses planar slab results. Both the antenna reflection and the radome shadow contribution are taken into account. Although only linear copolarized comparisons are presented here, the analysis is kept arbitrary with respect to incident and seeker antenna polarizations. Measurements include a line source experiment that tests the antenna model sensitivity to geometry. A simple distributed source experiment, in the form of a planar slab radome with thickness corrugation, tests the influence of transmission through varying wall thickness. Effects of curvature are assessed with an offset hemisphere radome and finally a series of tangent ogive radome comparisons verify the limits of the analysis. A trend for the yaw errors to be less accurate than the pitch errors is consistently noted for the tangent ogive radomes, and this behavior is discussed. (Author)

A80-14495 A Doppler technique for measuring an aircraft's velocity from the spectrum of its HF transmissions. R. W. Jenkins (Department of Communications, Communications Research Centre, Ottawa, Canada). *IEEE Transactions on Antennas and Propagation,* vol. AP-27, Nov. 1979, p. 885-888.

Unmodulated HF signals transmitted by a distant aircraft over the ocean showed a Doppler-spread component of total power 15-25 dB less than the normal coherent component. By interpreting the spread component as caused by nonspecular scatter from the ocean, both the aircraft ground speed and the velocity component in the direction of the observer can be derived without prior knowledge of the exact frequency of transmission. The results using this technique agree with values determined from the aircraft log within a median difference of six percent. (Author)

A80-14510 Base pressure fluctuations. A. I. Shvets. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1979, p. 88-96.) *Fluid Dynamics,* vol. 14, no. 3, Nov. 1979, p. 394-401. 26 refs. Translation.

In the present experiments, cones with half-angles of 10, 20, 40, and 60 degrees and a short cylinder with an elliptical forward portion were used to study the influence of the shape factor and Mach number on aircraft acoustic loads produced by pressure pulsations. The results obtained at Mach numbers between 0.4 and 3.0 are diagrammed and discussed. V.P.

A80-14520 Numerical investigation of the external flow over the after-body and the flow within the nozzle for different jet regimes. R. K. Tagirov. *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1979, p. 169-172.) *Fluid Dynamics,* vol. 14, no. 3, Nov. 1979, p. 465-469. 7 refs. Translation.

A80-14598 Mathematics for computer graphics. R. A. Liming. Fallbrook, Calif., Aero Publishers, Inc., 1979. 390 p. 75 refs. $35.

The principal aim of the book is to establish an up-to-date systematic summary of the rudiments of a discipline for the new professional, the 'numerical design' engineer. The application of analytic geometry to design surfaces, and aerodynamic and structural shapes is discussed. Attention is given to airfoil design applications, analytic descriptions of the conic section, and to an exposition of the evolution of the nonmetric analytical-projective system of streamline shape development with conic sections. Six specific applications to a

critical design system are presented, including (1) landing gear kinematics, (2) engine mount geometry, and (3) procedures for establishing an aileron sub-assembly. C.F.W.

A80-14656 Turbine blade cooling in aero engines - Some new results, future trends, and research requirements. D. K. Hennecke (Motoren- und Turbinen-Union München GmbH, Munich, West Germany). In: Studies in heat transfer: A Festschrift for E. R. G. Eckert. Washington, Hemisphere Publishing Corp.; New York, McGraw-Hill Book Co., 1979, p. 1-16. 24 refs. Bundesministerium der Verteidigung Contract No. ZTL-MTU4,02.

Some cascade and engine test results on cooled turbine blades are presented. It is shown that application of cascade results to engine conditions is still an unresolved problem. Furthermore, a comparison with analytical results reveals some serious shortcomings in the present knowledge of the basic phenomena. This and a discussion of future trends are taken as the basis for a recommendation for future research in this area of engineering science. There is a definite need for a survey paper on turbine blade cooling, including a compilation of available experimental data and prediction methods. S.D.

A80-14700 * # The role of technology as air transportation faces the fuel situation. C. Driver (NASA, Langley Research Center, Hampton, Va.). *Upper Midwest Council, Meeting, Minneapolis, Minn., Nov. 1, 1979, Paper.* 14 p. 17 refs.

The discussion of system integrators whose task is to identify the application and payoff of various research disciplines is limited to aircraft of the subsonic commerical transport type. The aim is to provide a brief description of the existing fuel situation, the progress made in fuel reduction, near-term prospects for further reductions, and long-term prospects for even further reductions, all primarily from the technology point of view. V.P.

A80-14726 Runners of circumferential seals - Requirements and performance. P. C. Stein (Stein Seal Co., Philadelphia, Pa.). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Lubrication Conference, Dayton, Ohio, Oct. 16-18, 1979, ASLE Preprint 79-LC-3B-1.* 10 p.

Runners for circumferential seals are more than adjuncts to the seals. They are major components and must have geometric precision equal to that of the seal ring segments and such precision must be maintained during all phases of the operational profile. Furthermore, in applications where speed, temperature and pressure differential are severe, as in aircraft turbo-engine main shaft seals, the runners must undertake the major share of extracting and dissipating heat. The two main types of runners, overcooled and undercooled, are examined with respect to methods of cooling and heat flow conditions, including thermal gradients and thermal deformations. The general hydraulics of oil flow in and about runners in the intense centrifugal fields created by rapid rotation are examined and oil flow quantities and velocities are evaluated. Insofar as experimental results are available, evidence from testing augments the discussion. (Author)

A80-14742 Third body formation and the wear of PTFE fibre-based dry bearings. J. K. Lancaster (Royal Aircraft Establishment, Farnborough, Hants., England), D. Play, M. Godet (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France), A. P. Verrall, and R. Waghorne (Fulmer Research Institute, Ltd., Stoke Poges, Berks., England). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Lubrication Conference, Dayton, Ohio, Oct. 16-18, 1979, ASME Paper 79-Lub-7.* 10 p. 34 refs. Members, $1.50; nonmembers, $3.00. Research supported by the Direction des Recherches et Moyens d'Essais.

Dry bearing tests have been made with a PTFE fibre/glass fibre/phenolic resin composite against stainless steel to examine the influence of time of sliding, counterface roughness and load. The worn surfaces were examined by optical and scanning electron microscopy, energy dispersive analysis of X-rays (EDAX) and X-ray photoelectron spectroscopy (ESCA). It is shown that the coefficient of friction and the rate of wear are strongly influenced by the formation of third bodies on both sliding surfaces. The structure and composition of these third bodies depend on the time of sliding and the load, but are independent of counterface roughness. Wear of the PTFE composite appears to occur on several scales, and considerable degradation of PTFE is evident within the third body (transfer film) on the counterface. The significance of these observations to the measured friction and wear rates is discussed. (Author)

A80-14794 A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volumes 1, 2, 3 & 4. Congress sponsored by the International Federation of Automatic Control and Ministry of Education of Finland. Edited by A. Niemi (Helsinki University of Technology, Esbo, Finland). Oxford and New York, Pergamon Press, 1979. Vol. 1, 839 p.; vol. 2, 837 p.; vol. 3, 742 p.; vol. 4, 367 p. Price of four volumes, $400.

The Congress focused on electric power system dynamics, thermal power plant control, nuclear power plant dynamics and control, thermal processes in metallurgical industries, computer control of paper plants, chemical process control, heating systems, modelling of physiological systems, clinical health care control, systems engineering, management systems, mathematical programming, applications in control, guidance and control of aircraft, spacecraft navigation and guidance, transportation systems, and environmental and urban systems. Papers were presented on oil yield from oil shale retorting, parameter estimation of radiocardiograms with minicomputers, integrated walking robot modelling and simulation, energy management and singular perturbations in flight mechanics, attitude and orbit control requirements on application satellites and their ground stations, a combined system of vehicle motion control, command and stability systems for aircraft, and optimal orbital transfer strategy for geostationary satellites. A.T.

A80-14809 Variable-sweep optimization. H. J. Kelley (Analytical Mechanics Associates, Inc., Jericho, N.Y.), J. Shinar, and D. Bar-Moshe (Technion - Israel Institute of Technology, Haifa, Israel). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2.
Oxford and New York, Pergamon Press, 1979, p. 1107-1113. 9 refs.

A hodograph-vector-control concept is applied to the optimization of variable sweep in maneuvering flight. For a flight-control mode which is basically manual, with only the sweep control adjusted automatically as a function of flight conditions and the conventional flight controls, the hodograph approach leads to sweep commands dependent on Mach number, lift coefficient, and throttle/speed-brake setting. Some computations for an example are presented. (Author)

A80-14822 * Application of stochastic optimal reduced state feedback gain computation procedures to the design of aircraft gust alleviation controllers. K. Sobel and H. Kaufman (Rensselaer Polytechnic Institute, Troy, N.Y.). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1227-1233. 8 refs. Grants No. NsG-1188; No. NsG-1384.

A stochastic linear model that accounts for process parameter and initial uncertainty, measurement noise, and a restricted number of measurable outputs was used to determine feedback gains useful for reducing the vertical acceleration which results from the presence of a vertical wind gust. Considered in the study were the influence of various feedback configurations, the effects of sensor noise, flight condition changes, and initialization procedures. Results showed that for sixth order linearized longitudinal motion, a controller with

feedback on three states could be designed for effective gust alleviation taking into account both sensor noise and flight condition variation. (Author)

A80-14823 A new procedure for linear optimal flight control. H. Kimura and N. Morizumi (Kyushu University, Fukuoka, Japan). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1235-1242.

An extension of Kimura's method (1977) to a form feasible for application to the synthesis of the general flight-control systems that include controller dynamics is presented. The performance index used here includes the time rates of those components of the state vector which represent the plant accelerations in order to impose costs on control efforts. In the resultant closed-loop system, main dynamical modes can be decoupled according to the control multiplicity with response parameters that are very close to the desired ones. An example is given for the synthesis of a longitudinal flight control system. C.F.W.

A80-14824 Command- and stability systems for aircraft - A new digital adaptive approach. U. Hartmann and V. Krebs (Bodenseewerk Gerätetechnik GmbH, Überlingen, West Germany). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1243-1249. 11 refs.

The paper describes digital control and a special stabilization concept which requires only three dynamic parameters of the aircraft to meet the standard quality criteria. Three steps are outlined: (1) a design procedure for the stabilization of the longitudinal motion of the aircraft, (2) the defining of dynamic characteristics of the control loop in terms of damping, eigenfrequency, and overshoot, and (3) the identification of the aircraft parameters. A recursive, weighted least squares algorithm is used which delivers sufficient, fast, and accurate online parameter estimates. C.F.W.

A80-14825 Active multivariable isolation for an helicopter by decoupling and frequency domain methods. G. Schulz (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Dynamik der Flugsysteme, Oberpfaffenhofen, West Germany). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1251-1258. Research supported by the Bundesministerium für Forschung und Technologie.

The application of active control technology for compensation of vibrations generated by the helicopter rotor and transmitted to the cell was investigated. Three electrohydraulic force generators were used as active controllers between the rotor/gearbox unit and the helicopter cell. The multivariable model of the helicopter is first decoupled in three subsystems, and a compensator is developed using frequency domain methods which isolates the cell from the oscillating rotor/gearbox unit at the first harmonic frequency and also fixes the cell to the unit for ascend or descend maneuvers. Finally, it was shown that the poles of the closed-loop system of 24th order can be placed almost arbitrarily, and simulations demonstrated that vibration isolation is achieved by this system guaranteeing maneuverability in ascend or descend maneuvers. A.T.

A80-14826 Follow-up and final-value control of a special non-linear process - A study on optimal aircraft guidance during the final landing phase. H. Strobel (Hochschule für Verkehrswesen, Dresden, East Germany) and A. M. Petrescu (Bucuresti, Institutul Politehnic, Bucharest, Rumania). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1259-1266. 11 refs.

The paper studies the control algorithms needed for an optimal automated aircraft guidance during the final landing phase. A nominal landing trajectory is obtained by means of a nonlinear aircraft model. A feedback controller is designed using a linearized time-varying aircraft and a deterministic Markovian wind model. It is shown that this minimizes the deviations between the nominal and the real trajectories (follow up control) and warrants the fulfilment of soft and hard final conditions (final value control). Finally, both algorithms are tested in simulation studies using a nonlinear aircraft and a stochastic model. M.E.P.

A80-14833 * Optimal washout for control of a moving base simulator. M. Kurosaki (Stanford University, Stanford, Calif.). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2, Oxford and New York, Pergamon Press, 1979, p. 1311-1318. 10 refs. Grant No. NsG-2178.

A general form of an optimal washout filter is derived using state-space linear optimal control theory, and this is applied to the design of washout filters of various types of moving base motion simulators, including the NASA's vertical motion simulator. Attention is given to the linear elements of a washout filter. One of the nonlinearities considered is braking which may be required near the end of the simulator excursion to prevent a crash. Although the general form of the optimal washout filter is applicable to time-variant system, the applications analyzed in the study are restricted to time-invariant cases. V.T.

A80-14838 Fuzzy controls for maintenance scheduling in transportation systems. M. M. Etschmaier (Pittsburgh, University, Pittsburgh, Pa.). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1543-1550. 8 refs.

The paper presents a new approach to scheduling of periodic maintenance by using fuzzy controls to regulate flight hour loads for aircraft. Because of many random effects and due to schedule complexity it is virtually impossible to achieve a precise match between the prescribed and actual utilization of each vehicle. Instead, only fuzzy targets for vehicle utilization are prescribed, with a feedback loop adjusting the targets periodically based only on the actual utilization. A second feedback loop monitors the general performance of the dispatcher and provides a basis for self-learning features of the system. The design of the control system is described, noting that the new trajectories are recalculated every week for each aircraft; the fuzzy controls are discussed which are optimized by considering the angle between the required aircraft trajectory and the average trajectory of all aircraft. A.T.

A80-14839 A simulation model for aircraft sequencing in the near terminal area. A. Andreussi, L. Bianco, and S. Ricciardelli (CNR, Centro di Studio dei Sistemi di Controllo e Calcolo Automatici, Rome, Italy). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 2. Oxford and New York, Pergamon Press, 1979, p. 1551-1558. 5 refs.

The paper develops a simulation model to assist in aircraft sequencing operations in the near terminal area. The main characteristics of the model are defined and the general structure of a terminal area with a variable number of feeded fixes and alternative paths from the fixes to the runways, is considered. The model is designed so as to evaluate different operating policies, and a discrete events simulation philosphy using Fortran is employed. A model application to the Rome terminal area is illustrated. It is concluded that the results obtained show that the model is general enough to simulate the terminal area behavior of any airport. M.E.P.

A80-14859 On some realistic applications of identification methods. J. Richalet, A. Mallet, P. Mereau, G. Prévost, and J.-L. Testud (ADERSA/GERBIOS, Vélizy-Villacoublay, Yvelines, France). In: A link between science and applications of automatic control; Proceedings of the Seventh Triennial World Congress, Helsinki, Finland, June 12-16, 1978. Volume 3. Oxford and New York, Pergamon Press, 1979, p. 1947-1960. 19 refs.

Four practical applications of mathematical modeling are presented in order to demonstrate the usefulness and difficulties of the modeling and identification processes. Attention is given to a physical model of a complex biological process, the physiological regulation of water balance in amphibians by hormonal control of the permeability of the urinary bladder, and the explanatory nature of the model in facilitating the exchange of information between experiments and hypothesis is emphasized. Representation models, in which the parameters are not intended to be understandable in physical terms, are also described for the diagnosis of wear in a fleet of jet engines, on-line identification for the self-adaptive control of an aircraft and the identification of a complex multivariable industrial process, namely the supervisory control of a steam generator. Modeling in these applications is used as an information reducing technique, as a basis for control, and as an identification technique, respectively. Theoretical limitations and practical difficulties, to model making are also discussed. A.L.W.

A80-14944 Error analysis of an algorithm for magnetic compensation of aircraft. S. H. Bickel (Texas Instruments, Inc., Dallas, Tex.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-15, Sept. 1979, p. 620-626.

The Tolles and Lawson (1950) equations were programmed on the IBM 370-65 computer. The least mean squared (LMS) solution of these equations, which was developed for a microprocessor compensation program, was also simulated on the IBM 370 computer. By measuring the simulated figure of merit (FOM) before and after applying compensation, several types of error were studied. It was found that the error introduced by truncation effects on a 16-bit microprocessor limits the FOM to 50 milligammas. Effects such as hysteresis which cause a time-varying field produce time variations in Tolles and Lawson coefficients. It is suggested that whitening and/or adaptive techniques could be used to minimize such variations. V.T.

A80-14947 Pulse compression results using metallic reflective array lines. J. T. Godfrey, C. H. Grauling, and C. E. Nothnick (Westinghouse Electric Corp., Systems Development Div., Baltimore, Md.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-15, Sept. 1979, p. 673-682. 28 refs.

Radar pulse-compression results are presented for the first reflective-array compressor (RAC) dispersive delay lines (DDL) with both metallic reflecting arrays and phase-compensating films. The time-bandwidth product of the devices reported is approximately 400. Operation in a recirculation loop with a 37.5-dB Taylor weighting filter yielded 36-dB near-in range sidelobes. RMS phase errors less than 0.71 degrees across the band were achieved. Greater than 50-dB rejection of spurious response is achieved in the far-out range gate region. The potential for high-quality cost-effective fabrication of metallic RAC DDL for system applications is explored. (Author)

A80-14949 * Tradeoff between picture element dimensions and noncoherent averaging in side-looking airborne radar. R. K. Moore (Kansas, University, Lawrence, Kan.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-15, Sept. 1979, p. 697-708. 13 refs. Contract No. JPL-954169.

An experiment was performed in which three synthetic-aperture images and one real-aperture image were successively degraded in spatial resolution, both retaining the same number of independent samples per pixel and using the spatial degradation to allow averaging of different numbers of independent samples within each pixel. The original and degraded images were provided to three interpreters familiar with both aerial photographs and radar images. The interpreters were asked to grade each image in terms of their ability to interpret various specified features on the image. The numerical interpretability grades were then used as a quantitative measure of the utility of the different kinds of image processing and different resolutions. The experiment demonstrated empirically that the interpretability is related exponentially to the SGL volume which is the product of azimuth, range, and gray-level resolution. V.T.

A80-14950 Magnetic position and orientation tracking system. F. H. Raab, E. B. Blood, T. O. Steiner, and H. R. Jones (Polhemus Navigation Sciences, Inc., Essex Junction, Vt.). *IEEE Transactions on Aerospace and Electronic Systems,* vol. AES-15, Sept. 1979, p. 709-718. 16 refs.

Three-axis generation and sensing of quasi-static magnetic-dipole fields provide information sufficient to determine both the position and orientation of the sensor relative to the source. Linear rotation transformations based upon the previous measurements are applied to both the source excitation and sensor output vectors, yielding quantities that are linearly proportional to small changes in the position and orientation. Changes are separated using linear combinations of sensor output vectors, transformed to the desired coordinate frame, and used to update the previous measurements. Practical considerations for a head-tracking application are discussed. (Author)

A80-15082 # New trends and possibilities of propeller development (Nove smery a moznosti rozvoje leteckych vrtuli). Z. Hujecek. *Zpravodaj VZLU,* no. 3, 1979, p. 105-111. 7 refs. In Czech.

A parametric analysis method is developed for the design optimization of a propeller aircraft. Four-, five-, and six-bladed propellers for the same engine shaft horse power and specific static thrust are compared. Techniques for achieving airframe/powerplant optimization are described. B.J.

A80-15083 # Parameter selection for aerodynamic design of propellers (Moznosti volby konstrukcnich parametru pri adaptaci vrtule z hlediska aerodynamiky vrtule). J. Sveda. *Zpravodaj VZLU,* no. 3, 1979, p. 113-119. In Czech.

Propeller aerodynamic design procedures are reviewed with particular emphasis given to blade-tip Mach number as a parameter influencing propeller noise. A concept of aerodynamic 'adaptation' is described and illustrated by an example concerning the determination of propeller diameter limits. B.J.

A80-15084 # Design solutions for highly loaded stages of radial compressors (Prispevek k reseni vysoce zatizenych stupnu radialniho kompresoru). V. Vanek. *Zpravodaj VZLU,* no. 3, 1979, p. 121-129. 10 refs. In Czech.

The current status of radial compressor technology is briefly reviewed. This is followed by a description of methods for designing and developing rotors and diffusers of radial compressor stages. Particular emphasis is placed on the first stage of predevelopment of radial compressors. B.J.

A80-15085 # Limitation of the content of harmful substances in aircraft engine exhaust gases - New requirements on combustion chambers (Omezeni obsahu skodlivin ve vyfukovych plynech leteckych motoru - Nove pozadavky na konstrukci spalovacich komor). V. Vnuk. *Zpravodaj VZLU,* no. 3, 1979, p. 131-138. 6 refs. In Czech.

The environmental effects of such exhaust-gas substances as carbon monoxide and nitrogen oxides are briefly described, and attention is given to EPA guidelines controlling such emissions. Design requirements for present-day engine combustion chambers, with a view to reducing harmful emissions, are discussed. B.J.

A80-15086 # Utilization of dynamic simulators of aircraft turbine engines (Uplatneni simulatoru dynamickych vlastnosti leteckych turbinovych motoru). J. Barton. *Zpravodaj VZLU,* no. 3, 1979, p. 139-144. 8 refs. In Czech.

The design of dynamic engine simulators is described, with particular application to problems of powerplant control. This introductory paper covers basic variants and general procedures of dynamic simulation schemes. B.J.

A80-15088 # **Analytical modeling of the dynamics of aircraft powerplant subassembly units (Analyticke modelovani dynamiky uzlu leteckych pohonnych jednotek).** Z. Dolezal. *Zpravodaj VZLU,* no. 4, 1979, p. 169-177. 8 refs. In Czech.

The principles of modeling powerplant units on the basis of modern computing techniques are developed. Attention is given to a method for investigating the coupled forced vibrations of complex linear subassemblies or systems with rotating or nonrotating elements. The modeling is based on knowledge of the stability properties of individual components of the system; input parameters for the components can, in simpler cases, be calculated using subroutines or, in more complex cases, they can be determined experimentally. B.J.

A80-15089 # **Life prediction of turbine blades under low-cycle fatigue and creep (Problematika predpovedi zivotnosti turbinovych lopatek v podminkach nizkocyklove unavy a creepu).** J. Statecny. *Zpravodaj VZLU,* no. 4, 1979, p. 179-190. 17 refs. In Czech.

Low-cycle fatigue and creep can limit the life of rotor and stator blades, especially if they are cooled. The present paper notes that these factors must be taken into account during the design stage, in the optimization of blade shape for a given cooling configuration and material. The life prediction process during the design stage and its gradual analytical and experimental refinement during development and the initial phases of operation are outlined. B.J.

A80-15090 # **Reliability and life of aircraft gas turbine engines (Prispevek k problematice spolehlivosti a zivotnosti LTM).** S. Soukup, M. Svoboda, and M. Holl. *Zpravodaj VZLU,* no. 4, 1979, p. 191-198. 6 refs. In Czech.

The role of operational data in the enhancement of aircraft engine reliability is outlined. Methods of obtaining such data are described along with the utilization of this data for the evaluation and prediction of engine reliability. Engine design requirements associated with improved maintenance methods and in-flight testing methods are examined. B.J.

A80-15121 * # **Assessment of airframe noise.** P. J. W. Block (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, Va.). *Journal of Aircraft,* vol. 16, Dec. 1979, p. 834-841. 17 refs.

A component method of airframe noise prediction is used to predict levels of operational and proposed aircraft airframe noise to assess the contribution of airframe noise to community noise levels. This is done after first evaluating the prediction method using newly acquired detailed measurements from full-scale aircraft and models. In the course of the evaluation, modeling techniques of airframe noise sources are examined with attention to scaling. Finally, when used to predict approach airframe EPNLs, the levels fell about 10 EPNdB below current noise regulations and about 5 EPNdB below proposed noise regulations. (Author)

A80-15123 * # **Examination of the flap-lag stability of rigid articulated rotor blades.** K. R. V. Kaza (NASA, Lewis Research Center, Cleveland; Toledo, University, Toledo, Ohio) and R. G. Kvaternik (NASA, Langley Research Center, Structures and Dynamics Div., Hampton, Va.). *Journal of Aircraft,* vol. 16, Dec. 1979, p. 876-884. 20 refs.

A critical examination of flap-lag stability of a centrally hinged, spring-restrained rigid blade in both hover and forward flight is presented. Several differences in the equations of motion for blade flap-lag stability in the existing literature are identified. A rigorous and systematic development of these equations for a rigid articulated blade in forward flight shows the existence of some linear aerodynamic coupling terms associated with blade steady-state flapping and lagging in the perturbation equations. The differences identified are shown to be associated with whether or not the lag hinge flaps with the blade. The implications of these differences on stability are examined, and it is shown that the pitch-lag coupling terms associated with a hinge arrangement in which the lag hinge flaps with the blade have a marked influence on flap-lag stability, depending on the system parameters. (Author)

A80-15124 # **Effects of nonconstant enthalpy addition on fan-nozzle combinations.** G. C. Oates (Washington, University, Seattle, Wash.) and W. M. Presz, Jr. (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.). *Journal of Aircraft,* vol. 16, Dec. 1979, p. 891-893.

Compressor or turbine stage loading may be increased, or the efficiency improved for a given load, through a nonconstant enthalpy addition to the flow along the length of the blade (Dorman et al., 1968). The resultant nonuniform flow at exit from the stage will have losses if the flow is passed through a nozzle for propulsion purposes. The paper considers two limiting cases in estimating the expected effect of flow nonuniformities on engine thrust. For an engine with nonconstant enthalpy addition across the fan stage, but with otherwise perfect components, the flow can be (1) completely unmixed (isentropic), or (2) fully mixed in an ideal constant area mixer before expansion through the nozzle. Although the calculations presented are based on the simplified model of a perfect engine, it is expected that the predicted trends for the ratio of the net thrusts will remain quite accurate. S.D.

A80-15125 # **Estimating aircraft true airspeed using temperatures from two different probes.** C. J. Biter and J. L. Anderson (National Center for Atmospheric Research, Boulder, Colo.). *Journal of Aircraft,* vol. 16, Dec. 1979, p. 893, 894. NSF-sponsored research.

The National Hail Research Experiment has extensively used aircraft to obtain meteorological measurements around and inside hailstorms. During a specific multiaircraft thunderstorm research investigation, the electronic signal from the dynamic pressure sensor on one aircraft was 'lost', rendering the meteorological data useless. The paper describes a procedure designed to estimate the missing true airspeed (TAS) in order to correct the raw meteorological measurements. The discussion covers the underlying concept and equations, along with pertinent test and application. It is shown that an estimate of aircraft TAS can be derived from temperatures measured by two probes with different recovery coefficients. The computation is sensitive to temperature errors and is only applicable to out-of-cloud data. Nevertheless, it can produce a TAS that is sufficiently accurate to correct the raw temperature measurements and can be used in wind computations when the wind field is relatively strong, as in the vicinity of a thunderstorm. S.D.

A80-15126 # **A new look at C sub n beta, dyn.** R. A. Calico, Jr. (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). *Journal of Aircraft,* vol. 16, Dec. 1979, p. 895, 896.

Inertially slender aircraft are known to be spin prone at high angles of attack. Various parameters have been suggested in an attempt to explain and predict spin entry conditions; one of these is the criterion C sub n beta, dyn. The paper demonstrates that this criterion results from a lateral stability analysis of the perturbation equations about a symmetric equilibrium condition using only static derivatives. Also, an expression is developed for this criterion using general body axes. This form reduces to the usual form for the special case of principal axes. Care must be exercised that this special form not be used for other systems of axes. S.D.

A80-15176 # **Method for increasing the accuracy of an airborne geodetic radio rangefinder (Metod povysheniia tochnosti samoletnogo geodezicheskogo radiodal'nomera).** A. I. Belov, A. M. Rasin, and L. S. Goldobina. *Geodeziia i Aerofotos'emka,* no. 4, 1979, p. 42-49. 5 refs. In Russian.

The paper analyzes the accuracy of an airborne two-antenna rangefinder, with a view to reducing errors associated with reflections from the underlying surface. Two components of range error are investigated: fluctuating and determinate. The analysis makes it possible to determine basic design and operational parameters for the rangefinder system. B.J.

A80-15220 * Data and analysis procedures for improved aerial applications mission performance. B. J. Holmes, D. K. Morris (NASA, Langley Research Center, Hampton, Va.), and K. Razak. *American Society of Agricultural Engineers and National Agricultural Aviation Association, Joint Technical Session on Agricultural Aviation Research, Las Vegas, Nev., Dec. 10-13, 1979, ASAE Paper AA 79-001.* 31 p. 13 refs.

An analysis procedure is given and cases analyzed for the effects of wing geometry on lateral transport of a variety of agricultural particles released in the wake of an agricultural airplane. The cases analyzed simulate the release of particles from a fuselage centerline-mounted dry material spreader; however, the procedure applies to particles released anywhere along the wing span. Consideration is given to the effects of taper ratio, aspect ratio, wing loading, and deflected flaps. It is noted that significant lateral transport of large particles can be achieved using high-lift devices positioned to create a strong vortex near the location of particle release. V.T.

A80-15227 # Thermal control systems for pod-mounted avionics. E. F. Swain and G. C. Letton, Jr. (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-2.* 10 p. Members, $1.50; nonmembers, $3.00.

The paper provides information on recent thermal control systems for pod-mounted avionics, shows the trends in pod thermal control provisions, documents important findings (or lessons learned), and encourages the development of better systems in the future. Design requirements and constraints are discussed, along with various possible cooling approaches and procedures for system selection and analysis. Ideas are given for improving thermal control systems on future pod-mounted avionics systems. The best approach is suggested to be a closed-loop system which avoids the use of expendables and provides a self-contained ground cooling capability. S.D.

A80-15229 # Development and characterization of an evaporative cold plate for thermal control of avionic equipment. G. S. Glenn (Boeing Aerospace Co. Seattle, Wash.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-4.* 10 p. 6 refs. Members, $1.50; nonmembers, $3.00.

An experimental program was conducted to develop an evaporative cold plate configuration which would be reasonably free from attitude or maneuver constraints. Cold plate performance expressed in terms of surface heat flux as a function of wall superheat, and the wall temperature distribution, is shown for four cold plate configurations. The fourth cold plate design was tested successfully throughout a wide range of attitudes. (Author)

A80-15230 # Chilled recirculation ECS for aircraft. G. C. Rannenberg (United Technologies Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-5.* 7 p. Members, $1.50; nonmembers, $3.00.

Refrigeration supply temperatures of currently produced air cycle environmental control systems must be maintained above 32 F to prevent icing problems in water separators, ducts, and heat exchangers. However, several new ECS cycles capable of usefully utilizing subfreezing refrigeration potential by chilling recirculation air are now being developed. These candidate schemes simultaneously eliminate icing problems, provide water separation, and usefully cool cabin recirculation air, while efficiently utilizing supply pressures higher than those which would cause ice in conventional systems. The ability to utilize subfreezing refrigeration potential to chill recirculation air results in a significant reduction in the amount of compressed air required to power the cycle, and a corresponding decrease in power and fuel consumption chargeable to the ECS. (Author)

A80-15232 # Environmental control system design for the Tomahawk Cruise Missile. A. B. Walburn and H. M. Dupont (General Dynamics Corp., Convair Div., San Diego, Calif.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-7.* 5 p. Members, $1.50; nonmembers, $3.00.

The design concepts for the environmental control system (ECS) for Tomahawk Cruise Missile are presented. The ECS which is mostly passive uses simple state-of-the-art concepts. Fuel and ram air are the two heat transfer fluids which dump waste heat to the missile surrounding environment. Both ground and flight test data are used to correlate analytical performance prediction models and verify system performance. (Author)

A80-15233 # Aircraft humidification system development. P. F. Halfpenny (Lockheed-California Co., Burbank, Calif.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-8.* 7 p. Members, $1.50; nonmembers, $3.00.

Without the addition of moisture from passengers and crew, aircraft air has a relative humidity of about 4%; this is less moisture than is found in desert areas of the world. The paper describes the British Airways L-1011 humidification system. The system design utilizes potable water from the aircraft tanks and evaporates it by mixing with hot engine bleed air. The discussion covers the requirements for humidification, an analysis of the psychrometric parameters, methods of contaminate control, and water treatment concepts. The present design has been operated over 1500 hours in the laboratory and is now considered viable for aircraft application. S.D.

A80-15234 # Future requirements for environmental control systems in naval aircraft. J. E. McNamara (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-9.* 8 p. Members, $1.50; nonmembers, $3.00.

Avionics reliability and crew performance depend directly on the environmental control system (ECS) in naval aircraft. A discussion of current problems associated with the ECS reveals the adverse effects of ECS deficiencies. Attention is given to an examination of recent developments, along with future requirements and developments. The impact of the ECS on the total aircraft, especially on life cycle costs and take-off gross weight is emphasized. A lightweight ECS proposed by the Navy is briefly discussed, where the term lightweight refers to reducing the aircraft penalty of the ECS. S.D.

A80-15245 # Test and analysis of the ASALM-PTV insulated combustion chamber. W. E. Roberts, E. R. Bowman, and S. Wasserberg (Marquardt Co., Van Nuys, Calif.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-21.* 6 p. Members, $1.50; nonmembers, $3.00. Contract No. F33657-76-C-0355.

Direct-connect ground test simulations of climb-cruise-dive flight trajectories were made on the Advanced Strategic Air Launched Missile - Propulsion Technology Validation (ASALM-PTV) ramjet engine to check structural durability. Thermal protection of the metal shell was provided by a filled, silicone elastomer (DC93-104) with welded CRES 321 stainless steel metal ribbon and radial vent holes. Excessive temperatures caused initial test failure by eroding the DC93-104 insulation. A thermal model of the DC93-104,

incorporating internal insulation heating from combustion gas temperature using a forced connection heat transfer coefficient, temperature nodes with constant heat capacity, internodal heat conduction utilizing an effective conductivity as a function of local insulation temperature, and including shell external aerodynamic heating and backside heating air shroud heat rejection, was concluded to be a satisfactory analytical tool to evaluate a corrective design, after actual test conditions were applied to the model. Dual height ribbon, a change to CRES 310 stainless steel, and elimination of the vent holes showed satisfactory results. J.P.B.

A80-15259 # Helicopter environmental control - Commercial and military solutions. J. B. Phillips (AiResearch Manufacturing Company of California, Torrance, Calif.). *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, 9th, San Francisco, Calif., July 16-19, 1979, Paper 79-ENAs-35.* 6 p. Members, $1.50; nonmembers, $3.00.

Environmental control units for both military, where performance is essential, and executive business, where comfort and low cost are paramount, helicopters use an air-cycle system designed on the simple-cycle principle with similar primary components: the heat exchangers and cooling turbines. The shaft-driven compressor, which leaves engine power virtually undepleted, is preferred for military craft (which have 4000 kw of shaft power versus 1600 kw for commercial), while less expensive engine bleed is acceptable for commercial uses. The following features can minimize the performance penalties of the engine-bleed system: high pressure bleed air is available to power its ejector recirculation system, allowing sub-zero turbine outlet conditions (more cooling capacity); dual (primary and auxiliary) nozzle cooling turbine, and an automatic-manual economy valve which acts as a pressure regulator (limiting bleed flow). J.P.B.

A80-15330 The Kirsten rotor as a wind turbine (Der Kirstenrotor als Windrad). W. M. Pieper (Giessen, Fachhochschule, Giessen, West Germany). *Brennstoff-Wärme-Kraft,* vol. 31, Nov. 1979, p. 441-445. 18 refs. In German.

The paper calculates the output of a Kirsten rotor in terms of the various relationships between peripheral speed and wind speed and for various blade widths. Attention is given to the kinematics and dynamics of the Kirsten rotor. An equation is derived for the numerical evaluation of the rotor output. Finally, a demonstration model tested in a water tunnel is mentioned and comparisons are made with the Darrieus rotor. M.E.P.

A80-15425 Characteristics of a Laval nozzle with gasdynamic regulation. I. S. Varganov (Kievskoe Vysshee Voennoe Aviatsionnoe Inzhenernoe Uchilishche, Kiev, Ukrainian SSR). *(Prikladnaia Mekhanika,* vol. 15, Apr. 1979, p. 97-99.) *Soviet Applied Mechanics,* vol. 15, no. 4, Oct. 1979, p. 351-353. Translation.

Experimental data are presented on the thrust characteristics of Laval nozzles with gasdynamic regulation. Particular consideration is given to the influence of nozzle underexpansion or overexpansion on the thrust coefficient. B.J.

A80-15475 Certain types of separated flow over slotted wings. A. V. Petrov (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR). *(TsAGI, Uchenye Zapiski,* vol. 8, no. 2, 1977, p. 16-25.) *Fluid Mechanics - Soviet Research,* vol. 7, Sept.-Oct. 1978, p. 80-89. 7 refs. Translation.

In the present paper, the results of theoretical and experimental studies concerning the lift characteristics and flow spectra are summarized for angles of attack ranging from -10 to +40 degrees and maximum camber between 0.1 and 0.35. The existence of a reverse flow region just above the laminar boundary layer is demonstrated. The configuration of the separated region is studied as a function of the angle of attack, the slotted-flap angle, the maximum camber, and the Reynolds number. V.P.

A80-15476 An experimental method for investigating the mutual aerodynamic interference of aircraft components at supersonic velocities. L. G. Vasenev and A. M. Kharimonov. *(TsAGI, Uchenye Zapiski,* vol. 9, no. 1, 1978, p. 101-107.) *Fluid Mechanics - Soviet Research,* vol. 7, Sept.-Oct. 1978, p. 90-98. Translation.

A method is developed for the experimental investigation of the aerodynamic interference of components of aircraft. The method is based on the measurement of the natural aerodynamic characteristics of the components with a system of intramodel strain-gage balances. Results of investigations of the interference of a thin delta wing and a cylindrical body with an ogival nose section are given. The tests were run in a wind tunnel with M = 2.0. It is shown that this method provides adequately high accuracy for investigating the contributions of individual components of aircraft to the overall interference loads. (Author)

A80-15477 Experimental check of a direct method for optimizing the aerodynamic shape of bodies in supersonic flows. N. N. Glushkov, D. P. Kromkov, and L. M. Shkadov. *(TsAGI, Uchenye Zapiski,* vol. 9, no. 1, 1978, p. 1-10.) *Fluid Mechanics - Soviet Research,* vol. 7, Sept.-Oct. 1978, p. 99-108. Translation.

The data of an experimental check of a method for calculating the body shape deformation that results in drag reduction are presented. The method uses experimental data on the pressure distribution over the surface of a basic model in the forward flow and the computed (within the scope of linear theory) pressure diagram in the return flow. A check of the method on an unswept wing-fuselage model, with Mach number M = 1.5, showed that the calculated airfoil surface deformation (at constant wing volume) resulted in a 6% reduction in the drag on the model. (Author)

A80-15628 Glider accidents in France in the last ten years (Les accidents de planeur en France dans les dix dernières années). J. P. Crange, G. Dollander, and M. Boulangé (Nancy I, Université, Nancy, France). *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare,* vol. 18, 2nd Quarter, 1979, p. 108-113. In French.

The evolution of gliding as a leisure activity in France over the years 1968 to 1977 is traced, and the circumstances and seriousness of accidents are examined. Consideration is given to the replacement of older, limited performance gliders by recent, classical design aircraft and the modern, high-performance plastic gliders, and to the increase in pilots and flight activity. Glider accidents during the last ten years are broken down by severity to the aircraft, year, total flight time, season, pilot age, flight circumstances and physical injuries, including fatalities, and the role of pilot errors is emphasized. Improvements to glider safety are also discussed. A.L.W.

A80-15630 Helicopter vibrations (Les vibrations de l'hélicoptère). J. Richard (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne, France). *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare,* vol. 18, 2nd Quarter, 1979, p. 124-130. In French.

Helicopter vibrations occuring in the course of hovering and forward flight are examined, with a consideration of the levels acceptable to passengers and crew. The operating principles of the helicopter main rotor in hovering and translational flight are discussed, noting the requirements for flapping and drag hinges in translational flight. It is shown that during the course of translational flight, the main rotor produces periodic excitatory forces due to rotor deformations, as well as blade stalling, the presence of an inversion circle and compressibility effects at the advancing blade; vibrations are also caused by the tail rotor, blade wakes and other rotating equipment. Means of attenuating the transmission of rotor vibrations to the passengers are considered, and the characterization, measurement and evaluation of vibratory levels encountered in various helicopters with various vibration reduction techniques are discussed. A.L.W.

A80-15631 **Presentation of the STRADA trajectory system /landing trajectography system/ (Présentation du système de trajectoire STRADA /système de trajectographie d'atterrissage).** M. Hebert, R. Auffret, R. P. Delahaye, and P. J. Metges. *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare*, vol. 18, 2nd Quarter, 1979, p. 131-135. In French.

The STRADA (French acronym for landing trajectory system) system currently in use by the French Centre d'Essais en Vol to reconstruct the approach and landing trajectories of test aircraft is presented. The development and operational history of the monostatic lidar system, which provides elevation angle, bearing and distance data by laser telemetry, are outlined, and the STRADA station at Bretigny is described. The precision of the STRADA system in determining position and velocity parameters with respect to an ILS beacon is indicated for three phases of automatic approach, and the instrument layout and reliability assurance measures are presented. STRADA activity from 1974 to 1978 is summarized, and advantages including autonomous functioning, rapid data treatment, precision, reliability, and minimal aircraft involvement of STRADA relative to conventional cinetheodolite systems are noted. A.L.W.

A80-15632 **The effect of intermittent aircraft noise on sleep. III (Influence des bruits intermittents d'avions sur le sommeil. III).** M. V. Strumza. *Médecine Aéronautique et Spatiale, Médecine Subaquatique et Hyperbare*, vol. 18, 2nd Quarter, 1979, p. 136-141. 108 refs. In French.

The influences of aircraft noise characteristics and individual characteristics on the sleep of persons subjected to intermittent aircraft noise are reviewed, and conclusions regarding sleep perturbations due to aircraft noise are presented. The effects of noise duration and intensity on the number of wakings per night, total sleep duration and the duration of each stage of sleep are considered, together with effects of the ages, sexes, circadian rhythms and individual characteristics of subjects on their reactions to aircraft noise during sleep. The effects of habituation, noise type, sound intensity and duration, the number of stimuli, the intensity difference between the background and intermittent noises, noise information content, subject characteristics, the depth of sleep and the time of night in which the noise is heard are summarized, noting the major effect of sound intensity on the number of awakenings. A.L.W.

A80-15736 * # **Design of elastomer dampers for a high-speed flexible rotor.** J. A. Tecza, A. J. Smalley (Mechanical Technology, Inc., Latham, N.Y.), M. S. Darlow, and R. E. Cunningham (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Design Engineering Technical Conference, St. Louis, Mo., Sept. 10-12, 1979, Paper 79-DET-88*. 9 p. 26 refs. Members, $1.50; nonmembers, $3.00. NASA-sponsored research.

This paper describes the methods used to design elastomerically damped supports for high-speed, flexible rotor-bearing systems. The procedure consists of using a damped natural frequency analysis to identify stiffness and damping requirements for the supports over the speed range. Optimum values for these coefficients are found and unbalance response analysis is used to calculate expected rotor behavior. Equations for calculating the shear and compressive stiffness and damping of button-type elastomer mounts are given, as is a procedure for their application to the design of the elastomeric mounts. These techniques were successfully applied to the design of damped elastomeric supports for a high-speed rotor, which traverses two bending critical speeds. Results of the testing showed that the rotor was well behaved and showed linear response to unbalance. Measured modal damping exceeded expectations and tests were conducted with both high- and low-loss elastomers, enabling the exploration of the practical range of elastomer damping capability. (Author)

A80-15737 # **Optimization of aircraft undercarriages.** C. Venkatesan and V. T. Nagaraj (Hindustan Aeronautics, Ltd., Aircraft Design Bureau, Bangalore, India). *American Society of Mechanical Engineers, Design Engineering Technical Conference, St. Louis, Mo., Sept. 10-12, 1979, Paper 79-DET-89*. 12 p. 10 refs. Members, $1.50; nonmembers, $3.00.

In this paper, the results of an optimization study carried out for the selection of landing gear parameters of an aircraft are presented. The landing gear parameters are optimized for the two qualitatively different conditions of operation of the aircraft namely landing and taxying. The relative importance of various parameters is brought out and some simple guidelines are suggested for the optimum selection of the landing gear parameters. Finally, a suggestion for employment of a 'dual spring' in the shock absorber is made. This 'dual spring' would ensure optimum conditions of operation of the aircraft for both landing and taxying maneuvers. (Author)

A80-15741 # **Dynamic analysis of rotating asymmetric cross-section blade packet.** J. Thomas and M. Sabuncu (Surrey, University, Guildford, England). *American Society of Mechanical Engineers, Design Engineering Technical Conference, St. Louis, Mo., Sept. 10-12, 1979, Paper 79-DET-93*. 23 p. 12 refs. Members, $1.50; nonmembers, $3.00.

A finite element model for the analysis of vibration characteristics of asymmetric cross-section blade packet in a centrifugal field is presented. One end of the blade is assumed to be fixed at the periphery of a disk rotating about its center, while the other end is connected by a curved shroud. A finite element model based on displacement functions obtained by the integration of strain functions is developed for the shroud and blade assembly, and the effect of the shroud dimensions, stagger angle, rotational speed, disk radius, and distance of shear center from the centroid on the vibration characteristics of blade packets is presented. A method of predicting vibration frequencies of a blade packet from the frequencies of independent vibration modes of its components is developed to predict possible occurrence of the modes of vibration of the packet and to obtain vibration frequency values without involved analysis. A.T.

A80-15742 # **Vibration characteristics of asymmetric cross-section bladed disk under rotation.** J. Thomas (Surrey, University, Guildford, England) and M. Sabuncu. *American Society of Mechanical Engineers, Design Engineering Technical Conference, St. Louis, Mo., Sept. 10-12, 1979, Paper 79-DET-94*. 17 p. 25 refs. Members, $1.50; nonmembers, $3.00. Research supported by the University of Surrey.

This paper presents a study of vibration characteristics of blades attached to an elastic disk under rotating and non-rotating conditions. A finite element model based on a sector element for the disk in conjunction with the wave propagation theory and cyclic symmetry is developed and successfully applied. An aerofoil element for the blade with and without pretwist angle having strong convergence characteristics is used to model the blade. The effect of stagger angle, pretwist angle, the distance between shear centre and centroid, the speed of rotation, and the number of blades on the vibration characteristics of bladed disks are presented in a graphical form. Comparison of theoretical and experimental results shows good agreement. (Author)

A80-15743 # **Finite element analysis of rotating pretwisted asymmetric cross-section blades.** J. Thomas (Surrey, University, Guildford, England) and M. Sabuncu. *American Society of Mechanical Engineers, Design Engineering Technical Conference, St. Louis, Mo., Sept. 10-12, 1979, Paper 79-DET-95*. 13 p. 9 refs. Members, $1.50; nonmembers, $3.00. Research supported by the University of Surrey.

This paper presents a finite element model for the dynamic analysis of an asymmetric cross-section blade. The blade is assumed to be fixed at the periphery of a disk rotating at constant angular velocity. The dynamic stiffness for free vibration of the blade is derived from the strain and kinetic energies using Lagrange's equation. The element model developed has the degrees of freedom assigned in such a way that the compatibility conditions and the

boundary conditions can be incorporated into any system when the displacement compatibilities are considered. The model developed is applied to an aerofoil cross-section gas turbine type blading and the frequencies of vibration and their corresponding mode-shapes are presented for various rotational speeds, stagger and pretwist angles. Good agreement is found with the experimental and theoretical results of other investigators. The convergence characteristics of the element indicates the suitability of this method over other conventional methods of analysis. (Author)

A80-15815 The 'Martello' 3D radar antenna. R. W. Ashton, P. C. Carlier, W. J. Hall, R. I. Henderson, and P. S. Raphael (GEC-Marconi Electronics, Ltd., Marconi Research Laboratories, Great Baddow, Essex, England). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 16-20.

Requirements for radar systems detecting targets in three dimensions are briefly described. Design of the Martello 3D radar antenna is presented with consideration given to a vertical splitting, phase compensation, and horizontal network and dipole elements. The Martello radar employs a mechanical scanning system in the azimuth plane and an IF processing system in the elevation plane. In operation, a sq-cosec-shaped elevation pattern is transmitted, and 8 narrow elevation patterns are received. By interpolation of the received signals, the elevation angle of the target can be determined. The azimuth and range of the target are determined as in a 2D scanning system. V.T.

A80-15827 HF aircraft aerials - Some predicted and measured results. J. I. R. Owen (Royal Aircraft Establishment, Radio and Navigation Dept., Farnborough, Hants., England). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 87-90.

The paper describes a technique for the analysis of the performance of aircraft HF antennas, and an application of the method which led to an antenna configuration enabling the aircraft to transmit and receive simultaneously on HF radio links. A computer program employing wire grid analysis to predict antenna performance is discussed. Use of the program in the development of notch antennas has been demonstrated by a wing root notch installed in the RAE Comet IV flight-test aircraft. This antenna was designed to produce radiation patterns that exhibited different structures and polarizations from those produced by the tail fin notch. The feasibility of using these two notches for simultaneous transmission and reception of HF signals is shown. V.T.

A80-15847 The analysis of an elliptic twist reflecting Cassegrain antenna using GTD. M. Scorer, R. Graham, I. Barnard (Marconi Avionics, Ltd., Borehamwood, Herts., England). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 208-212. 9 refs. Research supported by the Ministry of Defence (Procurement Executive).

The paper discusses the application of the geometrical theory of diffraction (GTD) to the analysis of a typical airborne antenna, the elliptic twist reflecting Cassegrain antenna. The antenna consists of a feed, wire grid subreflector, and a twist reflecting main reflector. Two main areas are examined prior to the full analysis (1) the feed assembly and (2) the performance of solid, wire grid and polarization twisting reflectors. The problems encountered due to the elliptic cross-section of the antenna are analyzed. V.T.

A80-15864 On site determination of vertical beam location and characteristics using statistical method. I. Hunter (Marconi Avionics, Ltd., Basildon, Essex, England). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 292-296.

An immediate way of determining the essential antenna pattern, found by carrying out a simple analysis on a woefully small set of results is examined. The method presented can be used as an extension to the whole polar diagram and may prove its application in similar circumstances of a distant transmitter and a certainty of multipath fading. Statistics of a normalized fade envelope in dB, where A is linear, is tabularly depicted. C.F.W.

A80-15885 Currents induced on crossed cylinders excited by a plane electromagnetic pulse. S. G. Brazier and D. C. Brewster (GEC-Marconi Electronics, Ltd., Marconi Research Laboratories, Chelmsford, Essex, England). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 413-417. Research supported by the Ministry of Defence (Procurement Executive).

The theory of King and Wu (1975) is used to provide the bulk current response of a cross to a step function excitation which is normally incident. The case investigated in detail deals with a cross made of moderately thin cylinders. The response of the cross in the frequency domain exhibits certain resonances and the first four can be accounted for by reference to a simple zero-order theory. For crosses made of fatter cylinders, a step function response may be rather crude, however, the response has similar qualitative features to the previously known results. A modification to the theory is proposed to handle the extra problems caused by reflections in a parallel plate simulator. V.T.

A80-15889 Radiation characteristics of printed slot antenna with a switchable parasitic slot. D. T. Shahani and B. Bhat (Indian Institute of Technology, Delhi, India). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 435-437.

A planar radiating element consisting of a rivetless printed slot fed by a strip resonator and an adjacent parallel parasitic slot excited by a stripline package edge radiation, is described. The excitation of the parasitic slot can be switched off by inserting a metallic plunger at the center of the slot by means of an external switch. Radiation patterns of the element corresponding to the two switching states and those of a two element array for various switching combinations are reported to demonstrate the utility of the parasitic slot in pattern shaping. V.T.

A80-15892 Some novel design techniques for conformal antennas. H. S. Jones, Jr. (U.S. Army, Harry Diamond Laboratories, Adelphi, Md.). In: International Conference on Antennas and Propagation, London, England, November 28-30, 1978, Proceedings. Part 1. London, Institution of Electrical Engineers, 1978, p. 448-452. 6 refs.

Design techniques for conformal antennas are presented including designs for dielectric-loaded cavity radiators quadrature parallel-plate antennas, integrated-random antennas, and edge-slot radiators. Working models designed for a variety of applications have been fabricated for operation in the frequency range from UHF to K-band. It is noted that aside from the weight and space saving features realized and the usage on conformal surfaces, these antennas are efficient and cost effective. Antennas designed and constructed by these techniques are suitable for use in widely diverse applications, e.g., missiles, vehicular communication, spacecraft, telemetry, auto safety, and traffic control. V.T.

A80-15920 Lockheed-Georgia's projects for the 1980s. M. Grangier. *Interavia*, vol. 34, Dec. 1979, p. 1153-1155.

A survey of projects, under consideration by the manufacturer in order to protect and extend its share of the heavy transport market, is presented. These projects include the L-100-30 Combi, a mixed passenger/cargo version of the L-100-30 with 105-107 seats

and over 50,750 lb maximum payload capacity, and the L-400, a twin engine derivative of the C-130 which would be cheaper to acquire and operate than the four engine C-130 and only require a crew of two. Also discussed are the L-100-75 which would incorporate a fuselage extended by 35 ft and C-130 H derivatives such as the C-130 WBS and C-130 VLS. Attention is given to the flatbed project, developed under a contract from NASA. This aircraft would incorporate a skeleton-type airframe to which would be fixed a variety of detachable cabins. Finally, the C-5 Galaxie based LX/MRSA project is covered. In conclusion, it is stressed that with the current economic situation, the most viable projects are those that derive directly from existing programs and also do not imply heavy investments. M.E.P.

A80-16085 Comparative performance measurements on a Savonius rotor with ancillary surfaces. D. V. Nguyen (Thiès, Ecole Polytechnique, Thiès, Senegal). *Wind Engineering,* vol. 3, no. 2, 1979, p. 115-120. 8 refs.

In an attempt to improve the performance of the conventional Savonius rotor, a model rotor was fitted with ancillary surfaces of aerofoil and 'umbrella' form to produce six alternative configurations. Wind tunnel tests on the models showed the performance to be improved in only one case; in the other units tested the drag effect of the ancillary surfaces appeared to predominate over any possible flow improvement. (Author)

A80-16094 Acoustic fatique failure of inlet guide vanes due to intake flow distortions in an aircraft engine. N. R. Keshavan (Hindustan Aeronautics, Ltd., Bangalore, India). *Journal of Sound and Vibration,* vol. 67, Nov. 22, 1979, p. 278, 279.

A80-16170 # Centering and longitudinal static stability of canard aircraft (Sul centraggio e sulla stabilita statica longitudinale del velivolo canard). G. Rotondi (Milano, Politecnico, Milan, Italy). *Ingegneria,* Sept.-Oct. 1979, p. 257-269. In Italian.

A rigorous aerodynamic analysis of canard aircraft (such as the Swedish SAAB 37 Viggen) is presented, showing their superior life, reduced drag, and higher efficiency particularly at high speeds, and comparing them with conventional aircraft. Basic considerations include the conditions of equilibrium, and the aircraft's longitudinal static stability and barycenter. Obtaining the canard aircraft's high lift coefficient, however, depends on the possibility of obtaining correspondingly high lift coefficient values for its elevator, taking pitching moment into account. The Soviet solution appears in their supersonic Tupolev Tu-144, which utilizes a retractable anterior elevator. J.P.B.

A80-16182 A numerical simulation of fog dissipation using passive burner lines. I - Model development and comparison with observations. II - Sensitivity experiments. P. M. Tag (U.S. Naval Environmental Prediction Research Facility, Monterey, Calif.). *Journal of Applied Meteorology,* vol. 18, Nov. 1979, p. 1442-1471. 21 refs.

A two-dimensional model developed to simulate fog dissipation using passive burner lines under cross-wind or no-wind conditions is presented. It is based on Murray's (1970) vorticity model with a stretched vertical grid, a provision for an ambient wind field, and variable eddy exchange coefficients added to it. The model is tested by comparing results to empirical temperature distribution data resulting from burner lines, located both outdoors and in a wind tunnel, positioned in a cross-wind. It is determined that the parameterization of the eddy coefficients influences the resulting temperature profiles most, and that a form in which deformation and buoyancy are summed provides the best results. A coefficient based solely on the deformation or vorticity gradients was inadequate, and several additional experiments which utilize a soil heat flux parameterization support empirical estimates of a 5% heat loss to the soil. A.T.

A80-16271 Seminar on Vibration Control, Pennsylvania State University, University Park, Pa., October 8-12, 1979, Proceedings. Seminar sponsored by the Pennsylvania State University. Edited by J. C. Snowdon (Pennsylvania State University, University Park, Pa.). University Park, Pennsylvania State University, 1979. 682 p. $30.

The paper deals with some modern concepts, theories, and methods associated with the use of damping materials to reduce resonant vibrational amplitudes in structures and reduce structure-borne noise. The topics covered include: damping of rubberlike materials; isolation and absorption of machinery vibration; applications of viscoelastic materials; suppression of the vibration response of beams and plates; isolators with enhanced high-energy performance; reduction of flow-induced vibration of complex structures; design of damping systems and their application; reduction of the vibration response of plates and shells; and the characteristics of multiresonant vibrators and techniques of vibration reduction. V.P.

A80-16272 Design of damping systems and their application. A. Nashif (Anatrol Corp., Cincinnati, Ohio). In: Seminar on Vibration Control, University Park, Pa., October 8-12, 1979, Proceedings. University Park, Pennsylvania State University, 1979. 96 p. 9 refs.

Some design considerations concerning the application of damping to structures, the understanding of their vibrational behavior, and the properties of the damping material are outlined. The effects of temperature, frequency, and strain amplitude on the properties of viscoelastic materials are discussed, and the equivalence of low-temperature and high-frequency effects is demonstrated. Design procedures are described which can be used to evaluate (quickly and accurately) the effectiveness of various surface damping treatments. V.P.

A80-16275 # Technical diagnostics of aircraft gas-turbine engines (Tekhnicheskaia diagnostika aviatsionnykh gaxoturbinnykh dvigatelei). N. N. Sirotin and Iu. M. Korovkin. Moscow, Izdatel'stvo Mashinostroenie, 1979. 272 p. 48 refs. In Russian.

The principles, basic problems, and the mathematical and physical fundamentals of the technical diagnostics of aircraft gas-turbine engines are treated in this book. The influence of malfunctions in the engine systems on the diagnostic information is demonstrated, and methods of detecting malfunctions during engine operation are outlined. Guidelines are given for designing diagnostics systems in the preliminary and final stages of engine design and construction. V.P.

A80-16385 # Maintenance of aircraft, helicopters, and aircraft engines /2nd revised and enlarged edition/ (Remont samoletov, vertoletov i aviatsionnykh dvigatelei /2nd revised and enlarged edition/). L. A. Beilin, Iu. V. Nazarov, and I. I. Zhelezniak. Moscow, Izdatel'stvo Transport, 1979. 264 p. In Russian.

The book presents the organizational basis of civil aviation maintenance and methods of organizing maintenance procedures of aircraft equipment under shop and operational conditions. Basic principles of reliability and durability which determine equipment fitness and necessity of repair are presented, along with the methods of determining its technical condition and analysis of possible design and component defects and their detection methods. Repair of aircraft, components and assemblies, engines and helicopters in operation and in the repair shop is discussed including methods of disassembly and assembly, and testing. A.T.

A80-16395 # Theory of aircraft gas turbines /3rd revised and enlarged edition/ (Teoriia aviatsionnykh gazovykh turbin /3rd revised and enlarged edition/). V. Kh. Abiants. Moscow, Izdatel'stvo Mashinostroenie, 1979. 247 p. 36 refs. In Russian.

The book considers gas-dynamics of cooled turbines and discusses selection of parameters for turbojet, dual cycle turbojet, turboprop, and turboshaft engines. It examines in detail problems of staged gas flow and of the effect of the nonuniform temperature

field ahead of the turbine on its performance. Design of the final turbine stage and application of rectifying screens, automated design of gas turbine components, and computations of flow in the centrifugal turbine wheels and their design are described. In addition, consideration of gas turbine thermodynamics, the theory of multistage turbines, losses in turbines, and design of turbine blades are included. A.T.

A80-16397 **Aerospatiale's double squirrel.** M. Lambert. *Flight International*, vol. 116, Dec. 15, 1979, p. 2009-2012.

The design and features of the AS.355E Ecureuil 2 twin engine helicopter are surveyed, noting that 80% of the structure is common with the single engine version. It is reported that initially the Ecureuil 2 is a VFR machine, but the manufacturer aims to achieve Group A performance certification for public transport operation from helipads and rigs. The aircraft employs two Allison 250-C20F engines which are surrounded by new firewalls which will make the craft the first helicopter to meet the new fire protection norms of the US FAR Part 27, amendment 16. Discussion also covers optional equipment such as blade folding, modifications to dampen vibration, and useful load weight. Finally, attention is given to the manufacturer's working methods. M.E.P.

A80-16462 # **Aerodynamics and dynamics of turbojet aircraft /3rd revised and enlarged edition/ (Aerodinamika i dinamika poleta turboreaktivnykh samoletov /3rd revised and enlarged edition/).** T. I. Ligum. Moscow, Izdatel'stvo Transport, 1979. 320 p. In Russian.

The book presents physical principles of high velocity aerodynamics and the effect of air compressibility on wing and aircraft aerodynamic characteristics. It also examines the takeoff performance and design of swept wing aircraft along with engine characteristics, takeoff performance with different engines, the effect of engine malfunction, optimum altitude gain conditions, horizontal flight, descent, and landing. Problems of flight, stability, and aircraft controllability are discussed in relation to Soviet and international standards; acoustic, meteorological, aerodynamic disturbance, and icing conditions are also considered. A.T.

A80-16594 # **Reliability of aircraft disconnect joints (Nadezhnost' aviatsionnykh raz'emnykh soedinenii).** M. E. Khaimzon, K. A. Krylov, and A. I. Korablev. Moscow, Izdatel'stvo Transport, 1979. 192 p. 32 refs. In Russian.

The book contains information concerning the analysis and reliability of aircraft disconnect joints and break jacks and on the quantitative evaluation of reliability indices from operational and maintenance data. Typical contact-damage and failure of aircraft articulated joints is illustrated, and the failure mechanisms are identified. The influence of the operational conditions, loading parameters, and other factors on the wear of threaded and articulated joints is examined. V.P.

A80-16597 # **Theory of correlation-extremum navigation systems (Teoriia korreliatsionno-ekstremal'nykh navigatsionnykh sistem).** A. A. Krasovskii, I. N. Beloglazov, and G. P. Chigin. Moscow, Izdatel'stvo Nauka, 1979. 448 p. 139 refs. In Russian.

The book presents theoretical principles of the synthesis of the algorithms for a new class of navigation systems using spatial and surface physical fields of the earth (relief fields, anomalous geomagnetic fields, etc.). The synthesis is carried out by means of general and special methods of the theory of optimal estimation, identification, and control. It is shown that the structure of optimal algorithms of estimation in problems of navigation using geophysical fields is such that it involves calculation of analogs of correlation functions and search for extrema. Analytical and numerical studies of correlation-extremum algorithms are presented along with a considerable number of examples of these algorithms. V.T.

A80-16650 **Engine airframe commonality.** *Aviation Engineering and Maintenance*, vol. 3, Nov. 1979, p. 35-37.

By using commonality kits, whereby engines designed for use by more than one aircraft can be converted from one airframe configuration to another, a crew can perform engine conversion in half the time required without them, should an engine have to be removed from the wing. The kits contain numerous, clearly identified engine parts, as well as engine-to-airframe interface components designed to simplify conversion on the flight line. Commonality also allows short-period intermixing of engines in emergency situations. One manufacturer's high-bypass turbofan engine (the CF-6-50) is certified for use by the wide-body A300, B-747, and DC-10. J.P.B.

A80-16826 **Pollutant emission characteristics of future aviation jet fuels.** C. C. Gleason (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio) and J. A. Martone (USAF, Engineering and Services Center, Tyndall AFB, Fla.). *Air Pollution Control Association, Journal*, vol. 29, Dec. 1979, p. 1243-1245. 5 refs. USAF-supported research.

The pollutant emission characteristics of aviation jet fuels with various hydrogen contents, volatilities, aromatic types and end boiling points in single-can and full annular combustors are evaluated in order to investigate the use of lower-quality fuels in situations when petroleum is not readily available. Thirteen test fuels including the standard JP-4 and JP-8 and blends containing 12, 13 and 14% hydrogen by weight obtained by adding monocyclic or bicyclic aromatics were tested in the cannular J79 combustion system and the fully annular F101 combustor at simulated engine idle, cruise, takeoff and dash operating conditions. Results indicate that smoke and nitrogen oxide emissions are dependent on fuel hydrogen content, while CO and hydrocarbon emissions are more dependent on fuel volatility and viscosity. Neither the aromatic type nor the final boiling point are found to produce any significant effect on combustion characteristics, and the low smoke emission levels of the F101 combustor are verified. A.L.W.

A80-16831 # **Evaluation of strength safety factors under multicomponent loading with consideration of material properties scatter (Otsenka zapasov prochnosti pri mnogokomponentnom nagruzhenii s uchetom razbrosa svoistv materiala).** V. I. Tseitlin and D. G. Fedorchenko (Kuibyshevskii Motorostroitel'nyi Zavod, Kuibyshev, USSR). *Problemy Prochnosti*, Sept. 1979, p. 31-33. 7 refs. In Russian.

The paper proposes a method of evaluation of strength under multicomponent loading taking into account material properties scatter using experimental data obtained with separate application of loads. An indestructability probability curve is plotted since fatigue and long-term test results have a large scatter. Expressions are derived for computation of strength safety margin coefficients based on variable and cyclic stresses. Although the proposed method is approximate, its application will cover many loading combinations and provide a more complete description of the load-carrying capacity of the component than currently used estimates based on separate loading tests. A.T.

A80-16949 # **Size distribution and surface area measurements of gas turbine combustor smoke.** W. R. Wyatt, J. A. Clark, J. E. Peters, and A. M. Mellor (Purdue University, West Lafayette, Ind.). *Journal of Energy*, vol. 3, Sept.-Oct. 1979, p. 285-290. 12 refs. Army-sponsored research.

This work is concerned with measurements of mass concentration, size distribution, and specific surface area of soot particles extracted from a model gas turbine combustor. Particles from a variety of fuels including JP-4, Jet A, and DF-2 were collected using a water-cooled stainless steel probe and a heated filter. A centerline mass concentration profile for DF-2, obtained by measurement of sample mass and gas volume, showed concentrations greater than or nearly equal to previously reported results for five fuels. Size distribution measurements, obtained both by counting particles shown on electron microscope photographs and by a Stokes flow settling technique, showed no apparent change in size distribution with axial location. Specific surface area measurements were made to

try to explain the lack of change in size distribution with axial location. The data show a dramatic decrease in the particle specific surface area as the particles travel from 16.5 cm to 29.2 cm downstream of the flameholder. Three hypotheses have been proposed to explain both the size distribution and specific surface area results. (Author)

A80-16954 Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports (Schweissen im Luft- und Raumfahrzeugbau - Konstruktion, Werkstoffe, Schweissverfahren, Wartung; Internationale Sondertagung, 1st, Berlin, West Germany, December 7, 8, 1978, Vorträge). Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH (DVS-Berichte. Volume 53), 1978. 140 p. In German and English.

Particular papers are presented on such topics as the fatigue properties of welded joints, the use of welding in the manufacture of the water tank for the second stage of the Ariane vehicle, electron beam welding of the Spacelab IGLOO structure, and the use of titanium in the aerospace industry. Attention is also given to the following: high temperature brazing using currentless nickel plating; welding in engine maintenance; resistance spot welding of aluminum alloys in airframe manufacture; electron beam and diffusion welding for the construction of Airbus flap tracks; and thermal spraying of aircraft and engine components. B.J.

A80-16955 Future applications of welding technologies in the aerospace industry. U. Krüger (Schweisstechnische Lehr- und Versuchsanstalt, Berlin, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports. Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 1-9.

The coming decade in the field of aerospace engineering will be characterized by efforts to introduce fiber-reinforced materials on a large scale. This will occur at the expense of aluminum with an anticipated increase in the use of titanium. The fact that production and processing of titanium is a costly business will make necessary cost reduction by the use of semifinished parts with dimensions approaching the finished contours, which will then be welded together. Electron beam welding and diffusion welding are suitable for such purposes. In addition to these methods, conventional methods of joining are also being developed. B.J.

A80-16959 Some applications of three welding processes in the aerospace industry. J. Gauthier (Sciaky, Vitry-sur-Seine, Val-de-Marne, France). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports. Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 33-38.

Procedures and equipment used to perform resistance, fusion, and electron beam welding are described. Attention is given to such details as equipment for automatic spot welding, seam welding of a jet engine vane, equipment for TIG welding of boosters, and electron beam welding for jet engine housing repair. B.J.

A80-16961 Fully mechanized circumferential welding for engines. P. Zaremba (Klöckner-Humboldt-Deutz AG, Oberursel, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports.
Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 48-52.

The fully mechanized inert gas tungsten arc welding process has been developed especially for the welding of tubes of small wall thickness. This paper considers the application of this procedure to modern turbine engines and discusses such aspects as welding current supply and control unit, welding head and working table, preparation of welding, and the inspection procedure. B.J.

A80-16963 Series EB welding of high-loaded titanium structures. J. Berggreen and G. Gans (Messerschmitt-Bölkow-Blohm GmbH, Augsburg, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports. Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 59-63.

Electron beam welding of titanium structures is examined with respect to requirements for Ti structures, details of EB welding application, quality assurance, and cost effectiveness. It is noted that the reliability of large EB-welded Ti structures has been demonstrated by static and dynamic and flight tests. B.J.

A80-16966 Situation of welding in engine maintenance. W. Jürgens (Deutsche Lufthansa AG, Hamburg, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports.
Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 72-79.

The current status of application of a variety of welding processes in engine overhaul is reviewed. Attention is given to the following process: TIG; resistance welding; EB welding; plasma arc welding; and brazing. Rapair examples are presented and attention is given to quality control issues. Advantages and disadvantages of the various techniques are discussed. B.J.

A80-16968 Contribution on resistance spot welding of aluminium alloys in airframe manufacturing. U. Krüger (Schweisstechnische Lehr- und Versuchsanstalt, Berlin, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports.
Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 85-97. 15 refs.

The previous use and current status of resistance spot welding are briefly reviewed. This is followed by discussions of corrosion protection and behavior, static strength and fatigue properties, weld bonding, and strain hardening of spots. It is found that resistance spot welding remains a feasible procedure which allows low-cost production solutions in aluminum airframe construction without the sacrifice of any component characteristics. Some of the disadvantages of the process are also examined. B.J.

A80-16970 Electron beam and diffusion welding as an economic procedure for building Airbus-flap tracks. D. Mietrach (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports.
Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 103-113. 6 refs.

Test results confirm the technical feasibility of the proposed concept for the Airbus: namely to convert from steel to titanium for the flap tracks; to use semifinished products that have contours similar to the final contour; to join the latter in modern welding processes; and to obtain the required stiffness by reinforcing the tracks with CFRP laminates. Electron beam and diffusion welds made on these semifinished products resulted in reproducible flawless welds. This was confirmed by NDT as well as fatigue and wear tests. In addition, the new design led to a reduction in direct operating costs. B.J.

A80-16971 Thermal spraying of aircraft- and engine components. M. Malik (Deutsche Lufthansa AG, Hamburg, West Germany). In: Welding in the aerospace industry - Design, materials, welding methods, maintenance; International Conference, 1st, Berlin, West Germany, December 7, 8, 1978, Reports.
Düsseldorf, Deutscher Verlag für Schweisstechnik GmbH, 1978, p. 114-121. 6 refs.

Various applications of thermal sprayed coatings on aircraft and engine components are reviewed. On high strength steel parts (e.g., landing gear) coatings have performed satisfactorily in certain areas; attention is given to the enhancement of the corrosion protection of coatings. In compressors and turbines abradable coatings applied to seal liners have to be produced under controlled conditions so that a compromise between abradability, erosion, density, and coating strength is achieved. Attention is also given to the poor properties of wear-resistant coatings in the case of nonuniform structure. B.J.

A80-16977 **AV-8B Advanced Harrier.** G. Warwick. *Flight International,* vol. 116, Dec. 29, 1979, p. 2127-2132; 2141, 2142.

Technical specifications and test results of the AV-8B Advanced Harrier aircraft replacing the AV-8A are presented. A supercritical aerofoil section improves cruise performance: 23.3% of the aircraft, including the 230 sq. ft. wings, consists of lightweight, corrosion-resistant carbon-fiber composite (graphite epoxy) with no known fatigue life. Other features include underfuselage devices to increase vertical takeoff lift and thrust, rectangular, zero-scarf titanium front nozzles, and supercirculation that generates 6,700 lb of extra STO lift. A standard 21,500 lb-thrust Pegasus 11 powers the 29,750 lb of gross weight, including 9,120 of bombs delivered by the Hughes angle-rate bombing system, which utilizes a combined laser/TV tracker. J.P.B.

A80-17006 # **Resonant wave interactions on a swept wing.** S. G. Lekoudis. *AIAA Journal,* vol. 18, Jan. 1980, p. 122-124. 10 refs.

The nonlinear stability of a three-dimensional boundary layer flow on a swept wing with laminar flow control is considered in terms of resonant wave interactions. For a locally parallel, three dimensional boundary layer flow consisting of a steady mean part and an unsteady disturbance part consisting of wave triads, it is found that the disturbance is governed by the Orr-Somerfeld problem for the case of a three-dimensional boundary layer. A set of quasi-linear, first-order, partial differential equations for the slowly varying disturbance amplitudes is then derived from the resonance conditions. It is shown that the necessary conditions for resonant interaction exist for crossflow instability waves on a typical laminar flow control wing, and implications for the prediction of transitions on swept wings are discussed. A.L.W.

A80-17013 **Prediction of jet noise in flight from static tests.** A. Michalke (Berlin, Technische Universität, Berlin, West Germany) and U. Michel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung Turbulenzforschung, Berlin, West Germany). *Journal of Sound and Vibration,* vol. 67, Dec. 8, 1979, p. 341-367. 32 refs.

The sound intensity of jet noise from aircraft in flight is derived in a coordinate system fixed to the jet engine. For this reason a convected form of the Lighthill equation is solved, with special care taken of jet temperature effects. Under certain assumptions and approximations, the in-flight and static sound intensities are related in a simple manner. Thus the directivity of jet noise in flight can be predicted. The theoretical result is checked with measurements. The agreement is remarkably good. (Author)

A80-17142 # **Influence of burnishing on the structure and durability of elements operating under variable loads (Wplyw nagniatania na konstrukcje i trwalosc elementow pracujacych przy obciazeniach zmiennych).** J. Lunarski (Rzeszow, Politechnika, Rzeszow, Poland). *Technika Lotnicza i Astronautyczna,* vol. 34, Nov. 1979, p. 13-17. 14 refs. In Polish.

Although burnishing is known to be an effective method of improving the durability of structural members, this technique to date has not found application in the aircraft industry. In the experiments described, burnishing alone or in combination with such techniques as heat treatment, polishing, or thermochemical treatment was found to improve the fatigue strength, wear resistance, and corrosion resistance of aircraft elements tested under variable loads. V.P.

A80-17143 # **Analysis of programs for regulating helicopter turbine engines (Analiza programow regulacyjnych turbinowego silnika smiglowcowego).** T. Gajewski (Wyzsza Oficerska Szkola Lotnicza, Deblin, Poland). *Technika Lotnicza i Astronautyczna,* vol. 34, Nov. 1979, p. 27-29. 8 refs. In Polish.

The paper deals with the formulation of principles and programs for regulating two- and single-spool helicopter turbine engines. The influence of programming on engine performance in stand tests, under various environmental conditions, and at high altitudes is examined. Programmed control is studied for take-off and nominal ratings. V.P.

A80-17269 # **Optimization of flight-vehicle control on the basis of equations of motion of a variable-component body (Optimizatsiia upravleniia letatel'nym apparatom po uravneniiam dvizheniia tela peremennogo sostava).** V. I. Piatakov (Akademiia Nauk Ukrainskoi SSR, Institut Kibernetiki, Kiev, Ukrainian SSR). *Kibernetika i Vychislitel'naia Tekhnika,* no. 43, 1979, p. 94-101. In Russian.

The Pontryagin maximum principle is used to handle the variational problem of minimum-fuel vertical flight of a winged flight vehicle. A two-stage algorithm is proposed for calculating the extremum control vector; it is based on a modified Newton method and a descent method and can be realized on digital computer. B.J.

A80-17289 **Airport ground traffic services in the West German Republic and the US open-air policy - Critical remarks concerning Article 9 of the supplementary agreement of Nov. 1, 1978 to the German-American Air Traffic Agreement of 1955 (Flughafen-Bodenverkehrsdienste in der Bundesrepublik Deutschland und Open-Sky-Luftverkehrspolitik der USA - Kritische Anmerkungen zu Art. 9 einer Zusatzvereinbarung vom 1. November 1978 zum deutsch-amerikanischen Luftverkehrsabkommen 1955).** H. Achtnich. *Zeitschrift für Luft- und Weltraumrecht,* vol. 28, Dec. 1979, p. 307-315. 30 refs. In German.

The paper outlines the agreements made on Nov. 1, 1978 between West Germany and the U.S. regarding airground handling services. A discussion of some of the multilateral and bilateral air traffic regional laws is presented, together with a list outlining the rights and jurisdiction of various ground services. C.F.W.

A80-17327 **Airports, railway stations and people.** E. R. C. Roberts. In: Design for passenger transport; Proceedings of the Conference, Nottingham, England, April 6, 7, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 3-8. 14 refs.

The paper considers design and operational problems of airports and railway stations in the U.K. Problems of luggage retrieval, passenger information, food and cleanliness, and passenger waiting are discussed, noting that airline delays can be reduced and the waiting time can be made more comfortable providing facilities in the luggage reclaim area. The actual savings at the duty free shops are lower than advertised, and facilities for the disabled are inadequate. The seven British airports have Consumer Consultative Committees whose function is to consult with airport authorities on matters concerning airport users and neighboring population, and who can improve passenger comfort at airports. The railway stations often require long wait in unheated quarters, do not provide convenient means for luggage transportation, and food is often inadequate. However, the Transport Consultative Committees can improve these conditions, and designers can provide clean and efficient airports and railway stations. A.T.

A80-17328 **Interchange design.** A. A. Wood and I. C. Downs (West Midlands County Council, England). In: Design for

passenger transport; Proceedings of the Conference, Nottingham, England, April 6, 7, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 9-15.

The paper defines three interrelated elements in design of transport interchanges: care and comfort of passenger movement, operator needs, and exploitation of the commercial potential resulting from concentration of passengers. These factors are considered in detail using the design of a new Birmingham airport, linked to road and rail facilities and the New Exhibition Center. The designer's task is to ensure that the passenger can transfer from one mode of transport to another in safety and comfort, which requires his knowledge of transport types and various management needs. The planning of the Birmingham airport, its relationship with the National Exhibition Center and the Birmingham International Station, and airline and travel industry requirements are discussed, including employment, service industries, terminal location and facilities, and customs and immigration procedures. It is concluded that the primary requirement for the designer is to produce civilized surroundings that would make travel attractive. A.T.

A80-17329 Passenger behaviour and expectations at an airport. R. Deighton (British Airports Authority, London, England). In: Design for passenger transport; Proceedings of the Conference, Nottingham, England, April 6, 7, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 39-43.

The paper examines two surveys to assess passenger behavior and expectations at an airport. The first survey observed passengers' actions while passing through the terminal, and the second queried their opinions of the airport and suggestions for its improvement. It was found that the passenger behavior on arrival is almost entirely oriented towards reclaiming their baggage and leaving the airport, while those departing behave more leisurely, making use of the ancillary facilities. The passenger expectation survey showed that they were interested in quality of service, with business passengers primarily concerned with speed, and older passengers with walking distances and baggage assistance. A.T.

A80-17332 The interior design of wide bodied aircraft. G. Molony (British Airways, Hounslow, Middx., England). In: Design for passenger transport; Proceedings of the Conference, Nottingham, England, April 6, 7, 1978. Oxford, Pergamon Press, Ltd., 1979, p. 93-102.

The paper examines the basic constraints to be met in designing large widebody aircraft. The interior design must consider the fuselage dimensions, width of a gangway, and passenger seating; constraints, including weight determined by items carried on aircraft, cost of the interior, and time required to deliver interior equipment are examined. The seat dimensions, the interior materials, safety regulations, and decor to produce an effect of width are discussed, along with food service which may be required to supply food to 350 passengers during a 1-1/2 hr flight. Finally, toilets and baggage handling are considered. The popularity of the twin aisle layout of the widebodied aircraft is established with the public and the resulting lower cost established them with the airlines. A.T.

A80-17334 Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1978 (Nederlandse Vereniging voor Luchtvaarttechniek, Jaarboek 1978). Edited by F. J. Sterk. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1979. 109 p. In Dutch and English.

This collection of papers on aeronautical engineering includes such topics as limitations on the life of aircraft wings, education of aeronautical engineers at the technical high schools of Haarlem and Delft, and soaring flight optimization theory and an application to sailplane design. Attention is also given to achievements and targets of aviation safety and to handling problems through compressor deterioration. B.J.

A80-17335 # Is the structural life of an aircraft wing limited. H. P. L. Vergouwen (Fokker-VFW, Schiphol Airport, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1978. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1979, p. 1.1-1.8.

The Fokker approach regarding structural fatigue of aircraft wings (and other fail-safe parts of the aircraft) is summarized. Some comments on the design and subsequent full-scale testing of existing and future wings are presented. It is concluded that, though wing life is limited, the cracking that occurs during full-scale testing enables the manufacturer to instruct the operator how and when to inspect the aircraft in order to ensure that it is fail-safe. B.J.

A80-17338 # Soaring flight optimization theory and an application in sailplane design. L. M. M. Boermans (Delft, Technische Hogeschool, Delft, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1978. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1979, p. 4.1-4.19. 20 refs.

It is shown that well-known classical theory of sailplane flight, based upon a rather simple atmospheric model, is adequate to cover all previous optimal solutions if it is slightly extended and properly interpreted. This approach, formulated in terms familiar to most sailplane pilots, provides insight into the various optimal flight modes and ultimately leads to a simple plot which may be useful in actual cross-country flying. As an example, consideration is given to optimal aspect-ratio design of a standard class glass-fiber sailplane, taking into account various atmospheric conditions, practical minimum weights, and the use of water ballast. B.J.

A80-17339 # Safety in aviation; achievements and targets. H. Wittenberg (Delft, Technische Hogeschool, Delft, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1978. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1979, p. 5.1-5.26. 13 refs.

This review paper considers statistical data on aircraft accidents, accident rates per aircraft class and world region, and aviation safety in comparison with other means of transport. Particular emphasis is placed on safety criteria and targets. Aircraft accident analysis is examined and attention is given to airworthiness requirements. It is concluded that the future improvement of aviation safety will not result from isolated deliberate actions but has to be attained through numerous small but important improvements in all activities of the aircraft manufacturer, the aircraft operators, and aviation authorities. B.J.

A80-17340 # Handling problems through compressor deterioration. J. P. K. Vleghert (National Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). In: Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1978. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1979, p. 6.1-6.14.

RNLAF investigations have disclosed performance loss and an increased rate of in-flight compressor stalls due to compressor deterioration of some of the 15-year-old engines. Test bed studies showed that significant loss of air mass flow occurred near the surge line under conditions which were not covered by the normal post-overhaul acceptance tests. It was also found that impending stall is always preceded by increasing pressure fluctuations, although the level of these pressure fluctuations varied with different engines. A method was developed to routine-check this phenomenon. B.J.

STAR ENTRIES

N80-12000# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
AEROELASTIC PROBLEMS IN AIRCRAFT DESIGN
1979 534 p Lecture held at Rhode-Saint-Genese, Belgium, 7-11 May 1979
(VKI-Lec-Ser-1979-8) Avail: NTIS HC A23/MF A01

A review of present knowledge in aeroelasticity and the methods used to solve aeroelastic problems are discussed. A modal analysis of aircraft structures and a determination of structural inputs for aeroelastic analyses are presented. Aircraft flutter and dynamic response, wind tunnel flutter techniques, and flight flutter techniques are examined.

N80-12001# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
A SURVEY OF AEROELASTIC PROBLEMS
H. Foersching *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 p 1-15 refs

Avail: NTIS HC A23/MF A01

A survey and a classification of aeroelastic problems are presented. The interaction of the aeroelastic system forces is demonstrated by means of functional diagrams, and the application of operators for the general formulation of aeroelastic problems is shown. Author

N80-12002# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
AEROELASTICITY FROM THE VIEWPOINT OF THE DESIGNER
H. Foersching *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 32 p

Avail: NTIS HC A23/MF A01

The effects of aeroelastic phenomena on aircraft design and development are discussed and illuminated through representative practical examples. A survey of structural dynamic loading problems arising with the development of launch vehicles is presented. A.W.H.

N80-12003# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
MODAL ANALYSIS OF AIRCRAFT STRUCTURES
H. Foersching *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 26 p

Avail: NTIS HC A23/MF A01

The physical and analytical relations of the modal approach, in terms of natural modes and generalized coordinates, for the analytical treatment of dynamic aeroelastic problems of aircraft are demonstrated. Two modal techniques are derived based on the generalized equations of motion of the elastic structure. These are a modal substructure coupling technique, and a modal perturbation method. A.W.H.

N80-12004# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
LIFTING SURFACE DIVERGENCE AND CONTROL EFFECTIVENESS
H. Foersching *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 35 p

Avail: NTIS HC A23/MF A01

The various methods of analyzing static aeroelastic phenomena on high aspect ratio swept and unswept wings are presented. The problems of static aeroelastic divergence, aileron effectiveness, and symmetric and antisymmetric lift distribution are discussed. Examples of the various computation procedures are presented. A.W.H.

N80-12006# Office National d'Etudes et de Recherches Aerospatiales, Leclerc (France).
NEW METHODS FOR GROUND TESTS OF AERONAUTICAL STRUCTURES
G. Piazzoli *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 22 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A23/MF A01

The dynamical identification of structures by classical method, based on the distribution of synchronous multiexcitations appropriate for each modal resonance, is discussed. The inaccuracies of the method when it is applied to complex systems, such as aeronautical structures, are described. Two methods are described. The first method consists in resolving the eigenvalues equations of a complex power matrix. The second method is based on the research of a set of forces which isolate one mode and cancel all others. The data acquisition and processing techniques of the ground tests are described. A.W.H.

N80-12007# Avions Marcel Dassault, Saint-Cloud (France).
PRACTICAL ASPECTS OF THE CALCULATION OF STRUCTURAL VIBRATIONS
J. P. Brevan *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 60 p refs

Avail: NTIS HC A23/MF A01

The computation of the vibration modes of structures with finite element models, which leads to large sparse generalized eigen problems, is presented. The basic tools such as sparse matrix factorization are described. A review of the methods for eigensolutions is given. Two methods currently in use, the Lanczos method and the subspace iteration method, are examined. A dynamic substructuring method is presented. Practical results for the model of a complete aircraft are given. A.W.H.

N80-12009# National Aerospace Lab., Amsterdam (Netherlands).
REMARKS ON THE TRANSONIC FLOW PAST OSCILLATING AIRFOILS
H. Tijdeman *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 33 p refs

Avail: NTIS HC A23/MF A01

The characteristics of unsteady and steady transonic flow are reported. The transonic flow past an oscillating airfoil is discussed. Three types of shock waves which are identified in the flow field of an airfoil are examined. The linear relation between the frequency of oscillation and the motion of the shock wave is discussed. A qualitative analysis of the contribution of an oscillating shock wave to the overall loading is presented. A.W.H.

N80-12010# Liege Univ. (Belgium).
AIRCRAFT FLUTTER AND DYNAMIC RESPONSE
M. Geradin *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 58 p refs

Avail: NTIS HC A23/MF A01

The equations of motion and the dynamics of the elastic airplane are presented. The fundamentals of unsteady aerodynamics and an analysis of flutter and dynamic response are discussed. A.W.H.

N80-12011# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
WIND TUNNEL FLUTTER INVESTIGATIONS
O. Sensburg *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 59 p refs

Avail: NTIS HC A23/MF A01

Wind tunnel investigations with rigid and dynamically scaled models are examined. An assessment of the influence of parameter variations on flutter speed such as geometry changes, stiffness changes, and external store mass properties is presented. The measurement of unsteady aerodynamic forces with direct pressure transducers or tubes is discussed. Buffet investigations on rigid models are reported. A.W.H.

N80-12012# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

FLIGHT FLUTTER TESTING

G. Haidl and M. Steininger *In* Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design 1979 41 p refs

Avail: NTIS HC A23/MF A01

The excitation methods applied to flight flutter testing are described. Examples of excitation by frequency sweep, pseudo random, harmonic oscillation and control feedback technique are given and their effectiveness and adaption to digital processing is discussed. Experience with generating aerodynamic forces by control surfaces or additional vanes is presented. The digital analysis of flight flutter test data is evaluated. Recommendations for selection of analysis parameters and how to avoid errors due to digital processing are given. Errors and effects of digital blockwise computation and analysis procedures like block overlapping, windowing, averaging or curve fitting are demonstrated. A.W.H.

N80-12014# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

CALCULATION OF TRANSONIC FLOWS AROUND WINGS

Jean-Jacques Chattot, Colette Coulombeix, and Carlos daSilvaTome *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1978-4 Jun. 1979 p 1-41 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris) no. 1978-4, Jul.-Aug. 1978 p 143-159 Original language report was announced as A79-11132

Avail: NTIS HC A08/MF A01

The full potential equation is chosen as a mathematical model for simulating transonic flows of an ideal fluid past symmetrical wings set without side-slip in a uniform subsonic free stream. Two relaxation methods are presented. In the first method the equation is written in quasi-linear form and is discretized using a mixed scheme of the Murman-Cole type. The algebraic set of difference equations is solved by column relaxation. In the second method the equation, together with an artificial viscosity term, is written in conservation form and is discretized using a centered scheme. An approximate factorization method is used to solve the difference equations. Results obtained with the two methods are presented for a rectangular wing, the M6 wing and the AFV-D wing, and include comparisons with experimental data. Author (ESA)

N80-12019# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PRELIMINARY TESTS IN A CRYOGENIC WIND TUNNEL DRIVEN BY INDUCTION

Roger Michel and Dietrich Faulmann *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1978-4 Jun. 1979 p 145-152 Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris) no. 1978-4, Jul.-Aug. 1978 p 205-207 Presented at Supersonic Tunnel Assoc. Meeting, El Segundo, Calif., 17-18 Apr. 1978 Original language report was announced as A79-15300

Avail: NTIS HC A08/MF A01

A 1/4 scale cryogenic operation pilot wind tunnel test for higher Reynolds number was performed to verify a liquid nitrogen injection fast cooling process. The cryogenic operation was combined with an induction driven operation in the hope that the short flow duration will give rise to a decrease in the wall and model surface temperature only, avoiding some technological problems. Operation temperatures down to 100 K were obtained. Thin layers of wall insulation are shown to be efficient in containing nitrogen consumption. It is concluded that the simplicity of implementation makes the process promising for adapting existing wind tunnels to cryogenic operation. Author (ESA)

N80-12025# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AEROACOUSTIC CHARACTERIZATION OF FREE JETS

Georges Elias, Annie Lelarge, Jean Maulard, and Mariano Perulli *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1978-5 Jul. 1979 p 55-69 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris), no. 1978-5, Sep. - Oct. 1978 p 251-261 Original language report was announced as A79-18534

Avail: NTIS HC A06/MF A01

The methods used to characterize sources of aircraft engine noise are described. These include (1) IR radiometry, which is sensitive to temperature fluctuations, (2) laser Schlieren method, giving data proportional to components of the density gradient, (3) Doppler laser anemometry, and (4) fluorescence diffusion measurements to deduce mean and fluctuating concentration. Complex measurements by more than one technique and employing crossed paths were experimented with, in order to reveal the complementary possibilities of the methods. By means of a principle of scale separation and suitable data evaluation methods, reliable statements about noise sources could be obtained. Author (ESA)

N80-12030# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

ONERA AERODYNAMIC RESEARCH WORK ON HELICOPTERS

Jean-Jacques Philippe and Claude Armand *In its* La Rech. Aerospatiale, Bi-monthly Bull. No. 1978-6 Sep. 1979 p 1-23 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel (Paris) no. 1978-6, Nov. - Dec. 1978 p 287-304 Presented at AGARD Symp. on "Rotocraft Design", Moffett Field, Calif., 16-19 May 1977 Original language report was announced as N78-19148

Avail: NTIS HC A06/MF A01

Aerodynamic research on helicopters included basic research in two or three dimensional flows and studies on rotors. The study of steady and unsteady characteristics of airfoils and of problems pertaining to blade tips and to vortex interactions is discussed. For the rotors, a computing program for the forces on the blades, based on the acceleration potential method was developed. The problems of unsteady transonic aerodynamics related to high speed flight are also discussed. In order to perform wind tunnel tests for helicopter companies and for research purposes two rotor test rigs were developed. Results of the total forces on helicopter, for absolute pressure on the blades, for identification of the boundary layers, for smoke visualization, and for rotating blade deformations are presented. Author (ESA)

N80-12037# European Space Agency, Paris (France).

THE NORMAL FORCE ON A CRUCIFORM MISSILE AT BANK ANGLES OF A DEG AND 45 DEG

Helmut Esch *In its* Contrib. to Gas Dyn. and Aerodyn. Jun. 1979 p 45-60 refs Transl. into ENGLISH from 'Die Normalkraft eines Flugkoerpers mit Kreuzleitwerk bei Rollagen von o deg und 45 deg,' DFVLR, Cologne Report DLR-FB-77-36, Jul. 1977

Avail: NTIS HC A15/MF A01

Force and pressure distribution measurements were made on a body-tail combination to investigate the influence of bank angle on the normal force. A subsonic Mach number and supersonic Mach numbers between 2 and 4 were investigated for incidence angles up to 19 deg. The experimental data is compared with results from simple theoretical methods. It is shown that the normal force on a cruciform tail is more strongly decreased for x attitude than for + attitude. This is due to the separated body cortices that occur. Author (ESA)

N80-12039# European Space Agency, Paris (France).

NORMAL FORCE DERIVATIVE AND CENTER OF PRESSURE MOVEMENT DUE TO MACH NUMBER ON WING-BODY COMBINATIONS WITH TRIANGULAR WINGS OF THE SAME SPAN AND DIFFERENT ASPECT RATIOS AT SUPERSONIC SPEEDS

Wolfgang Wyborny *In its* Contrib. to Gas Dyn. and Aerodyn. Jun. 1979 p 79-96 refs Transl. into ENGLISH from 'Normalkraftanstieg und Verschiebung des Luft-krafttangriffspunktes ueber der Machzal von Rumpf-Leitwerk-Kombinationen mit Rochenleitwerken gleicher Spannweite bei verschiedenen Flaechenverhaeltnissen im Ueberschall,' DFVLR, Cologne Report DLR-FB-77-36, Jul. 1977

Avail: NTIS HC A15/MF A01

Experimental results from wind tunnel measurements on wing-body combinations at Mach numbers of 1.57, 2.25, 2.89 and 4.15 at small angles of attack are compared with calculated results obtained using a semi-empirical method, based on linearized supersonic theory, slender body theory and empirical data. The parameters, other than Mach number, are the aspect ratio of the triangular wing (b square/F between 0.75 and 1.75) and the wing sweepback angle. The models consist of a cylindrical body of diameter D = 30 mm with an ogival forebody, whose radius in the first case is 2.5 D and in the second is 7.5 D. The total length of the model is therefore, in the first case, L = 12 D while in the second, it is L = 7.9 D. The span of the exposed triangular wings is B = 1.5 D. Author (ESA)

N80-12046# European Space Agency, Paris (France).
VERIFICATION OF THE EXPERIMENTALLY DETERMINED LAMINAR-TURBULENT TRANSITION ON A SWEPT WING

Ernst Heinrich Hirschel and Vera Jawtusch *In its* Contrib. to Gas Dyn. and Aerodyn. Jun. 1979 p 229-250 refs Transl. into ENGLISH from Nachrechung des experimentell ermittelten Uebergangs laminar-turbulent an einem gepfeilten Fluegel, DFVLR, Cologne Report DLR-FB-77-36, Jul. 1977 Sponsored in part by German Res. Council (DFG)

Avail: NTIS HC A15/MF A01

An investigation of the location of the transition line on a finite tapered swept wing is presented in order to make assertions about known stability and transition criteria. For the suction and the pressure side of the wing for different angles of attack. The boundary layer is calculated with panel method results as an external flow field. The boundary layer in calculated using the approximation locally infinite swept wing. The stability and transition criteria are applied to this boundary layer. A comparison of the experimental with the theoretical results shows the need for further experiments, as well as extended correlation investigations, in order to improve the prediction possibilities for the laminar-turbulent transition in three dimensional boundary layers. Author (ESA)

N80-12051 New York Univ., N. Y.
AN ARTIFICIAL VISCOSITY METHOD FOR THE DESIGN OF SUPERCRITICAL AIRFOILS Ph.D. Thesis
Geoffrey B. McFadden 1979 167 p
Avail: Univ. Microfilms Order No. 7925492

An inverse method for the numerical design of supercritical airfoils is presented. The speed distribution along the surface of the desired profile is prescribed and the shape required to generate such a profile is computed. In contrast to other approaches to the design problem that employ the hodograph transformation, this technique does not produce shockless solutions. Instead, an artificial viscosity is used to inhibit the formation of shocks in the flow during the design procedure with the result that weak shocks may appear in the actual flow past the profile. By choosing the prescribed velocity distribution correctly, the wave drag associated with these shocks is small and airfoils can be obtained that compare favorably with shockless airfoils, in their overall performance. Dissert. Abstr.

N80-12052 Dayton Univ., Ohio.
DEVELOPMENT OF STABILITY METHODS FOR APPLICATION TO NONLINEAR AEROELASTIC OPTIMIZATION Ph.D. Thesis
Ronald Franklin Taylor 1979 192 p
Avail: Univ. Microfilms Order No. 7925694

An approximate procedure is developed which determines the amplitude dependent stability of nonlinear systems. This procedure, the method of imposed disturbances, is shown to be applicable to studies of the sensitivity of nonlinear aeroelastic systems to changes in design variables. Emphasis is placed on airfoil and panel flutter instabilities in aerodynamically nonlinear flow. The method is applied to nonlinear transonic flutter and divergence of a two dimensional airfoil. Airloads are predicted using an existing small disturbance computer code, which determines structural loads due to airflow containing moving shock waves. A nonlinear two degree of freedom follower load problem is studied to demonstrate the applicability of the method of imposed disturbances to a multiple degree of freedom system. Another multiple degree of freedom system examined is a sandwich panel in nonlinear hypersonic flow, for which the rate of change of limit amplitude with respect to structural design variables is studied. Dissert. Abstr.

N80-12053*# Wichita State Univ., Kans.
WIND TUNNEL FORCE AND PRESSURE TESTS OF A 21% THICK GENERAL AVIATION AIRFOIL WITH 20% AILERON, 25% SLOTTED FLAP AND 10% SLOT-LIP SPOILER
W. H. Wentz, Jr. and K. A. Fiscko Washington NASA Jun. 1979 114 p ref
(Grant NsG-1165)
(NASA-CR-3081; WSU-AR-77-6) Avail: NTIS HC A06/MF A01 CSCL 01A

Force and surface pressure distributions were measured for the 21% LS(1)-0421 modified airfoil fitted with 20% aileron, 25% slotted flap and 10% slot lip spoiler. All tests were conducted at a Reynolds number of 2.2 x 10 to the 6th power and a Mach number of 0.13. The lift, drag, pitching moments, control surface normal force and hinge moments, and surface pressure distributions are included in the results. Incremental performance of flap and aileron are discussed and compared to the GA(W)-2 airfoil. Spoiler control which shows a slight reversal tendency at high alpha, is examined. A.W.H.

N80-12054*# Boeing Co., Seattle, Wash. Commercial Airplane Group.
TWO-DIMENSIONAL WIND-TUNNEL TESTS OF A NASA SUPERCRITICAL AIRFOIL WITH VARIOUS HIGH-LIFT SYSTEMS. VOLUME 1: DATA ANALYSIS
E. Omar, T. Zierten, and A. Mahal Washington NASA Apr. 1977 87 p refs
(Contract NAS1-10824)
(NASA-CR-2214; D6-41063-1-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 01A

High-lift systems for a NASA, 9.3%, method for calculating the viscous flow about two-dimensional multicomponent airfoils was evaluated by comparing its predictions with test data. High-lift systems derived from supercritical airfoils were compared in terms of performance to high-lift systems derived from conventional airfoils. The high-lift systems for the supercritical airfoil were designed to achieve maximum lift and consisted of: a single-slotted flap; a double-slotted flap and a leading-edge slat; and a triple-slotted flap and a leading-edge slat. Agreement between theoretical predictions and experimental results are also discussed. R.C.T.

N80-12055*# Boeing Co., Seattle, Wash.
TWO-DIMENSIONAL WIND-TUNNEL TESTS OF A NASA SUPERCRITICAL AIRFOIL WITH VARIOUS HIGH-LIFT SYSTEMS. VOLUME 2: TEST DATA Final Report
E. Omar, T. Zierten, M. Hahn, E. Szpiro, and A. Mahal Washington NASA Apr. 1977 234 p
(Contract NAS1-10824)
(NASA-CR-2215; D6-41063-2-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 01A

Three high lift systems for a 9.3 percent blunt based, supercritical airfoil were designed, fabricated, and wind tunnel tested. A method for calculating the viscous flow about two dimensional multicomponent airfoils was evaluated by comparing its predictions with test data. A comparison of high lift systems derived from supercritical airfoils with high lift systems derived from conventional airfoils is presented. The high lift systems for

the supercritical airfoil were designed to achieve maximum lift and consisted of: (1) a single slotted flap, (2) a double slotted flap and a leading edge slat, and (3) a triple slotted flap and a leading edge slat. Aerodynamic force and moment data and surface pressure data are presented for all configurations and boundary layer and wake profiles for the single slotted flap configuration. The wind-tunnel models, test facilities and instrumentation, and data reduction are described. Author

N80-12059*# General Dynamics/Convair, San Diego, Calif. Convair Div.

WIND TUNNEL INVESTIGATION OF AN OBLIQUE WING TRANSPORT MODEL AT MACH NUMBERS BETWEEN 0.6 AND 1.4

R. L. Black, J. K. Beamish, and W. K. Alexander Jul. 1975 334 p refs

(Contract NAS2-8127)

(NASA-CR-137697; HST-TR-344-0) Avail: NTIS HC A15/MF A01 CSCL 01A

Models of three practical oblique-wing transport configurations were tested in the NASA Ames 11 foot wind tunnel. The three configurations used a common forward fuselage, wing, and support system but employed different aft fuselage sections simulating alternate propulsion system installations. These included an integrated propulsion system, pylon-mounted nacelles, and clean (no propulsion system) configuration. The tests were conducted over a Mach number range from 0.6 to 1.4 and at sweep angles from 0 to 60 degrees. The nominal unit Reynolds number was 1.83 million per meter and the angle of attack range was -3 to +6 degrees. The models were mounted in the tunnel by means of a lower blade support system. The interference effects of this lower blade and the flow inclination were determined by using an image blade system and testing the configuration in both the upright and inverted positions. M.M.M.

N80-12060*# Bihrle Applied Research, Inc., Jericho, N. Y.

ROTARY BALANCE DATA FOR A TYPICAL SINGLE-ENGINE GENERAL AVIATION DESIGN FOR AN ANGLE-OF-ATTACK RANGE OF 8 DEGREES TO 35 DEGREES, 3. EFFECT OF WING LEADING-EDGE MODIFICATIONS, MODEL A

William Bihrle, Jr. and William Mulcay Nov. 1979 176 p refs

(Contract NAS1-14849)

(NASA-CR-3102) Avail: NTIS HC A05/MF A01 CSCL 01A

Aerodynamic characteristics obtained in a rotational flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/5 scale, single-engine, low-wing, general aviation airplane model. The configurations tested included the basic airplane, sixteen wing leading-edge modifications and lateral-directional control settings. Data are presented for all configurations without analysis for an angle of attack range of 8 deg to 35 deg and clockwise and counter-clockwise rotations covering an Omega b/2v range from 0 to 0.85. Also, data are presented above 35 deg of attack for some configurations. Author

N80-12064*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

AERODYNAMIC CHARACTERISTICS OF A HYPERSONIC RESEARCH AIRPLANE CONCEPT HAVING A 70 DEG SWEPT DOUBLE-DELTA WING AT MACH NUMBERS FROM 0.80 TO 1.20, WITH SUMMARY OF DATA FROM 0.20 TO 6.0

Jim A. Penland, James B. Hallissy, and James L. Dillon Washington Dec. 1979 147 p refs

(NASA-TP-1552; L-13158) Avail: NTIS HC A07/MF A01 CSCL 01A

The static longitudinal, lateral, and directional stability characteristics of a hypersonic research airplane concept having a 70 deg swept double-delta wing were investigated. Force tests were conducted in the Langley 8 foot transonic pressure tunnel for a Reynolds number (based on fuselage length) range of 6.30 x 10 to the 6th power to 7.03 x 10 to the 6th power, at angles of attack from about -4 deg to 23 deg, and at angles of sideslip of 0 deg and 5 deg. The configuration variables included the wing planform, tip fins, the center vertical tail, and scramjet engine modules. Variations of the more important aerodynamic parameters with Mach number for Mach numbers from 0.20 to 6.0 are summarized. A state-of-the-art example of theoretically predicting performance parameters and static longitudinal and directional stability over the Mach number range is included. A.R.H.

N80-12065*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

APPLICATION OF SUPERSONIC LINEAR THEORY AND HYPERSONIC IMPACT METHODS TO THREE NONSLENDER HYPERSONIC AIRPLANE CONCEPTS AT MACH NUMBERS FROM 1.10 TO 2.86

Jimmy L. Pittman Washington Dec. 1979 59 p refs

(NASA-TP-1539; L-13142) Avail: NTIS HC A04/MF A01 CSCL 10A

Aerodynamic predictions from supersonic linear theory and hypersonic impact theory were compared with experimental data for three hypersonic research airplane concepts over a Mach number range from 1.10 to 2.86. The linear theory gave good lift prediction and fair to good pitching-moment prediction over the Mach number (M) range. The tangent-cone theory predictions were good for lift and fair to good for pitching moment for M more than or equal to 2.0. The combined tangent-cone theory predictions were good for lift and fair to good for pitching moment for M more than or equal to 2.0. The combined tangent-cone/tangent-wedge method gave the least accurate prediction of lift and pitching moment. The zero-lift drag was overestimated, especially for M less than 2.0. The linear theory drag prediction was generally poor, with areas of good agreement only for M less than or equal to 1.2. For M more than or equal to 2.), the tangent-cone method predicted the zero-lift drag most accurately. R.C.T.

N80-12069# Calspan Advanced Technology Center, Buffalo, N.Y.

TRESTLE WIND TUNNEL STUDY Final Report, Sep. 1977 - Aug. 1978

Gary R. Ludwid and Joseph P. Nenni Mar. 1979 255 p refs

(Contract F29601-77-C-0093)

(AD-A072791; AFWL-TR-78-184; AD-E200340; Calspan-6171-A-2) Avail: NTIS HC A12/MF A01 CSCL 20/4

This report presents the results of an experimental and analytical study to determine the effects of atmospheric winds on aircraft situated on the ramp and test stand of the TRESTLE facility which is being built at Kirtland Air Force Base, New Mexico. The program included model tests to determine the wind flow patterns around the TRESTLE facility and the use of the wind flow data in an analysis to predict the effects of these winds on various large aircraft. The model tests, which were conducted in the Calspan Atmospheric Simulation Facility, included flow visualization studies and quantitative hot-film anemometer measurements of three components of mean velocity. A simplified method of analysis was developed to estimate the forces and moments on aircraft situated in the experimentally determined flow field. The analysis incorporated provisions to account for unconventional wind-aircraft orientations and nonuniform flow fields. Results of the program are presented for twelve wind directions, three different aircraft, and nine positions of each aircraft on the TRESTLE facility ramp and test stand. GRA

N80-12070# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

TURBULENT BOUNDARY LAYERS ON AN AIRFOIL IN SEVERAL ADVERSE PRESSURE GRADIENTS M.S. Thesis Final Report, 1 Jan. 1977 - 30 Jun. 1978

Richard T. Cervisi Aug. 1978 135 p refs

(Contract F49620-77-C-0031; AF Proj. 2307)

(AD-A072839; AFOSR-78-1450TR; MIT-TR-203) Avail: NTIS HC A07/MF A01 CSCL 20/4

Turbulent boundary layer profiles in a wide range of adverse pressure gradients were measured using a boundary layer velocity-flow angle measuring probe designed for this experiment. The different pressure gradients were created on a NACA 0012 airfoil by changing the angular orientation of an elliptic cylinder

placed near the airfoils trailing edge. Rotating the elliptic cylinder to various angular positions changed the effective angle of attack and camber of the airfoil-ellipse combination thereby creating different pressure distributions about the airfoil. In anticipation of spinning the ellipse to create an unsteady flow in future experiments, this experiment defined the steady state environment. The boundary layer profiles are presented in three different graphical formats; conventional nondimensional plots, profiles in modified Law of the Wall coordinates and Velocity Defect Law graphs. The Law of the Wall was modified to account for longitudinal streamline curvature. Local skin friction coefficients were found using the modified Law of the Wall in the form of a Clauser chart. The boundary layer data was checked for repeatability, consistency and agreement with theory and previous experiments. The final results were deemed excellent GRA

N80-12072# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

A METHOD FOR ASSESSING THE IMPACT OF WAKE VORTICES OF USAF OPERATIONS Final Report, 15 Dec. 1978 - 5 Apr. 1979

George Kurylowich Jul. 1979 111 p refs
(AD-A072967; AFFDL-TR-79-3060) Avail: NTIS HC A06/MF A01 CSCL 01/2

Experience as a consultant to the Safety Office at Norton AFB led to compiling the engineering tools presented, so that this report can be used by engineering personnel to investigate future incidents/accidents and existing USAF operations that are impacted by the vortical wake hazard. The approach presented is amenable to easy hand computations. Mixed airplane/helicopter operations can be assessed, since the engineering tools to determine the location and strength of the rotor downwash field behind a helicopter are presented. Finally, a simplified mathematical model is given to represent this hazard for use in USAF simulators, to make pilots aware of the problems associated with operating in wake-contaminated airspace. GRA

N80-12073# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.

AEROELASTIC RESPONSE ANALYSIS OF TWO DIMENSIONAL, SINGLE AND TWO DEGREE OF FREEDOM AIRFOILS IN LOW-FREQUENCY, SMALL-DISTURBANCE UNSTEADY TRANSONIC FLOW Final Report, Nov. 1978 - May 1979

T. Y. Yang, P. Guruswamy, and A. G. Striz Wright-Patterson AFB, Ohio AFFDL Jun. 1979 55 p refs
(Grant AF-AFOSR-3523-78; AF Proj. 2307)
(AD-A073379; AFFDL-TR-79-3077) Avail: NTIS HC A04/MF A01 CSCL 20/4

A procedure is developed to obtain the aeroelastic responses of single and two degree of freedom aeroelastic systems in transonic flow. The fluid is described by the two dimensional unsteady low-frequency transonic potential equation based on small disturbance theory. The aerodynamic computer code LTRAN2 which is based on a fully implicit time integration scheme is employed to obtain the aerodynamic forces. The structural equations are simultaneously integrated with the potential flow equations by a numerical method and the aeroelastic responses are obtained. Results for neutrally stable responses are compared with those obtained by the U-g method. Aeroelastic responses are obtained for flat plates (single and two degree of freedom) at M = 0.7 by the linear part of LTRAN2. Examples of an NACA 64A006 airfoil at Mach numbers of 0.88 and 0.85 are also analyzed. Response results obtained for a single pitching degree of freedom system at M = 0.88 are compared with an existing solution. The response results obtained for a two degree of freedom system at M = 0.85 for neutrally stable condition are correlated with those obtained by the flutter analysis. Results also include stable and unstable response curves and their variations with altitude. GRA

N80-12075# Army Missile Research and Development Command, Redstone Arsenal, Ala. Technology Lab.

REAL TIME DIGITAL MODEL OF A ROLLING AIRFRAME

Victor S. Grimes, Jr. 31 Jul. 1978 50 p refs
(DA Proj. 1X4-64306-D-646)
(AD-A073456; DRDMI-T-78-75) Avail: NTIS HC A03/MF A01 CSCL 20/4

An all-digital airframe model of a rolling missile is developed by using tunable convolution and integration techniques. The model is capable of handling high frequency airframe dynamics in real time with large time steps and hardware in the loop (HWIL). This model is currently in use in three applications at the MIRADCOM Advanced Simulation Center in Aeroballistics Directorate, Technology Laboratory. GRA

N80-12076*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

TECHNOLOGY OPTIONS FOR AN ENHANCED AIR CARGO SYSTEM

Matthew M. Winston Oct. 1979 34 p refs Presented at the ASCE Natl. Convention, Atlanta, 22-26 Oct. 1979
(NASA-TM-80173) Avail: NTIS HC A03/MF A01 CSCL 01C .

A view of potential enhancements to the air cargo system through technology application is provided. NASA's role in addressing deficiencies of the current civil and military air cargo systems is outlined. The evolution of conventional airfreighter design is traced and projected through the 1990's. Also, several advanced airfreighter concepts incorporating unconventional design features are described to show their potentials benefits. A number of ongoing NASA technology programs are discussed to indicate the wide range of advanced technologies offering potential benefits to the air cargo system. The promise of advanced airfreighters is then viewed in light of the future air cargo infrastructure predicted by extensive systems studies. The derived outlook concludes that the aircraft technology benefits may be offset somewhat by adverse economic, environmental, and institutional constraints. Author

N80-12077# Air Force Engineering and Services Center, Tyndall AFB, Fla.

AN EVALUATION OF THE BIRD/AIRCRAFT STRIKE HAZARD AT SELECTED UNITED KINGDOM BASES: RAF MILDENHALL, RAF ALCONBURY, RAF UPPER HEYFORD, RAF BENTWATERS, RAF FAIRFORD, RAF LAKENHEATH, AND RAF WOODBRIDGE Final Report, Nov. - Dec. 1978

James S. Kent, Joan Scott, and William H. Niemeier Jun. 1979 100 p refs
(AD-A073062; AFESC-TM-3-79) Avail: NTIS HC A05/MF A01 CSCL 01/2

Selected United Kingdom air bases were surveyed from 3 November to 4 December 1978 by the Air Force Engineering and Services Center's Bird/Aircraft Strike Hazard Team. During this period, operational and environmental factors which combine to create bird strike hazards at each location were observed. Specific recommendations based on observations are provided to reduce the bird strike hazard. GRA

N80-12079# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

PROPULSION AND ENERGETICS PANEL WORKING GROUP 2 ON AIRCRAFT FIRE SAFETY. VOLUME 1: EXECUTIVE SUMMARY

B. P. Botteri (AFSC) Sep. 1979 17 p
(AGARD-AR-132-Vol-1; ISBN-92-835-0246-9) Avail: NTIS HC A02/MF A01

The fire experience, areas in which fire protection enhancement is needed, technological advances in the areas of safety and personnel survivability for a civilian turbine engine transport aircraft are presented. M.M.M.

N80-12080# National Aviation Facilities Experimental Center, Atlantic City, N. J.

DABS SINGLE SENSOR PERFORMANCE TEST PLAN

Jul. 1979 157 p
(AD-A072695; FAA-NA-79-151) Avail: NTIS HC A04/MF A01 CSCL 17/7

The single-sensor performance tests are described which are to be conducted upon three engineering laboratory models of

the Discrete Address Beacon System (DABS) sensor. These sensors are to be installed at NAFEC and two adjacent sites: Elwood and Clementon, New Jersey. These performance tests address the following characteristics: surveillance processing, accuracy and resolution, data link, performance monitoring and failure recovery, network management (stand-alone mode) and communications. The results of these performance tests will be used to prepare a technical data package for DABS procurement. F.O.S.

N80-12082# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE IMPACT OF GLOBAL POSITIONING SYSTEM ON GUIDANCE AND CONTROLS SYSTEMS DESIGN OF MILITARY AIRCRAFT, VOLUME 1
G. C. Howell, ed. (Royal Aircraft Establishment) Sep. 1979 43 p refs 2 Vol.
(AGARD-AR-147-Vol-1; ISBN-92-835-1339-8) Avail: NTIS HC A03/MF A01

Contents: (1) to study the application of GPS to interdiction, ground attack, interception and close combat aircraft; (2) to determine the extent which improved performance or new capabilities are made possible; (3) to study the integration of GPS into guidance and control systems, determine the impact on system design, and indicate where simplification and cost savings may be brought about; and (4) to make recommendations for further and more detailed study of the most promising applications. M.M.M.

N80-12083 Kansas Univ., Lawrence.
THE DEVELOPMENT OF THE DAST 1 REMOTELY PILOTED RESEARCH VEHICLE FOR FLIGHT TESTING AN ACTIVE FLUTTER SUPPRESSION CONTROL SYSTEM Ph.D. Thesis
David Lee Grose 1979 368 p
Avail: Univ. Microfilms Order No. 7925873

The development of the DAST 1 remotely piloted research vehicle is described. The DAST 1 is a highly modified BQM-34E/F Firebee 2 supersonic aerial target incorporating a swept supercritical wing designed to flutter within the vehicle's flight envelope. The predicted flutter and rigid body characteristics are presented. A description of the analysis and design of an active flutter suppression control system designed to increase the flutter boundary of the DAST wing by a factor of 20% is given. The design and development of the digital remotely augmented primary flight control system and onboard analog backup control system is presented. An evaluation of the near real time flight flutter testing methods is made by comparing results of five flutter testing techniques on simulated DAST 1 flutter data.
Dissert. Abstr.

N80-12084*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BEHAVIOR OF AIRCRAFT ANTISKID BRAKING SYSTEMS ON DRY AND WET RUNWAY SURFACES. A SLIP-VELOCITY-CONTROLLED, PRESSURE-BIAS-MODULATED SYSTEM
Sandy M. Stubbs, John A. Tanner, and Eunice G. Smith Washington Dec. 1979 194 p refs
(NASA-TP-1051; L-11760) Avail: NTIS HC A09/MF A01 CSCL 01C

The braking and cornering response of a slip velocity controlled, pressure bias modulated aircraft antiskid braking system is investigated. The investigation, conducted on dry and wet runway surfaces, utilized one main gear wheel, brake, and tire assembly of a McDonnell Douglas DC 9 series 10 airplane. The landing gear strut was replaced by a dynamometer. The parameters, which were varied, included the carriage speed, tire loading, yaw angle, tire tread condition, brake system operating pressure, and runway wetness conditions. The effects of each of these parameters on the behavior of the skid control system is presented. Comparisons between data obtained with the skid control system and data obtained from single cycle braking tests without antiskid protection are examined. A.W.H.

N80-12085# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
PREDICTION OF DRAG COEFFICIENTS OF A SUPERSONIC V/STOL CONFIGURATION WITH VARIOUS STORE ARRANGEMENTS
Tsze C. Tai, Thomas H. Boyd, and Richard E. Kuhn Aug. 1979 43 p refs Presented at the Navy Symp. on Aerobalistics, NADC, Trevose, Penn., 22-24 Aug. 1978
(WR0230201)
(AD-A072999; DTNSRDC-79/074; DTNSRDC/AERO-1260) Avail: NTIS HC A03/MF A01 CSCL 20/4

Numerical computations, using supersonic area rule, linear theory and turbulent boundary layer solutions, were performed to evaluate the drag coefficients of a supersonic V/STOL configuration with various store arrangements. External stores included short- and medium-range missiles, electronic pod, and 600 gallon (2280 liters) fuel tanks. Predictions were based on cruise conditions at Mach numbers 1.2, 1.6, and 1.8 with Reynolds numbers between 2 and 66.2 million per foot. As expected, it was found that the drag coefficient decreases as the free-stream Mach number increases. The wave drag varies nonlinearly with added store capacity. Data indicate that for the same store capacity, the wave drag may be minimized by judicious selection of store location. GRA

N80-12086# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
THE PERFORMANCE OF A CONCEPTUAL VERTICAL ATTITUDE TAKEOFF AND LANDING FIGHTER AIRCRAFT Final Report, Sep. - Dec. 1978
Basil S. Papadales, Jr. Jan. 1979 30 p refs
(AD-A073100; DTNSRDC/ASED-76/06) Avail: NTIS HC A03/MF A01 CSCL 01/3

The performance of a conceptual 18,000 lb (8200 kg) vertical attitude takeoff and landing fighter aircraft is presented. The single-seat aircraft is designed around a single F100 turbofan. Contemporary avionics and materials technologies are assumed. The design payload includes an M61 cannon with ammunition and four Dogfight missiles. No compromises for mission capabilities, other than air combat, exist in the design. The fighter has a combat radius of 308 nm (570 km) with a maximum level speed in excess of Mach 2 at altitude. Range, turning, and specific excess energy performance are presented. Weight and range performance penalties for the inclusion of conventional landing gear, a rotating cockpit, and a multi-engine design are summarized. GRA

N80-12087# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
INERTIA CALCULATION PROCEDURE FOR PRELIMINARY DESIGN Final Report
Charles Lanham Apr. 1979 70 p refs
(AD-A072679; ASD-TR-79-5004) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report explains the methods involved in estimating aircraft moments of inertia for preliminary design purposes. Assumptions that were made for this procedure and the derviation of equations that evolved from these assumptions are included. An example using the method on the C-5A aircraft is shown. This procedure requires a knowledge of the major aircraft group weights, the location of major components (landing gear, avionics bay, etc.), geometry information, and inertias of some major subsystem items. Using this data, the moments of inertia about the roll, pitch, and yaw axes are calculated as well as the roll-yaw cross-product of inertia. GRA

N80-12088# Army Aviation Test Activity, Edwards AFB, Calif.
AH-1G LATERAL FLIGHT PERFORMANCE TEST
Leslie J. Hepler, James S. Kishi, and Albert L. Winn 30 Jun. 1979 21 p refs
(AD-A072868; USAASTA-71-43) Avail: NTIS HC A02/MF A01 CSCL 01/1

The lateral flight performance of the tractor-tail-rotor-configured AH-1G helicopter was evaluated at gross weights of 8500 and 9500 pounds. The AH-1G is capable of 0.53 g and 0.38 g accelerations in right and left lateral flight, respectively,

at 8500 pounds. At a 9500 pound gross weight, acceleration was 0.23 g to the right and 0.20 g to the left. Aircraft handling qualities and time required to attain maximum lateral velocity are dependent upon rate and type of control application. A step-type lateral control input permitted rapid attainment of accelerating attitude but produced yaw oscillations which resulted in loss of directional control and caused high pilot workload in stabilizing power and aircraft attitude. Ramp inputs delayed establishment of the accelerating attitude. A modified pulse input induced negligible roll and yaw oscillation and produced rapid establishment of the desired roll attitude. Direction-of-flight reversals induced large power transients that frequently exceeded the transmission torque limits. Precise heading and pitch attitude could not be maintained during the reversals. Airspeed in lateral flight could not be determined without special airspeed measuring devices. The sideward airspeed limit was exceeded frequently in left lateral flight with no warning or cue to the pilot that the limit had been reached. GRA

N80-12089# Battelle Columbus Labs., Ohio.
F-111 A/E DIGITAL BOMB-NAV SYSTEM SOFTWARE ANALYSIS Final Technical Report, Apr. - Nov. 1978
Ellis Hitt, Tom Clark, Mike Bridgman, Bill Young, and Norman Thompson Wright-Patterson AFB, Ohio AFAL Apr. 1979 331 p refs
(Contract F33615-76-C-1299; AF Proj. 2003)
(AD-A072826; AFAL-TR-79-1043) Avail: NTIS HC A15/MF A01 CSCL 09/2

The objective of this project was to perform an independent evaluation of the technical and economic factors affecting a set of software development alternatives for the F-111A and F-111E digital bomb-navigation system operational flight program. Specifically, the use of Jovial (J73/I), higher order language or the assembly language of the selected computer was compared. The comparison was to consider the implications of various software development options as well as the impact of the options on the existing software support organizations and facility at Sacramento, Cal. GRA

N80-12090*# Massachusetts Inst. of Tech., Cambridge.
PREMIXING QUALITY AND FLAME STABILITY: A THEORETICAL AND EXPERIMENTAL STUDY Final Report
Krishnan Radhakrishnan, John B. Heywood, and Rodney J. Tabaczynski Washington Dec. 1979 65 p refs
(Grant NGR-22-009-378)
(NASA-CR-3216) Avail: NTIS HC A04/MF A01 CSCL 21E

Models for predicting flame ignition and blowout in a combustor primary zone are presented. A correlation for the blowoff velocity of premixed turbulent flames is developed using the basic quantities of turbulent flow, and the laminar flame speed. A statistical model employing a Monte Carlo calculation procedure is developed to account for nonuniformities in a combustor primary zone. An overall kinetic rate equation is used to describe the fuel oxidation process. The model is used to predict the lean ignition and blow out limits of premixed turbulent flames; the effects of mixture nonuniformity on the lean ignition limit are explored using an assumed distribution of fuel-air ratios. Data on the effects of variations in inlet temperature, reference velocity and mixture uniformity on the lean ignition and blowout limits of gaseous propane-air flames are presented. A.W.H.

N80-12091*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
DESIGN, DURABILITY AND LOW COST PROCESSING TECHNOLOGY FOR COMPOSITE FAN EXIT GUIDE VANES
S. S. Blecherman Aug. 1979 139 p refs
(Contract NAS3-21037)
(NASA-CR-159677; PWA-5570-37) Avail: NTIS HC A07/MF A01 CSCL 21E

A lightweight composite fan exit guide vane for high bypass ratio gas turbine engine application was investigated. Eight candidate material/design combinations were evaluated by NASTRAN finite element analyses. A total of four combinations were selected for further analytical evaluation, part fabrication by two ventors, and fatigue test in dry and wet condition. A core and shell vane design was chosen in which the unidirectional graphite core fiber was the same for all candidates. The shell material, fiber orientation, and ply configuration were varied. Material tests were performed on raw material and composite specimens to establish specification requirements. Pre-test and post-test microstructural examination and nondestructive analyses were conducted to determine the effect of material variations on fatigue durability and failure mode. Relevant data were acquired with respect to design analysis, materials properties, inspection standards, improved durability, weight benefits, and part price of the composite fan exit guide vane. R.C.T.

N80-12092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE COMPONENT IMPROVEMENT PROGRAM: PERFORMANCE IMPROVEMENT
John E. McAulay 1979 17 p refs Presented at 18th Aerospace Sci. Meeting, Pasadena, Calif., 14-16 Jan. 1980; sponsored by AIAA
(NASA-TM-79304; E-256) Avail: NTIS HC A02/MF A01 CSCL 21E

Fuel consumption of commercial aircraft is considered. Fuel saving and retention components for new production and retrofit of JT9D, JT8D, and CF6 engines are reviewed. The manner in which the performance improvement concepts were selected for development and a summary of the current status of each of the 16 selected concepts are discussed. R.C.T.

N80-12093# General Dynamics Corp. Fort Worth, Tex. Fort Worth Div.
THE CRITICALITY OF ENGINE EXHAUST SIMULATIONS ON VSTOL MODEL-MEASURED GROUND EFFECTS Final Report, Jul. 1978 - Aug. 1979
J. R. Lummus Jul. 1979 213 p refs
(Contract N00014-78-C-0384)
(AD-A073114; ONR-CR-212-255-1F) Avail: NTIS HC A10/MF A01 CSCL 20/4

This experimental investigation demonstrated the criticality of performing accurate full-scale engine exhaust simulations during model-measured VSTOL ground effects testing. The effects of varying the nozzle exit turbulence, total pressure distributions, and nozzle pressure ratio on the net and component ground-induced forces for two-, three-, and four-nozzle configurations with large blocking surfaces (as well as a smaller, cruciform two-nozzle blocking surface more characteristic of a real aircraft planform) were studied. GRA

N80-12095# Dayton Univ. Research Inst., Ohio.
IMPACT DAMAGE ON TITANIUM LEADING EDGES FROM SMALL SOFT BODY OBJECTS Interim Report, Apr. 1976 - Aug. 1977
Robert S. Bertke and John P. Barber Mar. 1979 66 p refs
(Contract F33615-76-C-5124; AF Proj. 2307)
(AD-A072705; UDR-TR-78-54; AFML-TR-79-4019) Avail: NTIS HC A04/MF A01 CSCL 21/5

Impact damage on titanium leading edge configurations was investigated by performing leading edge soft-body impacts on flat-edge and tapered-edge specimens. The objectives were to determine the laboratory specimen size, boundary condition, and test methods necessary to adequately simulate the leading edge local damage of actual blades from soft-body impacts (such as birds). The effects of leading edge geometry, specimen mounting, impact velocity, impactor type, impactor size, and impact angle were investigated. The damage modes excited in titanium were identified. Damage measurement techniques were devised and the damage quantified. Comparisons of the damage were drawn regarding the effects of specimen size and mounting. GRA

N80-12097# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
SUPERSONIC COMBUSTION, AIR DISSOCIATION THROUGH SHOCK WAVES AND AERODYNAMICS OF CHEMICALLY REACTING GASES IN A PLANAR CONVERGING - DIVERGING NOZZLES Final Report, Mar. - Oct. 1978. M.S. Thesis - Ohio State Univ., Columbus

Dennis W. Schroll May 1979 72 p refs
(AD-A073135; ASD-TR-79-5002) Avail: NTIS HC A04/MF A01 CSCL 21/5

Much research has been accomplished to develop a supersonic ramjet engine. Very little headway has been made in theoretical design techniques as many of the standard computational methods used for ramjet subsonic combustion do not apply. For instance, it is possible to use a constant area nozzle for subsonic combustion in a ramjet as heat addition and frictional effects in the combustion chamber will decrease the pressure and accelerate the flow. For supersonic combustion the velocity decreases tending to choke the flow. To overcome this area increase in the combustion zone is used. A strong normal shock on the diffuser inlet for free stream mach numbers of 5 and 10 and the shock free flow of these mach numbers are assumed. Accompanied with the strong normal shock are large stagnation pressure losses in the diffuser inlet, meaning the diffuser inlet will act as a flat plate to oncoming airflow. For this reason, it would be best to provide air spillage and not use too large an inlet. The final Thrust Specific Fuel Consumption values are sufficiently high to warrant further investigation into supersonic combustion as a method of propulsion. GRA

N80-12099# Aeronautical Research Labs., Melbourne (Australia).
SEA KING Mk. 50 HELICOPTER FLIGHT CONTROL SYSTEM. A MATHEMATICAL MODEL OF THE AFCS (AUTOSTABILIZER/AUTOPILOT MODE)
C. R. Guy Feb. 1979 24 p refs
(ARL/Aero-Note-387; AR-001-605) Avail: NTIS HC A02/MF A01

A mathematical model for the autostabilizer/autopilot mode of the automatic flight control system (AFCS) for the Sea King Mk.50 helicopter is presented. An outline of the autostabilizer/autopilot used in the aircraft is given followed by a description of the mathematical model, which includes a representation of each major element of the aircraft system. R.C.T.

N80-12100*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
V/STOL FLIGHT SIMULATION
Nov. 1979 52 p refs
(NASA-TM-81156; A-8012) Avail: NTIS HC A04/MF A01 CSCL 01C

The requirements for a new research aircraft to provide in-flight V/STOL simulation were reviewed. The required capabilities were based on known limitations of ground based simulation and past/current experience with V/STOL inflight simulation. Results indicate that V/STOL inflight simulation capability is needed to aid in the design and development of high performance V/STOL aircraft. Although a new research V/STOL aircraft is preferred, an interim solution can be provided by use of the X-22A, the CH-47B, or the 4AV-8B aircraft modified for control/display flight research. R.C.T.

N80-12101# European Space Agency, Paris (France).
CONSTRUCTION PROBLEMS FOR HIGH REYNOLDS NUMBER WIND TUNNEL MODELS
Maurice Bazin Jun. 1979 50 p refs Transl. into ENGLISH of 'Problems de Construction de Maquettes pour les Souffleries a Grand Nombre de Reynolds', ONERA, Paris Report ONERA-NT-1978-6, 1978 Presented at 14th Colloq. d'Aerodyn. Appl. de l'Assoc. Aeron. et Astron. de France, Toulouse, 7-9 Nov. 1977 Original report in FRENCH previously announced as N79-32224
(ESA-TT-564; ONERA-NT-1978-6) Avail: NTIS HC A03/MF A01

Design structures, problems of definition, and materials for high Reynolds number wind tunnel models are discussed. Models for force and pressure distributions, air intakes, jet simulation, and dynamic flutter are considered. It is shown that deformations in operation under the effect of aerodynamic and thermal loads require new measuring techniques and the adaptation of the capacity, thermal protection, and calibration methods of the balance. The mechanical strength of the supports, in particular the risk of divergence, and the dynamic behavior of the mountings are the most severe limitations in the use of pressurized wind tunnels. Thermal problems are added in a cryogenic environment. The development of pressure measurement methods and instruments is considered. Author (ESA)

N80-12102# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DETERMINATION IN GROUND FACILITIES OF AERODYNAMIC STABILITY PARAMETERS OF AIRCRAFT
M. Scherer Sep. 1979 69 p refs In FRENCH; ENGLISH summary
(AGARD-AG-242; ISBN-92-835-2106-4) Avail: NTIS HC A04/MF A01

The present state of experimental ground facilities for determining the aerodynamic stability parameters of aircraft was deduced from the proceedings of the AGARD/FDP and FMP meetings of the last four years. A critical study of the experimental methods for analyzing unsteady aerodynamic phenomena brings to light the insufficiencies of present-day methods and means, especially as regards information necessary for the correct implementation of flight simulators in case of non-linear behavior (separation, shock wave). Suggestions are presented on the possible orientations of research for filling these gaps. Author

N80-12123# Martin Marietta Aerospace, Orlando, Fla.
TEST AND EVALUATION OF GRAPHITE/EPOXY COMPOSITE STRUCTURE Final Report, 16 Nov. 1978 - 16 Mar. 1979
Robert P. Hewitt, Jr., Frank H. Koo, and Robert D. Keys (Denver Div.) Jul. 1979 128 p refs
(Contract DAAG46-79-C-0006; DA Proj. IW1-62113-A-661)
(AD-A072770; OR-15448; AMMRC-TR-79-39) Avail: NTIS HC A07/MF A01 CSCL 11/4

The test and evaluation of a graphite/epoxy structure is part of a technology program to develop and validate composite structures for BMD interceptor applications. This contract is essentially an extension of work recently completed by Martin Marietta Corporation on Phase I of the Advanced Structures Prototype (ASP) program conducted for the Ballistic Missile Defense Advanced Technology Center (BMDATC) under Contract DASG60-77-C-0111. This report presents the results of the test and evaluation of six subscale conical frusta during the period from November 1979 through March 1979. The objective of this evaluation was to provide an increased structural data base for the assessment of the strength and stiffness properties of ultra-high modulus GY70/934 graphite/epoxy structure fabricated by the hand-laid gore, autoclave cure processes. The contractual effort was divided into three tasks: Task 1 - Fabrication of Conical Frusta; Task 2 - Static Testing of Frusta; Task 3 - Plan for Further Development. GRA

N80-12142*# Pennsylvania State Univ., University Park.
INVESTIGATION OF CRITICAL BURNING OF FUEL DROPLETS Final Report, 1 Sep. 1966 - 30 Jun. 1979
G. M. Faeth Jul. 1979 87 p refs
(Grant NGR-39-009-077)
(NASA-CR-159697) Avail: NTIS HC A04/MF A01 CSCL 21B

The general problem of spray combustion was investigated. The combustion of bipropellent droplets; combustion of hydrozine fuels; and combustion of sprays were studied. A model was developed to predict mean velocities and temperatures in a combusting gas jet. R.C.T.

N80-12210 Institut Franco-Allemand de Recherches, St. Louis (France).
THE DEVELOPMENT OF PASSIVE DOPPLER TECHNIQUES IN LRSL/ISL AND THEIR APPLICATIONS TO BALLISTIC AND AERODYNAMIC MEASUREMENTS
B. Koch *In its* Contrib. to Ballistics, Detonations, and Pulse Phys. 1979 p 122-166 refs In GERMAN; ENGLISH summary

 Avail: Issuing Activity

A concise review of the historical and logical stages in the development of passive CW Doppler interferometer instrumenta-

tion for velocity and continuous space time measurements together with applications to ballistic and aerodynamic problems is presented. The extensive use of CW gas lasers, and their application in instruments such as the laser-Doppler-anemometer for aerodynamic flow research are discussed. Examples are given. Author (ESA)

N80-12236# California Inst. of Tech., Pasadena.
LEADING EDGE FLUTTER OF SUPERCAVITATING HYDROFOILS Final Report
C. Brennen, K. Oey, and C. D. Babcock May 1979 85 p refs (Contract N00014-75-C-0379; SR0230101)
(AD-A073382; ENG-216-1) Avail: NTIS HC A05/MF A01 CSCL 13/10

This document represents the results of experiments and analysis of the phenomenon of leading edge flutter which has been observed to occur for supercavitating hydrofoils. The experiments confirmed the existence of such a single degree of freedom flutter involving chordwise bending and indicated that for long, natural (or vapor-filled) cavities the reduced flutter speed U sub F/omega sub FC was in the range 0.15 to 0.23. Secondary effects observed were the variation with the angle of attached (a minimum flutter speed occurred at 10 deg) and with a foil mass ratio. Shorter cavities typically yielded lower flutter speeds due to a complex interaction between the bubble collapse process occurring in the cavity closure region and the unsteady hydrodynamic load on the foil. Finally, a relatively simple theoretical analysis for supercavitating hydrofoils with elastic axes aft of mid-chord is presented. This linear analysis yields reduced flutter velocities somewhat lower than those observed. GRA

N80-12331# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
UNSTEADY FLOW IN TURBOMACHINES, VOLUME 2
2 Feb. 1979 349 p refs Lecture held at Rhode-Saint-Genese, Belgium, 29 Jan. - 2 Feb. 1979
(VKI-Lec-Ser-1979-3-Vol-2) Avail: NTIS HC A15/MF A01

Problems associated with unsteady flow in turbocompressors are discussed. Specific topics covered include temperature distortion and unsteady pressure distortion in compressor inflows, flow measurements in a rotating stall cell, temperature effects in blade-wake interference, high speed blade-wake interactions, and rotor stall in axial flow compressors.

N80-12332# Cranfield Inst. of Tech., Bedfordshire (England).
TEMPERATURE DISTORTION
R. E. Peacock *In* Von Karman Inst. for Fluid Dyn. Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 31 p refs

Avail: NTIS HC A15/MF A01

Mathematical models for compressors subject to temperature distorted inflow are presented along with supporting experimental evidence. A time lag term is added to the parallel compressor hypothesis to predict the stability line for a compressor and the characteristics in distorted flow. In addition, the detailed flow around the airfoils is examined to create a model which accounts for the effects of distortion on the airfoils as well as the effects of the airfoils on distortion. K.L.

N80-12333# Cranfield Inst. of Tech., Bedfordshire (England).
UNSTEADY PRESSURE DISTORTION
R. E. Peacock *In* Von Karman Inst. for Fluid Dyn. Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 26 p refs

Avail: NTIS HC A15/MF A01

A model is proposed for the solution of unsteady flows in a compressor embedded in ductwork and subjected to repetitive or nonrepetitive pulses. Various methods for generating the unsteady pulses are discussed. A three-stage aircraft type compressor was subjected to pulsating flows in order to determine experimentally the effects of pulsating flow on compressor performance. K.L.

N80-12334# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
FLOW MEASUREMENTS IN A ROTATING STALL CELL
F. A. E. Breugelmans *In its* Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 23 p refs

Avail: NTIS HC A15/MF A01

The cell structure in a low speed single stage compressor model is investigated for various stagger angles. The observations are compared to predictions based on two theories and to results of experiments with a three stage model. K.L.

N80-12335# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BLADE WAKE INTERFERENCE: TEMPERATURE EFFECT
F. A. E. Breugelmans *In its* Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 14 p refs

Avail: NTIS HC A15/MF A01

Wake motion through the mean section of a NACA 65 series rotor and cascade blading was investigated. Cascade flow was studied using a stationary wake generator and compared to a moving generator where temperature effects existed. The rotor configuration was investigated using the hot wire sampling technique at different overheat ratios and hot wire orientations. K.L.

N80-12336# Technische Hochschule, Aachen (West Germany).
HIGH SPEED BLADE-WAKE INTERACTIONS
H. E. Gallus *In* Von Karman Inst. for Fluid Dyn. Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 46 p refs

Avail: NTIS HC A15/MF A01

Measurements were conducted on single stage turbomachines in order to explore the dependency of wake production, transport, and interaction on the main geometric and aerodynamic parameters of subsonic and supersonic axial flow turbomachines. Some of the results are compared with numerical results from simplified theoretical approaches. K.L.

N80-12337# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
ROTATING STALL IN AXIAL FLOW COMPRESSORS
N. Orner *In its* Unsteady Flow in Turbomachines, Vol. 2 2 Feb. 1979 34 p refs
Avail: NTIS HC A15/MF A01

Some of the methods used to predict rotating stall or its characteristics are described. Predictions obtained using these methods are compared to experimental data obtained from four different single stage axial compressors, and their reliability is discussed. A nonlinear method is proposed to calculate rotating stall inception and characteristics in a quasi-three-dimensional compressible flow of a one stage or multistage axial flow compressor. The suitability of such a method for the solution of industrial problems is discussed and the missing experimental data for its improvement are identified. K.L.

N80-12368# Stuttgart Univ. (West Germany).
DESIGN OF SUPERCRITICAL COMPRESSOR AND TURBINE CASCADES WITH A NUMERICAL METHOD CONSIDERING AXIAL VELOCITY DENSITY RATIO
E. Schmidt *In* Von Karman Inst. for Fluid Dyn. Appl. of Numerical Methods to Flow Calculations in Turbomachines 1979 49 p refs
Avail: NTIS HC A21/MF A01

The development and application of a numerical design method for the design of two supercritical compressors and turbine cascades is presented. The use of the method to determine the blade contours from a given velocity distribution is discussed. The application of the numerical method for the computation of plane transonic flow field is described. An extension of the method which considers the variation of the axial velocity density ratio is discussed. A.W.H.

N80-12372*# Old Dominion Univ. Research Foundation, Norfolk, Va.
A SIMPLIFIED MODEL FOR THE VISCOUS CROSSFLOW IN A SLOTTED TEST SECTION
Charlie H. Cooke Nov. 1979 27 p refs
(Grant NsG-1517)
(NASA-CR-3206) Avail: NTIS HC A03/MF A01 CSCL 20D

A simplified physical model was constructed which simulates the viscous crossflow in a fluid layer near the slots at a fixed streamwise location in a slotted wind tunnel. For low to moderate Reynolds numbers, numerical solutions of the two dimensional, incompressible Navier-Stokes equations in stream function and vorticity, which govern the model flow, were obtained. Fairly general slot geometry was incorporated by means of the Thompson-Thames-Mastin transformation. An approximate factorization scheme with cyclic acceleration parameters was employed to solve a finite difference analog of the stream function equation. The vorticity equation was numerically solved with a modified version of the classical alternating direction implicit scheme. Although no quantitative assessment of solution accuracy can be made, numerical results for variations in incremental wall pressure around the slat are at least qualitatively similar to some experimental results. R.E.S.

N80-12412 Syracuse Univ., N. Y.
OIL WHIRL AND CRITICAL INSTABILITIES IN ROTOR-BEARING SYSTEMS Ph.D. Thesis
Ehtisham Uddin Ahmad Siddiqui 1979 272 p
Avail: Univ. Microfilms Order No. 7925653

The phenomenon of oil whirl is analyzed and the critical instabilities of a rotor system with flexible supports are determined. It is found that; (1) instability is not eliminated even for the case of infinitely rigid shafts; (2) a proper choice of foundation parameters raises the whirl threshold significantly above that obtained with rigid supports; and (3) external damping has a stabilizing effect on the rotor system, but the effect of external dampers on the critical speeds depends on the position of attachment to the rotor. A general formulation to determine critical speeds of an N mass system in journal bearings is given. To illustrate the feasibility of the program developed, damped natural frequencies are determined using a nine station model of a turbocompressor. Dissert. Abstr.

N80-12416# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
IMPROVED CAPABILITIES TO DETECT INCIPIENT BEARING FAILURES Interim Report, 1 May 1978 - 28 Feb. 1979
J. A. Alcorta and L. L. Packer Jun. 1979 67 p refs
(Contract F33615-78-C-2008; AF Proj. 3048)
(AD-A073123; FR-11509; AFAPL-TR-79-2050) Avail: NTIS HC A04/MF A01 CSCL 21/5

A methodology using a low level radiation technique for the detection of wear in gas turbine engine mainshaft bearings has been developed. In conjunction with SOAP analyses, the radioactive tag will detect low levels of wear and will simultaneously indicate whether the tagged bearing is the source of the wear. Iron-55 is employed as the active tag owing to its low radiation levels, long half-life, and homogeneity of the isotope in the bearing rollers. The low levels of radiation existent in the tagged wear particles requires the separation of wear debris from the oil. Membrane filtration of the oil for debris removal is undertaken due to its high recovery efficiency, simplicity of use, and adaptability for direct incorporation into the nuclear counting system. A gas flow proportional counter with cosmic guard detector and background shielding constitutes the most suitable low-level radio-activity measuring device for the iron-55 X-ray counting. The radioactive bearing tagging technique complements engine modularization by defining a diagnostic system that will identify specific engine bearings experiencing wear. By assessing the location of the distressed bearing, the tagging technique permits the confinement of engine teardown to the module in which the bearing is located. Author (GRA)

N80-12423# General Dynamics Corp. Fort Worth, Tex.
OPTIMIZATION OF COMPUTER AUTOMATED ULTRASONIC INSPECTION SYSTEM Final Report, Jun. 1976 - Oct. 1978
Bill G. W. Yee, J. C. Couchman, and F. H. Chang Feb. 1979 199 p refs Prepared in cooperation with Pattern Analysis and Recognition Corp.
(Contract F33615-76-C-5104; AF Proj. 7351)
(AD-A072677; AFML-TR-79-4016) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report describes the work conducted on a program to optimize the hardware and software of a computer automated ultrasonic inspection system which was developed under a previous Air Force Contract F33615-72-C-1828. The hardware modifications included improvements of the scan drive mechanism to increase inspection speed and development of improved ultrasonic circuitry to perform zone scanning inspections. Software developments included: (1) implementation of the zone scanning inspection method, (2) programs for signal processing to enhance random flaw detection, and (3) development of a Computer Aided Design Data Control (CADDC) method to interface the inspection system with data generated by Computer Aided Design (CAD) approach to component design. GRA

N80-12436# Aeronautical Research Labs., Melbourne (Australia).
A SPECIAL CRACK TIP ELEMENT FOR THREE-DIMENSIONAL CRACK PROBLEMS
R. Jones and R. J. Callinan Nov. 1978 21 p refs
(ARL-Struc-Note-374; AR-001-319) Avail: NTIS HC A02/MF A01

A finite element method for determining the stress intensity factors along the edge of a crack in an arbitrary three-dimensional body is presented. A spectral element is placed around the crack front and in each special element the stresses and displacements are derived using the asymptotic nature of the stress and displacement fields near a crack tip. The method is based on a technique for evaluating the stress intensity factors in cracked sheets, and coincides with this method in the case of a through crack in a thin sheet. As illustrative examples, the problems of a semicircular surface flaw and an internal penny shaped crack are considered. In each case the computed values of the stress intensity factors are in excellent agreement with known analytical results. M.M.M.

N80-12438*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY DESIGN PROCEDURE FOR INSULATED STRUCTURES SUBJECTED TO TRANSIENT HEATING
Howard M. Adelman Washington Dec. 1979 53 p refs
(NASA-TP-1534; L-13144) Avail: NTIS HC A04/MF A01 CSCL 20L

Minimum-mass designs were obtained for insulated structural panels loaded by a general set of inplane forces and a time dependent temperature. Temperature and stress histories in the structure are given by closed-form solutions, and optimization of the insulation and structural thicknesses is performed by nonlinear mathematical programming techniques. Design calculations are described to evaluate the structural efficiency of eight materials under combined heating and mechanical loads: graphite/polyimide, graphite/epoxy, boron/aluminum, titanium, aluminum, Rene 41, carbon/carbon, and Lockalloy. The effect on design mass of intensity and duration of heating were assessed. Results indicate that an optimum structure may have a temperature response well below the recommended allowable temperature for the material. R.C.T.

N80-12468 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
AIMS AND TASKS OF THE AIRCRAFT TEST PROGRAM [ZIELE UND AUFGABEN DES FLUGZEUGMESSPROGRAMS]
Manfred Schroeder *In* Tech. Hochschule On Meas. from Aircraft Jun. 1978 p 11-22 refs In GERMAN

Avail: Issuing Activity

Studies were carried out for developing German remote sensing equipment for future participation in international satellite projects for global and regional environmental monitoring systems. Emphasis is given to work in the following fields: multispectral imaging techniques, development of systems for the digital treatment of images, applications to geoscience problems, evaluations for future technological developments, balanced organizational and interdisciplinary teams. Author (ESA)

N80-12635# Pennsylvania State Univ., University Park. Center for the Study of Science Policy.
AIRCRAFT NOISE AND THE MARKET FOR RESIDENTIAL HOUSING: EMPIRICAL RESULTS FOR SEVEN SELECTED AIRPORTS Final Report, Jul. 1977 - Sep. 1978
Jon P. Nelson Sep. 1978 153 p
(Contract DOT-OS-70066)
(PB-297681/9; DOT/RSPA/DPB-50/78/24) Avail: NTIS HC A08/MF A01 CSCL 05C

The effect on property values of a decibel change in noise exposure forecast levels is studied. Census block and census tract data are employed for small geographic areas (about two miles radius) near seven selected major U.S. airports. In each of seven cases, the results indicate that aircraft noise has a negative and statistically significant effect on residential property values. GRA

N80-12741*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VALIDATION METHODS FOR FAULT-TOLERANT AVIONICS AND CONTROL SYSTEMS, WORKING GROUP MEETING 1
Washington Dec. 1979 112 p refs Workshop held at Hampton, Va., 12-14 Mar. 1979
(NASA-CP-2114; L-13436) Avail: NTIS HC A06/MF A01 CSCL 12A

The proceedings of the first working group meeting on validation methods for fault tolerant computer design are presented. The state of the art in fault tolerant computer validation was examined in order to provide a framework for future discussions concerning research issues for the validation of fault tolerant avionics and flight control systems. The development of positions concerning critical aspects of the validation process are given. R.C.T.

N80-12818*# Lockheed-Georgia Co., Marietta.
A STUDY OF THE PREDICTION OF CRUISE NOISE AND LAMINAR FLOW CONTROL NOISE CRITERIA FOR SUBSONIC AIR TRANSPORTS Final Report, May 1977 - Jun. 1978
G. Swift and P. Mungur Aug. 1979 262 p refs
(Contract NAS1-14946)
(NASA-CR-159104; LG78ER0218) Avail: NTIS HC A12/MF A01 CSCL 20A

General procedures for the prediction of component noise levels incident upon airframe surfaces during cruise are developed. Contributing noise sources are those associated with the propulsion system, the airframe and the laminar flow control (LFC) system. Transformation procedures from the best prediction base of each noise source to the transonic cruise condition are established. Two approaches to LFC/acoustic criteria are developed. The first is a semi-empirical extension of the X-21 LFC/acoustic criteria to include sensitivity to the spectrum and directionality of the sound field. In the second, the more fundamental problem of how sound excites boundary layer disturbances is analyzed by deriving and solving an inhomogeneous Orr-Sommerfeld equation in which the source terms are proportional to the production and dissipation of sound induced fluctuating vorticity. Numerical solutions are obtained and compared with corresponding measurements. Recommendations are made to improve and validate both the cruise noise prediction methods and the LFC/acoustic criteria. A.R.H.

N80-12819*# Lockheed-Georgia Co., Marietta.
NEAR-FIELD NOISE PREDICTION FOR AIRCRAFT IN CRUISING FLIGHT: METHODS MANUAL Final Report, May 1977 - Jun. 1978
J. G. Tibbetts Aug. 1979 97 p
(Contract NAS1-14946)
(NASA-CR-159105; LG78ER0219) Avail: NTIS HC A05/MF A01 CSCL 20A

Methods for predicting noise at any point on an aircraft while the aircraft is in a cruise flight regime are presented. Developed for use in laminar flow control (LFC) noise effects analyses, they can be used in any case where aircraft generated noise needs to be evaluated at a location on an aircraft while under high altitude, high speed conditions. For each noise source applicable to the LFC problem, a noise computational procedure is given in algorithm format, suitable for computerization. Three categories of noise sources are covered: (1) propulsion system, (2) airframe, and (3) LFC suction system. In addition, procedures are given for noise modifications due to source soundproofing and the shielding effects of the aircraft structure wherever needed. Sample cases, for each of the individual noise source procedures, are provided to familiarize the user with typical input and computed data. A.R.H.

N80-12820*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GROUND EFFECTS ON AIRCRAFT NOISE
William L. Willshire, Jr. and David A. Hilton Nov. 1979 71 p refs
(NASA-TM-80185) Avail: NTIS HC A04/MF A01 CSCL 20A

A flight experiment was conducted to investigate air-to-ground propagation of sound near grazing incidence. A turbojet-powered aircraft was flown at low altitudes over the ends of two microphone arrays. An eight-microphone array was positioned along a 1850 m concrete runway. The second array consisted of 12 microphones positioned parallel to the runway over grass. Twenty-eight flights were flown at altitudes ranging from 10 m to 160 m. The acoustic data recorded in the field reduced to one-third-octave band spectra and time correlated with the flight and weather information. A small portion of the data was further reduced to values of ground attenuation as a function of frequency and incidence angle by two different methods. In both methods, the acoustic signals compared originated from identical sources. Attenuation results obtained by using the two methods were in general agreement. The measured ground attenuation was largest in the frequency range of 200 to 400 Hz. A strong dependence was found between ground attenuation and incidence angle with little attenuation measured for angles of incidence greater than 10 to 15 degrees. A.R.H.

N80-12821*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTAL AND NUMERICAL RESULTS ON A SHEAR LAYER EXCITED BY A SOUND PULSE
Lucio Maestrello, Alvin Bayliss, and Eli Turkel Nov. 1979 47 p refs Presented at 32d Am. Phys. Soc. Meeting in Notre Dame, Indiana, 18-19 Nov. 1979
(NASA-TM-80183) Avail: NTIS HC A03/MF A01 CSCL 20A

The behavior of a sound in a jet was investigated. It is verified that the far-field acoustic power increased with flow velocity for the lower and medium frequency range. Experimentally, an attenuation at higher frequencies is also observed. This increase is found numerically to be due primarily to the interactions between the mean vorticity and the fluctuation velocities. Spectral decomposition of the real time data indicates that the power increase occurs in the low and middle frequency range, where the local instability waves have the largest spatial growth rate. The connection between this amplification and the local instability waves is discussed. Author

N80-12823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A TIME DEPENDENT DIFFERENCE THEORY FOR SOUND PROPAGATION IN DUCTS WITH FLOW
K. J. Baumeister 1979 38 p refs Presented at 98th Meeting of the Acoustical Soc. of Am., Salt Lake City, Utah, 26-30 Nov. 1979
(NASA-TM-79302; E-254) Avail: NTIS HC A03/MF A01 CSCL 20A

A time dependent numerical solution of the linearized continuity and momentum equation was developed for sound propagation in a two dimensional straight hard or soft wall duct with a sheared mean flow. The time dependent governing acoustic difference equations and boundary conditions were developed along with a numerical determination of the maximum stable time increments. A harmonic noise source radiating into a quiescent duct was analyzed. This explicit iteration method then calculated stepwise in real time to obtain the transient as well as the steady state solution of the acoustic field. Example calculations were presented for sound propagation in hard and soft wall ducts, with no flow and plug flow. Although the problem with sheared flow was formulated and programmed, sample calculations were not examined. The time dependent finite difference analysis was found to be superior to the steady state finite difference and finite element techniques because of shorter solution times and the elimination of large matrix storage requirements. R.C.T.

N80-12867# Boeing Vertol Co., Philadelphia, Pa.
HELICOPTER CANOPY INTERNAL REFLECTION INVESTIGATION Final Report, Jul. 1978 - Jan. 1979
Dino Piccione Jul. 1979 40 p
(Contract DAAK51-78-C-0009; DA Proj. 1L1-62209-AH-76) (AD-A073084; D210-11494-1; USARTL-TR-79-14) Avail: NTIS HC A03/MF A01 CSCL 01/3

The reflections on helicopter canopies from instrument panel light sources adversely affect night flight operations. A program objective was to investigate the application of Light Control Film, such as 3M or equivalent material, as a technique for eliminating helicopter canopy reflections in the AH-1S from instrument panel lighting which cause the pilot and copilot night flight operational problems. A mock-up of the AH-1S was used to test and evaluate the reflection conditions. Light control technology was reviewed to uncover corrective techniques or materials. The most promising approach was to apply 3M Light Control Film on the face of instruments and control panels. Most reflections were eliminated using this technique. A few problem areas still remain which appear to be treatable by applying a soft glare shield extension that enshrouds the cockpit. GRA

N80-12994*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUMMARY OF LOW-SPEED LONGITUDINAL AERODYNAMICS OF TWO POWERED CLOSE-COUPLED WING-CANARD FIGHTER CONFIGURATIONS
John W. Paulson, Jr. and James L. Thomas Washington Dec. 1979 92 p refs
(NASA-TP-1535; L-13157) Avail: NTIS HC A05/MF A01 CSCL 01A

Investigations of the low speed longitudinal characteristics of two powered close coupled wing-canard fighter configurations are discussed. Data obtained at angles of attack from -2 deg to 42 deg, Mach numbers from 0.12 to 0.20, nozzle and flap deflections from 0 deg to 40 deg, and thrust coefficients from 0 to 2.0, to represent both high angle of attack subsonic maneuvering characteristics and conventional takeoff and landing characteristics are examined. Data obtained with the nozzles deflected either 60 deg or 90 deg and the flaps deflected 60 deg to represent vertical or short takeoff and landing characteristics are discussed. A.W.H.

N80-12995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INCLUSION OF UNSTEADY AERODYNAMICS IN LONGITUDINAL PARAMETER ESTIMATION FROM FLIGHT DATA
M. J. Queijo, William R. Wells (Wright State Univ., Dayton, Ohio), and Dinesh A. Keskar Washington Dec. 1979 52 p refs
(NASA-TP-1536; L-13009) Avail: NTIS HC A04/MF A01 CSCL 01A

A simple vortex system, used to model unsteady aerodynamic effects into the rigid body longitudinal equations of motion of an aircraft, is described. The equations are used in the development of a parameter extraction algorithm. Use of the two parameter-estimation modes, one including and the other omitting unsteady aerodynamic modeling, is discussed as a means of estimating some acceleration derivatives. Computer generated data and flight data, used to demonstrate the use of the parameter-extraction algorithm are studied. A.W.H.

N80-12996*# Princeton Univ., N. J. Flight Research Lab.
AN EXPLORATORY INVESTIGATION OF THE STOL LANDING MANEUVER Final Report
Patrick H. Whyte Washington NASA Dec. 1979 74 p refs (Contract NAS2-7350)
(NASA-CR-3191; AMS-1231-T) Avail: NTIS HC A04/MF A01 CSCL 01A

The parameters influencing the STOL landing are identified and their effect on the ease and quality of the flare maneuver is discussed. Data from actual landings, supported by pilot commentary and pilot opinion rating, are analyzed. Hypotheses concerning the prediction of STOL handling qualities in the flare are proposed, and suggestions for future research are presented. A.W.H.

N80-12997*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSONIC AERODYNAMIC CHARACTERISTICS OF A SUPERSONIC CRUISE AIRCRAFT RESEARCH MODEL WITH THE ENGINES SUSPENDED ABOVE THE WING
Charles E. Mercer and George T. Carson, Jr. Dec. 1979 198 p refs
(NASA-TM-80145; L-12811) Avail: NTIS HC A09/MF A01 CSCL 01A

The influence of upper-surface nacelle exhaust flow on the aerodynamic characteristics of a supersonic cruise aircraft research configuration was investigated in a 16 foot transonic tunnel over a range of Mach numbers from 0.60 to 1.20. The arrow-wing transport configuration with engines suspended over the wing was tested at angles of attack from -4 deg to 6 deg and jet total pressure ratios from 1 to approximately 13. Wing-tip leading edge flap deflections of -10 deg to 10 deg were tested with the wing-body configuration. Various nacelle locations (chordwise, spanwise, and vertical) were tested over the ranges of Mach numbers, angles of attack, and jet total-pressure ratios. The results show that reflecting the wing-tip leading edge flap from 0 deg to -10 deg increased the maximum lift-drag ratio by 1.0 at subsonic speeds. Jet exhaust interference effects were negligible. R.E.S.

N80-12998*# Rockwell International Corp., Los Angeles, Calif.
AERODYNAMIC PRELIMINARY ANALYSIS SYSTEM. PART 1: THEORY Final Report
E. Bonner, W. Clever, and K. Dunn 1978 81 p refs
(Contract NAS1-14686)
(NASA-CR-145284) Avail: NTIS HC A05/MF A01 CSCL 01A

A comprehensive aerodynamic analysis program based on linearized potential theory is described. The solution treats thickness and attitude problems at subsonic and supersonic speeds. Three dimensional configurations with or without jet flaps having multiple non-planar surfaces of arbitrary planform and open or closed slender bodies of non-circular contour may be analyzed. Longitudinal and lateral-directional static and rotary derivative solutions may be generated. The analysis was implemented on a time sharing system in conjunction with an input tablet digitizer and an interactive graphics input/output display and editing terminal to maximize its responsiveness to the preliminary analysis problem. Nominal case computation time of 45 CPU seconds on the CDC 175 for a 200 panel simulation indicates the program provides an efficient analysis for systematically performing various aerodynamic configuration tradeoff and evaluation studies. Author

N80-13002*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
EFFECTS OF FUSELAGE FOREBODY GEOMETRY ON LOW-SPEED LATERAL-DIRECTIONAL CHARACTERISTICS OF TWIN-TAIL FIGHTER MODEL AT HIGH ANGLES OF ATTACK

Peter C. Carr and William P. Gilbert Dec. 1979 73 p refs (NASA-TP-1592; L-13270) Avail: NTIS HC A04/MF A01 CSCL 01A

Low-speed, static wind-tunnel tests were conducted to explore the effects of fighter fuselage forebody geometry on lateral-directional characteristics at high angles of attack and to provide data for general design procedures. Effects of eight different forebody configurations and several add-on devices (e.g., nose strakes, boundary-layer trip wires, and nose booms) were investigated. Tests showed that forebody design features such as fineness ratio, cross-sectional shape, and add-on devices can have a significant influence on both lateral-directional and longitudinal aerodynamic stability. Several of the forebodies produced both lateral-directional symmetry and strong favorable changes in lateral-directional stability. However, the same results also indicated that such forebody designs can produce significant reductions in longitudinal stability near maximum lift and can significantly change the influence of other configuration variables. The addition of devices to highly tailored forebody designs also can significantly degrade the stability improvements provided by the clean forebody. Author

N80-13003*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FORCE AND MOMENT DATA FROM A WIND-TUNNEL TEST OF A TILT-NACELLE V/STOL PROPULSION SYSTEM WITH AN ATTITUDE CONTROL VANE

Mark D. Betzina Nov. 1979 108 p refs (NASA-TM-81157; A-8013) Avail: NTIS HC A06/MF A01 CSCL 01A

A large scale, tilt nacelle V/STOL propulsion system, with an attitude control vane assembly mounted in the exhaust, was tested. The effectiveness of the control vane as well as the aerodynamic characteristics of the entire propulsion system were determined. The results, in the form of tabulated coefficients, for both the vane forces and moments and the total forces and moments produced by the propulsion system are presented. A.W.H.

N80-13014# Civil Aeromedical Inst., Oklahoma City, Okla.

EVALUATION OF SEATING AND RESTRAINT SYSTEMS CONDUCTED DURING FISCAL YEAR 1978

Richard F. Chandler and Edwin M. Trout Jun. 1979 228 p refs (AD-A074881; FAA-AM-79-17) Avail: NTIS HC A11/MF A01 CSCL 01/2

Results are presented of test programs conducted by the Protection and Survival Laboratory to investigate the performance of prototype or operational seating and restraint systems relative to their ability to provide protection against crash injury and to validate the performance of the FAA Seat Occupant Model: Light Aircraft (SOMLA). M.M.M.

N80-13016# Systems Control, Inc., Palo Alto, Calif.

ESTABLISHMENT CRITERIA FOR DISTANCE MEASUREMENT EQUIPMENT (DME) WITH INSTRUMENT LANDING SYSTEM AND/OR LOCALIZER APPROACH Final Report

H. L. Solomon, W. Heine, and M. Venturino Dec. 1978 68 p refs (Contracts DOT-FA77WAI-731; WI-78-3434-1) (AD-A069818; FAA-ASP-78-7) Avail: NTIS HC A04/MF A01 CSCL 17/7

The benefit/cost analysis presented considers the following factors: (1) use of DME in lieu of ILS outer marker beacon; (2) reduced probability of approach accidents; (3) averted flight disruptions due to reduced localizer minima; (4) averted missed approaches due to additional information provided; and (5) expedited aircraft departures due to reduced departure flight path length. M.M.M.

N80-13017# Lincoln Lab., Mass. Inst. of Tech., Lexington.

THE AIRCRAFT REPLY AND INTERFERENCE ENVIRONMENT SIMULATOR (ARIES). VOLUME 3: PROGRAMMER'S MANUAL

Michael Goon and D. A. Spencer 22 Mar. 1979 63 p refs (Contracts DOT-FA77WAI-261; F19628-78-C-0002; FAA Proj. 052-241-04) (AD-A074424; ATC-87-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 09/2

The ARIES Programmer's Manual presented describes the operation, signal formats and protocols of the Lincoln Laboratory-built input/output devices controlled by the Eclipse computer. The descriptions are primarily concerned with the logic of the interface boards that reside in the computer chassis and the formats of the words transferred to and from the computer. The logic of the devices themselves is described only to the extent necessary to understand the interface protocols and data formats. M.M.M.

N80-13018# Ohio Univ., Athens. Avionics Engineering Center.

IN-SERVICE IMPROVEMENTS AND MODERNIZATION OF ALL COMPONENTS OF THE INSTRUMENT LANDING SYSTEMS. VOLUME 1: SECTIONS 1-10 Final Report

Jul. 1978 675 p refs (Contract DOT-FA75WA-3549) (AD-A074425; EER-35-1-Vol-1; FAA-RD-78-112-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 17/7

Improvements and alternative utilization of the instrument landing (ILS) glide slope and localizer systems are considered. It is concluded that the ILS is a highly flexible and important navigational aid, with many possibilities for alternative use waiting to be fully realized. J.M.S.

N80-13019# Ohio Univ., Athens. Avionics Engineering Center.

IN-SERVICE IMPROVEMENTS AND MODERNIZATION OF ALL COMPONENTS OF THE INSTRUMENT LANDING SYSTEMS. VOLUME 2: SECTIONS 11 AND 12 Final Report, Oct. 1974 - Jul. 1978

Jul. 1978 858 p refs 2 Vol. (Contract DOT-FA75WA-3549) (AD-A074426; EER-35-1-Vol-2; FAA-RD-78-112-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 17/7

Results of an evaluation of localizer and glide-slope systems are given emphasizing antenna and monitor performance, terrain effects, and the effects of obstructions. Also, details of analyses and flight evaluations of Alford and Hollins localizer systems are provided together with findings during evaluations of the Watts Mark 1, 2, and 3 endfire, glide-slope systems. Technical results of development and evaluation work on the FAA-suggested techniques for determining range-rate and position during approach using the localizer signal are given. Nondestructive instrument landing system (ILS) fault testing techniques are described, as is a plan for development of an airport systems control/display facility. Special devices and techniques for use in ILS field work such as a mini-laboratory for collection of airborne data, digital data collection system, time domain reflectometry, and mathematical modeling to predict localizer and glide slope performance and facilitate setups are discussed. J.M.S.

N80-13020*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EXPERIMENTAL DETERMINATION OF POSITION-ESTIMATE ACCURACY USING BACK-AZIMUTH SIGNALS FROM A MICROWAVE LANDING SYSTEM

Charles E. Knox Dec. 1979 37 p (NASA-TP-1574; L-13074) Avail: NTIS HC A03/MF A01 CSCL 17G

Flight tests using the Boeing 737 airplane to obtain position estimates with back azimuth signals from a microwave landing system (MLS) are discussed. The equations and logic used to generate a navigation position estimate in the MLS back azimuth signal environment are described. The error in the navigation position estimate is determined. A summary of the Boeing 737 position estimate update process is described. The navigation position estimate error calculated flight data and radar tracking information is analyzed. The position estimate error data using the MLS inputs are compared with error data obtained during dual distance measuring equipment updates. A.W.H.

N80-13022# European Space Agency, Paris (France). Inst. fuer Flugmechanik.

THE SUPERPOSITION OF TWO-DIMENSIONAL ERROR FIELDS AND ITS INFLUENCE ON FLIGHT SAFETY OF AIR TRAFFIC

Otto Weber (DFVLR, Brunswick, West Germany) Mar. 1979 59 p refs Transl. into ENGLISH of "Die Ueberlagerung Zweidimensionaler Fehlerfelder und ihr Einfluss auf die Flugsicherheit im Luftverkehr", DFVLR, Brunswick Report DLR-FB-77-64, 21 Dec. 1978 Original German report available from DFVLR, Cologne DM 27.20

(ESA-TT-527-Rev; DLR-FB-77-64) Avail: NTIS HC A04/MF A01

The superposition of two dimensional error fields and their effects on air traffic flight safety are discussed. Local error fields significant with regard to flight safety are investigated and described by means of error ellipses, 95% circles, and other curves representing the same probability. Taking the upper wind field over Schleswig as an example, conclusions are drawn concerning the frequency distributions of asymmetrical real phenomena. Statistical laws for determining the mean error vector and the covariance matrix of a superimposed field from the corresponding values of the original normal distribution error fields are also discussed, and rules are given regarding the shape and the error contour area of the superposition. The safety cushion provided by the superposition of a ring shaped or extreme radical distribution with a normal distribution is contrasted to that provided by the superposition of two error fields having normal distributions. Author (ESA)

N80-13023# Sandia Labs., Albuquerque, N. Mex. Aerodynamics Dept. 5630.

AERODYNAMIC DESIGN OF AN EXTENDED-RANGE GUIDED BOMB

Randall C. Maydew 18 Jun. 1979 49 p refs Backup-document for AIAA synoptic scheduled for publication in Journal of Aircraft on Mar. 1980

(Log-C3719) Avail: NTIS HC A03/MF A01

The extended range bomb designed to provide a low altitude, 15 km stand off or a 2.5 km turn radius, return to target delivery capability from aircraft at release speeds from 330 to 800 KCAS is examined. The rocket boosted, 41.9 cm diameter bomb utilizes two orthogonal pairs of pneumatically actuated canards for attitude control and lift. The guidance and control system consists of a strapdown inertial measurement unit and a digital computer containing an autopilot and navigator. Computer simulations which indicated the canards must provide high lift with nearly linear characteristics to angles of attack of about 20 deg are discussed. Wind tunnel tests conducted to optimize the canard design are described and the results evaluated. A.W.H.

N80-13024*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

APPLICATION OF MODIFIED PROFILE ANALYSIS TO FUNCTION TESTING OF THE MOTION/NO-MOTION ISSUE IN AN AIRCRAFT GROUND-HANDLING SIMULATION

Russell V. Parrish, Burnell T. McKissick, and George G. Steinmetz Washington Dec. 1979 24 p refs

(NASA-TP-1540; L-13028) Avail: NTIS HC A02/MF A01 CSCL 01C

A recent modification of the methodology of profile analysis, which allows the testing for differences between two functions as a whole with a single test, rather than point by point with multiple tests is discussed. The modification is applied to the examination of the issue of motion/no motion conditions as shown by the lateral deviation curve as a function of engine cut speed of a piloted 737-100 simulator. The results of this application are presented along with those of more conventional statistical test procedures on the same simulator data. A.W.H.

N80-13025*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ANALYTICAL INVESTIGATION OF THE LANDING DYNAMICS OF A LARGE AIRPLANE WITH A LOAD-CONTROL SYSTEM IN THE MAIN LANDING GEAR

John R. McGehee and Huey D. Carden Dec. 1979 85 p refs (NASA-TP-1555; L-13250) Avail: NTIS HC A05/MF A01 CSCL 01C

The results of an evaluation of an active load-control landing gear computer program (ACOLAG) for predicting the landing dynamics of airplanes with passive and active main gears are presented. ACOLAG was used in an analytical investigation of the landing dynamics of a large airplane with both passive and active main gears. It was concluded that the program is valid for predicting the landing dynamics of airplanes with both passive and active main gears. It was shown that the active gear reduces airframe-gear forces and airplane motions following initial impact, and has the potential for significant reductions in structural fatigue damage relative to that which occurs with the passive gear. M.M.M.

N80-13026*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EXPLORATORY STUDY OF THE EFFECTS OF WING-LEADING-EDGE MODIFICATIONS ON THE STALL/SPIN BEHAVIOR OF A LIGHT GENERAL AVIATION AIRPLANE

Dec. 1979 98 p refs

(NASA-TP-1589; L-13143) Avail: NTIS HC A05/MF A01 CSCL 01C

Configurations with full-span and segmented leading-edge flaps and full-span and segmented leading-edge droop were tested. Studies were conducted with wind-tunnel models, with an outdoor radio-controlled model, and with a full-scale airplane. Results show that wing-leading-edge modifications can produce large effects on stall/spin characteristics, particularly on spin resistance. One outboard wing-leading-edge modification tested significantly improved lateral stability at stall, spin resistance, and developed spin characteristics. A.R.H.

N80-13027*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

FRICTION CHARACTERISTIC OF STEEL SKIDS EQUIPPED WITH SKEGS ON A LAKEBED SURFACE

Walter J. Sefic Dec. 1979 16 p refs

(NASA-TM-81347; H-1111) Avail: NTIS HC A02/MF A01 CSCL 01C

The coefficient of friction was determined for steel skids with and without skegs. The addition of a 1.27 centimeter deep skeg caused the coefficient of friction to increase from an average value of .36 to .53, a 47 percent increase over the flat skid. The addition of a .64 centimeter deep skeg increased the friction coefficient from .36 to .46, a 16 percent increase over the flat skid. Comparisons are made with data for similar test conditions obtained during the X-15 program. A.R.H.

N80-13028*# Boeing Vertol Co., Philadelphia, Pa.

ANALYSIS AND CORRELATION WITH THEORY OF ROTOR LIFT-LIMIT TEST DATA

Marc Sheffler Nov. 1979 126 p refs

(Contract NAS1-14317)

(NASA-CR-159139) Avail: NTIS HC A07/MF A01 CSCL 01C

A wind tunnel test program to define the cruise performance and determine any limitations to lift and propulsive force of a conventional helicopter rotor is described. A 2.96 foot radius model rotor was used. The maximum lift and propulsive force obtainable from an articulated rotor for advance ratios of 0.4 to 0.67, and the blade load growth as the lift approaches the limit are determined. Cruise rotor performance for advance ratios of 0.4 to 0.67 and the sensitivity of the rotor forces and moments to rotor control inputs as the lift limit is approached are established. A.W.H.

N80-13029# Kaman Aerospace Corp., Bloomfield, Conn.

DESIGN ASSESSMENT OF ADVANCED TECHNOLOGY LIGHTWEIGHT, LOW-COST MISSION-CONFIGURED GONDOLA MODULES Final Report, Aug. 1978 - Mar. 1979

John D. Porterfield Jul. 1979 175 p refs

(Contract DAAK51-78-C-0012; DA Proj. 1L1-62209-AH-76)

(AD-A073554; R-1568; USARTL-TR-79-16) Avail: NTIS HC A08/MF A01 CSCL 15/5

The objectives of this program were to identify applicable high strength materials and efficient structural concepts for application to various elements of the helicopter external gondola system (HEGS) and to subsequently prepare preliminary design arrangements for the HEGS-10, HEGS-20, and HEGS-Palletized modules. GRA

N80-13030# Rockwell International Corp., El Segundo, Calif. Los Angeles Div.
MECHANICAL POWER SYSTEM FOR AIRCRAFT INTERMITTENT UTILITY FUNCTIONS Final Technical Report, Mar. 1975 - Feb. 1979
C. W. Helsley Apr. 1979 282 p refs
(Contract F33615-75-C-2011; AF Proj. 3145)
(AD-A073297; RI/LAD-NA-79-64; AFAPL-TR-79-2028) Avail: NTIS HC A13/MF A01 CSCL 01/3

The program reported upon herein is designed to develop a satisfactory method for utilizing flywheel energy in an aircraft control system. To attain this objective, the program will design, fabricate and demonstrate a mechanical power package (MPP) for controlling and powering a high-horsepower utility actuation function. The MPP will consist of a hydraulic motor, a flywheel, an adapter gearbox, a controller, and a screwjack actuator, and will be designed to replace an existing hydraulic actuator. GRA

N80-13031# Ballistic Research Labs., Aberdeen Proving Ground, Md.
COMPUTER DESCRIPTION OF BLACK HAWK HELICOPTER Final Report
Gary G. Kuehl Jun. 1979 321 p refs Supersedes ARBRL-IMR-605
(AD-A073444; AD-E430285; ARBRL-TR-02172; ARBRL-IMR-605) Avail: NTIS HC A14/MF A01 CSCL 01/3

A computer description of the geometry of the Black Hawk Helicopter was made. This description was made using the technique of combinatorial geometry (COM-GEOM) and will be used as input to the GIFT computer code which generates data used in target vulnerability analyses. This report describes the method used in modelling the helicopter. The appendix contains computer listings of the data comprising the computer description of the vehicle. GRA

N80-13032# Northrop Research and Technology Center, Palos Verdes Peninsula, Calif.
INVESTIGATION OF ADVANCED PROGNOSTIC ANALYSIS TECHNIQUES Final Report
Ralph C. Grove Jun. 1979 261 p refs
(Contract DAAJ02-77-C-0054; DA Proj. 1L2-62209-AH-76)
(AD-A073553; NRTC-78-47R; USARTL-TR-79-10) Avail: NTIS HC A12/MF A01 CSCL 01/3

This report presents the results of an experimental program with the following objectives: to collect and process test data from six different UH-1 helicopter 90 degree gearboxes, tested for a total of 4712 hours under controlled conditions, and to perform a theoretical investigation and data analysis to develop and optimize trend detection and prediction algorithms for application to the processed test cell data in order to establish valid predictions of gearbox failure time. A variety of sensors were used to monitor the wear occurring in the gearboxes including oil debris monitors, accelerometers, a shock pulse analyzer, and temperature sensors. Spectrometric oil analyses of the gearbox oil were performed on daily samples from the gearbox oil reservoir. The gearboxes were disassembled and inspected for wear prior to and following each test. Wear measurement techniques included visual inspection by an expert, measurements of ball and ball track wear, dynamic noise testing of bearings, and scanning electron microscope photographs of the surface of one ball from each bearing. GRA

N80-13033# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
A COMPUTERIZED VSTOL/SMALL PLATFORM LANDING DYNAMICS INVESTIGATION MODEL Final Report
Ronald L. Nave 30 Sep. 1977 295 p
(WF41421203)
(AD-A073587; NADC-77024-30) Avail: NTIS HC A13/MF A01 CSCL 01/2

A digital computer program has been developed to investigate the dynamic interaction between VSTOL aircraft and ships. The model includes the ship, aircraft, pilot, and air turbulence. At present the aircraft model is configured to represent the AV8A Harrier, but other aircraft may be simulated by simple program changes. GRA

N80-13034# ARO, Inc., Arnold Air Force Station, Tenn.
A-10 CARRIAGE LOADS TEST Final Report, 26 May - 3 Jun. 1978
T. O. Shadow AEDC Jun. 1978 48 p Sponsored by the Air Force
(AD-A073442; AEDC-TSR-78-P9) Avail: NTIS HC A03/MF A01 CSCL 01/3

A wind tunnel test was conducted with a 0.05 scale model of the A-10 aircraft to obtain carriage loads data for various external store configurations. The external stores consisted of 14 different bombs and pods, four different loading racks, and three 600 gal ferrying tanks mounted in various combinations on all 11 pylons. The loads imposed by the stores on the pylons were measured on six of the 11 pylons with strain-gage balances mounted inside the pylons. Mach number was varied from 0.3 to 0.75 and aircraft sideslip angle was varied from -18 to 18 deg at constant angles of attack of 0, 5, 10, 15, and 20 deg. GRA

N80-13035# Royal Aircraft Establishment, Farnborough (England).
THE USE OF STRIP THEORY IN THE DYNAMICS OF DEFORMABLE AIRCRAFT
D. L. Woodcock London HMSO Aug. 1978 120 p refs
(RAE-TM-Struct-933; BR66481) Avail: NTIS HC A06/MF A01

A detailed formulation of the equations of motion of a deformable aircraft is given. The development is from Lagrange's equations for an inertial frame and is made in terms of the position, orientation, force, and inertia properties of narrow strips of the aircraft which lie fore and aft in the unperturbed state. The latter is one of constant linear velocity and zero angular velocity. Particular account is taken of the deformation and loading in the unperturbed state. Author (ESA)

N80-13036# Royal Aircraft Establishment, Farnborough (England).
FORMULATION OF THE EQUATIONS OF MOTION OF A DEFORMABLE AIRCRAFT USING LAGRANGE'S EQUATIONS IN AN ARBITRARY NON-INERTIAL FRAME OF REFERENCE
D. L. Woodcock London Dec. 1978 101 p refs
(RAE-TM-Struct-941; BR66754) Avail: NTIS HC A06/MF A01

The equations of motion of a deformable aircraft are developed in detail from Lagrange's equations for a non-inertial frame. By an appropriate choice of deformation modes the principal frame of reference can be specified as, for example, mean-body axes or body-fixed axes. Particular account is taken of the influence of the propulsive and effective forces produced by power units containing rotating parts. The development ventures to a certain extent into the non-linear regime. Author (ESA)

N80-13037# Royal Aircraft Establishment, Farnborough (England).
THE EQUATIONS OF MOTION OF AN AIRCRAFT EMBRACING ITS WHOLE-BODY AND DEFORMATIONAL DEGREES OF FREEDOM
C. H. E. Warren London HMSO Jan. 1979 58 p refs
(RAE-TR-79010; RAE-Struct-YSE/B/0778; BR67362) Avail: NTIS HC A04/MF A01

The problem of unifying and relating the approaches adopted by the flight dynamicist who makes small perturbation studies of the behavior of an aircraft in its whole-body degrees of freedom

and by the structural dynamicist who makes similar studies of the behavior in its deformational degrees of freedom is considered. A framework for a common approach is outlined. It goes as far as deriving the equations of motion and shows how the terms, etc., in these equations relate to those traditionally used by the flight dynamicist and structural dynamicist. Author (ESA)

N80-13038# Royal Aircraft Establishment, Farnborough (England).
A SUGGESTION AS TO A GENERAL DERIVATION OF THE EQUATIONS OF MOTION OF A DEFORMABLE AIRCRAFT FOR SMALL PERTURBATIONS WHICH WILL BE MOST GENERALLY ACCEPTABLE
D. L. Woodcock London HMSO Jan. 1979 53 p refs
(RAE-TR-79011; RAE-Struct-BF/B/0777; BR67657) Avail: NTIS HC A04/MF A01

A general derivation of the equations of motion of a deformable aircraft for small perturbations is offered which, it is hoped, will be acceptable to all traditions and inclinations. The deformations are represented by an expression which is precisely linear in the generalized coordinates. Lagrange's equation for an arbitrary noninertial frame is used, along with the principles of momentum, and it is shown how the resulting equations of motion can be particularized to suit various tastes. An appendix considers to some extent the determination of the Phugoid and shows that the traditional structural dynamicist's approach is just as adequate as that of the flight dynamicist. Author (ESA)

N80-13039# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
BEAVER AIRCRAFT PARAMETER IDENTIFICATION: TECHNICAL PREPARATIONS AND PRELIMINARY RESULTS
Henry C. Garretson, III 1978 79 p refs
(DFVLR-Mitt-78-01) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 28.30

Various factors affecting aircraft parameter identification are examined. A review of the preparation/flight test phases of this research program is presented. The Beaver aircraft digital simulation program, aircraft flight test instrumentation, and test data processing are described. Input signal optimization techniques are discussed and signals optimized using four different methods are presented. Production of a tape which automatically applied the optimized input signals in flight is described. The flight test phase consisted of 14 flights and resulted in useful data for 110 individual maneuvers. Preliminary identification results from representative maneuvers are given. Author (ESA)

N80-13040# New Mexico Univ., Albuquerque. Technology Application Center.
REMOTELY PILOTED VEHICLES. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Jul. 1979
Samuel C. Mauk Sep. 1979 47 p Sponsored by NTIS
(NTIS/PS-79/0875/9) Avail: NTIS HC $28.00/MF $28.00 CSCL 01C

Articles concerning aircraft design, flight tests, aircraft control, cost effectiveness automatic flight control, automatic pilots, and data links are presented. Civil aviation applications are included, although military uses of remotely piloted vehicles are stressed. Contains 181 citations. GRA

N80-13041*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TEST OF NAVIGATION AND GUIDANCE SENSOR ERRORS MEASURED ON STOL APPROACHES
David N. Warner and F. J. Moran Dec. 1979 42 p
(NASA-TM-81154; A-8008) Avail: NASA. Ames Res. Center, Moffett Field, Calif. 20546 CSCL 01D

Navigation and guidance sensor error characteristics were measured during STOL approach-flight investigations. Data from some of the state sensors of a digital avionics system were compared to corresponding outputs from an inertial navigation system. These sensors include the vertical gyro, compass, and accelerometers. Barometric altimeter data were compared to altitude measured by a tracking radar. Data were recorded with the Augmentor Wing Jet STOL Research Aircraft parked and in flight. Author

N80-13042# National Aviation Facilities Experimental Center, Atlantic City, N. J.
EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT AIRCRAFT TELEDYNE CONTINENTAL MOTORS 6-285-B PISTON ENGINE Final Report
Eric E. Becker Aug. 1979 98 p refs
(AD-A074338; FAA-NA-79-30; FAA-RD-79-67) Avail: NTIS HC A05/MF A01 CSCL 21/7

The 6-285-B engine was tested to develop an exhaust emissions data base. The data base consists of current production baseline emissions characteristics, lean out emissions data, effects of leaning out the fuel schedule on cylinder head temperatures, and data showing ambient effects on exhaust emissions and cylinder head temperatures. A.W.H.

N80-13043*# Boeing Co., Seattle, Wash. Advanced Airplane Branch.
COMPUTER CODE FOR ESTIMATING INSTALLED PERFORMANCE OF AIRCRAFT GAS TURBINE ENGINES. VOLUME 1: FINAL REPORT
Edward J. Kowalski Dec. 1979 204 p refs 3 Vol.
(Contract NAS3-21238)
(NASA-CR-159691; D180-25481-1-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 21E

A computerized method which utilizes the engine performance data is described. The method estimates the installed performance of aircraft gas turbine engines. This installation includes: engine weight and dimensions, inlet and nozzle internal performance and drag, inlet and nacelle weight, and nacelle drag. A.W.H.

N80-13044*# Boeing Co., Seattle, Wash. Advanced Airplane Branch.
COMPUTER CODE FOR ESTIMATING INSTALLED PERFORMANCE OF AIRCRAFT GAS TURBINE ENGINES. VOLUME 2: USERS MANUAL
Edward J. Kowalski Dec. 1979 444 p 3 Vol.
(Contract NAS3-21238)
(NASA-CR-159692; D180-25481-2-Vol-2) Avail: NTIS HC A19/MF A01 CSCL 21E

A computerized method which utilizes the engine performance data and estimates the installed performance of aircraft gas turbine engines is presented. This installation includes: engine weight and dimensions, inlet and nozzle internal performance and drag, inlet and nacelle weight, and nacelle drag. A user oriented description of the program input requirements, program output, deck setup, and operating instructions is presented. A.W.H.

N80-13045*# Boeing Co., Seattle, Wash. Advanced Airplane Branch.
COMPUTER CODE FOR ESTIMATING INSTALLED PERFORMANCE OF AIRCRAFT GAS TURBINE ENGINES. VOLUME 3: LIBRARY OF MAPS
Edward J. Kowalski Dec. 1979 415 p refs 3 Vol.
(Contract NAS3-21238)
(NASA-CR-159693; D180-25481-3-Vol-3) Avail: NTIS HC A18/MF A01 CSCL 21E

A computerized method which utilizes the engine performance data and estimates the installed performance of aircraft gas turbine engines is presented. This installation includes: engine weight and dimensions, inlet and nozzle internal performance and drag, inlet and nacelle weight, and nacelle drag. The use of two data base files to represent the engine and the inlet/nozzle/aftbody performance characteristics is discussed. The existing library of performance characteristics for inlets and nozzle/aftbodies and an example of the 1000 series of engine data tables is presented. A.W.H.

N80-13048*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
ADVANCED CATALYTIC COMBUSTORS FOR LOW POLLUTANT EMISSIONS, PHASE 1 Final Report

W. J. Dodds Nov. 1979 159 p refs Sponsored in part by Air Force Engineering Services Center, Tyndall AFB, Fla.
(Contract NAS3-20820)
(NASA-CR-159535; CEEDO-TR-79-03) Avail: NTIS HC A08/MF A01 CSCL 21E

The feasibility of employing the known attractive and distinguishing features of catalytic combustion technology to reduce nitric oxide emissions from gas turbine engines during subsonic, stratospheric cruise operation was investigated. Six conceptual combustor designs employing catalytic combustion were defined and evaluated for their potential to meet specific emissions and performance goals. Based on these evaluations, two parallel-staged, fixed-geometry designs were identified as the most promising concepts. Additional design studies were conducted to produce detailed preliminary designs of these two combustors. Results indicate that cruise nitric oxide emissions can be reduced by an order of magnitude relative to current technology levels by the use of catalytic combustion. Also, these combustors have the potential for operating over the EPA landing-takeoff cycle and at cruise with a low pressure drop, high combustion efficiency and with a very low overall level of emission pollutants. The use of catalytic combustion, however, requires advanced technology generation in order to obtain the time-temperature catalytic reactor performance and durability required for practical aircraft engine combustors. A.R.H.

N80-13049# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF AIRJET DISTORTION GENERATOR USED TO PRODUCE STEADY-STATE, TOTAL-PRESSURE DISTORTION AT THE INLET OF A GENERAL ELECTRIC F101-GE-100 TURBOFAN ENGINE Final Report, 30 Mar. - 31 May 1978
J. D. Hubble and R. E. Smith AEDC Aug. 1979 90 p refs
(AD-A072743; AEDC-TR-78-73) Avail: NTIS HC A05/MF A01 CSCL 21/5

A performance evaluation of an airjet distortion generator (ADG) system used to produce steady-state, total-pressure distortion at the inlet to a turbine engine was conducted. The capability of the system to duplicate screen-generated, classical and composite patterns and to maintain a constant distortion pattern over a range of airflows is presented. The effect of Reynolds number on the system's capability to match patterns is also investigated. A comparison of the effects of inlet distortion produced by screens to that produced by the airjet distortion generator system on the stability characteristics of the General Electric F101-GE-100 turbofan engine is described. GRA

N80-13050# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
BUILD 2 OF AN ACCELERATED MISSION TEST OF A TF-41 WITH BLOCK 76 HARDWARE Final Report, 2 Aug. - 20 Sep. 1978
Robert J. May, Jr. Jul. 1979 189 p refs
(AD-A073436; AFAPL-TR-79-2063) Avail: NTIS HC A09/MF A01 CSCL 21/5

An accelerated mission test (AMT) of a TF41 (S/N 142163) was conducted in the Air Force Aero Propulsion Laboratory's D Bay Sea-Level Engine Test Facility between 2 August 1978 and 20 September 1978. The primary objective of the test was to evaluate the structural reliability of a series of parts changes known as Block 76 hardware. A two-hundred-sixty-three hour test program was initially planned but only one-hundred-eighty-nine hours were actually completed due to the failure of a first stage high pressure turbine blade. Post-test teardown showed all of the Block 76 hardware to be in good condition. Engine performance deterioration was tracked and an exhaust gas temperature survey was performed and the data analyzed. This report describes the details of the test, including test objectives, approach, instrumentation, facility and results. GRA

N80-13051# Flight Dynamics Research Corp., Van Nuys, Calif.
HIGH SPEED EJECTORS Final Report, Sep. 1977 - Dec. 1978
Morton Alperin and Jiunn-Jenq Wu May 1979 92 p refs
(Contract F33615-77-C-3160)
(AD-A073378; FDRC-3160-12-78; AFFDL-TR-79-3048) Avail: NTIS HC A05/MF A01 CSCL 21/5

The performance of solid and jet-diffuser ejectors in motion in their thrust direction was analyzed under the assumption that all fluids are compressible and have arbitrary properties. Two solutions to the equations representing the laws of mass flow and energy conservation and the momentum theorem were obtained. The solutions were examined and only those regions that were consistent with the Second Law of Thermodynamics were utilized. In these valid regions, three distinct characteristic points were observed, and chosen as criteria for classification of ejector performance. These characteristic points determined which of nine possible ejector configurations provided optimal performance at any given flight and injected gas conditions. Detailed examination of the thermodynamic cycle was made for representative cases and data was presented to illustrate the influence of ejectors upon conventional gas generator performance. The influence of nozzle loss, skin friction and flow separation, incomplete kinetic and thermal mixing, and boundary layer ingestion were taken into consideration in the analysis. Correlation with existing stationary solid and jet-diffuser ejector experiments showed excellent agreement between theory and experiment. It has been shown that ejectors designed according to the methods described, can provide large improvement in propulsion system performance throughout the entire practical flight regime. GRA

N80-13052*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF RELAXED STATIC LONGITUDINAL STABILITY ON A SINGLE-STAGE-TO-ORBIT VEHICLE DESIGN
Delma C. Freeman, Jr. and Alan W. Wilhite Washington Dec. 1979 138 p refs
(NASA-TP-1594; L-13243) Avail: NTIS HC A07/MF A01 CSCL 22B

The effects of relaxing longitudinal stability requirements on single stage to orbit space vehicles is studied. A comparison of the mass and performance characteristics of two vehicles, one designed for positive levels of longitudinal stability and the other designed with relaxed stability requirements in a computer aided design process is presented. Both vehicles, required to meet the same mission characteristics are described. Wind tunnel tests, conducted over a Mach number range from 0.3 to 4.63 to verify estimated aerodynamic characteristics, are discussed. A.W.H.

N80-13054# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
DIGITAL LOAD CONTROL APPLIED TO FULL-SCALE AIRFRAME FATIGUE TESTS Final Report, Jan. 1976 - Jun. 1977
Nirmal K. Mondol and Richard M. Potter May 1979 175 p refs
(AD-A073588; AFFDL-TR-79-3011) Avail: NTIS HC A08/MF A01 CSCL 01/3

The modeling, analysis and digital simulation of an analog servo controller and its successful application to a full-scale airframe fatigue tests is described. Primary emphasis is on the use of minicomputers for dynamic load control of multiple channels. Hardware and software used to generate functions and control load is described. A brief comparison of digital system performance versus conventional analog controllers is included. GRA

N80-13055# Royal Aircraft Establishment, Farnborough (England).
SOME MEASUREMENTS OF BUFFETING ON AN AEROELASTIC MODEL OF A SLENDER WING AIRCRAFT
D. G. Mabey, C. W. Skingle, and J. C. Copley London HMSO Dec. 1978 24 p refs
(RAE-TM-Struct-942; BR66853) Avail: NTIS HC A02/MF A01

Buffeting tests on an aeroelastic model of a slender wing aircraft at Mach numbers of 0.2 and 0.3 and at low densities, over an angle of incidence range of from 0 to 24 deg were made. In general, the wing root strains resembled those measured previously on an ordinary wind tunnel model, with almost the same shape. The total damping in the first and third symmetric

modes was derived from tape records of the wing root strain signal. For both modes, the total damping was almost independent of angle of incidence, even in the region of vortex breakdown. For the first mode the measured aerodynamic damping was reasonably predicted by assuming that the model was a slender delta wing with attached flow. Author (ESA)

N80-13056# Association Aeronautique et Astronautique de France, Paris.

THE DEVELOPMENT OF ACTIVE CONTROL AND ITS APPLICATION TO FLUTTER SUPPRESSORS [RECENTS PROGRES SUR LES CONTROLES ACTIFS APPLIQUES AUX SUPPRESSEURS DE FLOTTEMENT]

R. Destuynder 1979 22 p refs In FRENCH; ENGLISH summary Presented at 15th Colloq. d'Aerodyn. Appl., Marseille, 7-9 Nov. 1978

(AAAF-NT-79-02; ISBN-2-7170-0529-3) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 17 (France and EEC) FF 21 (others)

Wind tunnel tests were performed on an aeroelastic model of a fighter wing mounted on the tunnel wall with different types of stores such as a tank or wing tip stores, in order to investigate the possibility of controling the flutter instabilities by means of the introduction of a control law acting upon wing stiffness. The results of two wind tunnel experiments in the high subsonic flow zone show that a relatively simple law can be used to suppress fluttering with the help of some experimental data. The difficulties introduced in the study of fully automatic control by the interaction between superimposed active control systems are pointed out. Author (ESA)

N80-13057# Federal Aviation Administration, Washington, D. C.

INSTALLATION CRITERIA FOR THE APPROACH LIGHTING SYSTEM IMPROVEMENT PROGRAM (ALSIP) Final Report

Steven Zaidman Nov. 1978 44 p

(AD-A070076; FAA-ASP-78-5) Avail: NTIS HC A03/MF A01 CSCL 01/5

An investment criteria for retrofit of runway approach lighting systems is presented. The retrofit of existing rigid light support structures with frangible mountings and the conversion of high intensity lighting systems to more energy efficient configurations is discussed. The criteria are developed by benefit versus cost analysis. A.W.H.

N80-13059# European Space Agency, Paris (France). Inst. fuer Aeroelastik.

INVESTIGATIONS ON UNSTEADY PRESSURE DISTRIBUTION MEASUREMENTS IN ROTATING SYSTEMS

Karl Kienappel (DFVLR, Goettingen, West Ger.) Jan. 1979 49 p refs Transl. into ENGLISH of 'Untersuchung zur Messung instationaerer Druecke in rotierenden Systemen", DFVLR, Goettingen, West Ger. Report DLR-FB-77-43, Aug. 1977 Original report in GERMAN previously announced as N78-31135 Original German report available from DFVLR, Cologne DM 23,80

(ESA-TT-503-Rev; DLR-FB-77-43) Avail: NTIS HC A03/MF A01

The theoretical basic requirements for measuring unsteady periodical pressure distributions in a rotating system are discussed. An experimental test set-up to investigate the problems of the measurement technology is described. First results of this experiment made in a 3 m wind tunnel are presented and discussed. Author (ESA)

N80-13060# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aerolastik.

INDUSTRIAL TRIAL RUN OF THE AVA DERIVATIVE BALANCE ON AN ALPHAJET JET MODEL IN A 3 m WINDTUNNEL Final Report

Eberhard Schmidt Bonn Bundesmin. fuer Forsch. u. Technol. Sep. 1978 62 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Forsch. u. Technol.

(BMFT-FB-W-78-07) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13,05

As part of a project to study stability derivative measurements in wind tunnels, a multicomponent derivative balance was given a trial run in a low speed wind tunnel. For the purpose of determining the servicability and reliability of this apparatus, a light weight model of the Alpha jet was used on which independant derivative measurements had already been performed. The comparison of results shows that this instrument for measuring dynamic stability derivatives on airplane and missile models in combined longitudinal or lateral motions performs adequately. Author (ESA)

N80-13061# National Engineering Lab., East Kilbride (Scotland). Flow Measurement Div.

AIR FLOW MEASUREMENTS IN A LARGE IRREGULARLY SHAPED TUNNEL USING ANEMOMETER AND PITOT-STATIC TUBE TRAVERSE

A. McHugh, F. C. Kinghorn (Natl. Coal Board, Bretby, U.K.), J. Allan (Natl. Coal Board, Doncaster, U.K.), and B. Webster Oct. 1978 25 p refs Sponsored by Metrology and Std. Requirements Board

(NEL-660) Avail: NTIS HC A02/MF A01

A series of traverses using anemometers and pitot tubes to measure the flow rate of air through an explosion gallery were carried out. Flow rates were also measured using a conical inlet fitted at the gallery outlet. Good agreement was found between the flow rates measured by the individual traverses, but these invariably gave a lower flow rate than the conical inlet, the average difference being about 6%. No definite explanation for this could be found, but conditions in the gallery could possibly cause the inlet to be read in error, although it did not show in subsequent scale model tests. Several methods of traversing the gallery were then used and a system for locating the measuring positions in such irregularly shaped ducts is proposed; these methods did not produce significantly different results, except for a 'continuously sweeping' method which gave flow rates higher than the others by about 2%. In an auxiliary study, it was shown that, unless great care is taken, serious errors can arise in anemometer calibrations. Author (ESA)

N80-13062# Royal Aircraft Establishment, Farnborough (England).

THE ACOUSTIC CHARACTERISTICS OF THE RAE 1.5m WIND TUNNEL

W. J. G. Trebble London HMSO Jan. 1979 50 p refs (RAE-TR-79002; RAE-Aero-3447; BR67864) Avail: NTIS HC A03/MF A01

Extensive modifications to the old 5 ft tunnel at RAE have provided an acoustic tunnel capable of airspeeds up to 60 m/sec. The drive-fan was replaced by a seven-bladed unit which is now mounted in the return circuit and acoustic splitters were installed in the circuit on both sides of the fan. An anechoic chamber lined with polyether foam was built around the test section to give good acoustic properties at frequencies above 1 kHz. The tunnel background noises level was reduced by more than 15 dB for frequencies below 5 kHz with less benefit at higher frequencies. Tests show that inside the airstream at 50 m/sec the noise level for third-octave bandwidths now drops from 75 dB at 1 kHz to 70 dB at 20 kHz. The noise level outside the airstream is some 5 to 10 dB quieter. Author (ESA)

N80-13148*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

PARAMETRIC STUDY OF THE ORBITER ROLLOUT USING AN APPROXIMATE SOLUTION

Benjamine J. Garland Nov. 1979 45 p refs

(NASA-TM-80837; JSC-16248; Rept-79-FM-44) Avail: NTIS HC A03/MF A01 CSCL 22B

An approximate solution to the motion of the Orbiter during rollout is used to perform a parametric study of the rollout distance required by the Orbiter. The study considers the maximum expected dispersions in the landing speed and the touchdown point. These dispersions are assumed to be correlated so that a fast landing occurs before the nominal touchdown point. The maximum rollout distance is required by the maximum landing speed with a 10 knot tailwind and the center of mass at the forward limit of its longitudinal travel. The maximum weight

that can be stopped within 15,000 feet on a hot day at Kennedy Space Center is 248,800 pounds. The energy absorbed by the brakes would exceed the limit for reuse of the brakes. Author

N80-13196# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
AIRFLOW EFFECTS ON FIRES, PART 2 Final Report, Jun. - Aug. 1976
Thomas Weeks, Charles C. Gebhard, and Gilbert L. Camburn May 1979 70 p refs
(AD-A073486; JTCG/AS-76-T-006) Avail: NTIS HC A04/MF A01 CSCL 21/4

This report expands the knowledge of airflow effects on fuel fires initiated by nonnuclear combat damage obtained from previous work reported in JTCG/AS-T-75-001. An investigation is made into the influence of selected airflow parameters (coefficient of pressure and the boundary layer thickness) upon the blowout velocity for a variety of damage conditions and angles-of-attack. GRA

N80-13253# Federal Aviation Administration, Washington, D. C.
COMPARATIVE EVALUTION OF FIREFIGHTING FOAM AGENTS Final Report, Jul. 1974 - Aug. 1977
George B. Geyer, Lawrence M. Neri, and Charles H. Urban 1979 114 p refs
(Contract FAA-081-431-100)
(AD-A074490; FAA-NA-79-2) Avail: NTIS HC A06/MF A01 CSCL 14/2

The fire extinguishing effectiveness of eight aqueous-film-forming-foams (AFFF), 11 fluoroprotein foams (FPF), and three protein form (PF) agents was investigated. Large-scale fire tests were performed under fixed fire conditions employing air-aspirating and non-air-aspirating nozzles on 82.4, 101, and 143 foot diameter jet A fuel fires. Experiments were performed with only one foam agent which was considered representative of each class. Experiments tend to validate the continuation of allowing a 30 percent reduction in the water requirement at certificated U.S. airports when AFFF is substituted for protein form (Federal Aviation Regulation (FAR) Part 139.49) and to maintain a 1:1 equivalency ratio when fluoroprotein foam is substituted for protein foam. The data also tend to substantiate the validity of allowing an equivalent reduction in water requirements at airports when the 3 percent AFFF, FPF, and PF agents are substituted for the 6 percent agents within each class. A.R.H.

N80-13255*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIRE-RESISTANT MATERIALS FOR AIRCRAFT PASSENGER SEAT CONSTRUCTION
L. L. Fewell, G. C. Tesoro (MIT, Boston), A. Moussa (MIT, Boston), and D. A. Kourtides Nov. 1979 20 p refs
(NASA-TM-78617; A-7946) Avail: NTIS HC A02/MF A01 CSCL 11G

The thermal response characteristics of fabric and fabric-foam assemblies are described. The various aspects of the ignition behavior of contemporary aircraft passenger seat upholstery fabric materials relative to fabric materials made from thermally stable polymers are evaluated. The role of the polymeric foam backing on the thermal response of the fabric-foam assembly is also ascertained. The optimum utilization of improved fire-resistant fabric and foam materials in the construction of aircraft passenger seats is suggested. M.M.M.

N80-13268*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEMPERATURE AND FLOW MEASUREMENTS ON NEAR-FREEZING AVIATION FUELS IN A WING-TANK MODEL
Robert Friedman and Francis J. Stockemer 1980 18 p refs
To be presented at the 25th Intern. Gas Turbine Conf., New Orleans, 9-13 Mar. 1980; sponsored by ASME
(NASA-TM-79285; E-156) Avail: NTIS HC A02/MF A01 CSCL 21D

Freezing behavior, pumpability, and temperature profiles for aviation turbine fuels were measured in a 190-liter tank chilled to simulate internal temperature gradients encountered in commercial airplane wing tanks. When the bulk of the fuel was above the specification freezing point, pumpout of the fuel removed all fuel except a layer adhering to the bottom chilled surfaces, and the unpumpable fraction depended on the fuel temperature near these surfaces. When the bulk of the fuel was at or below the freezing point, pumpout ceased when solids blocked the pump inlet, and the unpumpable fraction depended on the overall average temperature. K.L.

N80-13307 Indian Inst. of Tech., Kanpur.
SOME RECENT TRENDS IN AIRCRAFT FLUTTER RESEARCH
P. N. Murthy *In* SVIC Shock and Vibration Digest, Vol. 11, No. 5 May 1979 p 7-12 refs

Avail: SVIC, Code 8404, Naval Research Lab., Washington, D.C. 20375 CSCL 01/3

The advances in research and development in the area of flutter are reviewed. Two innovations in aircraft configurations, oblique wings and control configured vehicles, are examined. A.W.H.

N80-13336# Rome Air Development Center, Griffiss AFB, N.Y.
POSITIONAL ERROR ANALYSIS, A-10 AIRCRAFT ON THREE-AXIS GROUND MOUNT Technical In-house Report, Jun. 1977 - Dec. 1978
Jerome P. Scheiderich and William J. Bocchi Jul. 1979 71 p (AF Proj. 2114)
(AD-A073600; RADC-TR-79-220) Avail: NTIS HC A04/MF A01 CSCL 13/9

This report describes a test that was performed to determine the truth orientation of an A-10 aircraft mounted on a Scientific Atlanta Inc., Model PAEA-85 three-axis positioner at the Rome Air Development Center Newport Antenna Test Annex, and to estimate the errors inherent in using the aircraft positioning system in the process of antenna pattern testing. The report describes the following aspects of this effort: (1)Establishment of a reference coordinate system for the aircraft, and alignment of the aircraft on the positioner, (2) Description of the inclinometer system used for determining the aircraft orientation, (3) Test procedures, (4) Discussion of results, (5) Summary of errors, and (6) Conclusions and recommendations for the guidance of personnel using the system for aircraft antenna pattern testing. The total system error was determined to be less than 0.683 degrees for a pitch maneuver, and less than 0.533 degrees for a roll maneuver. GRA

N80-13347 George Washington Univ., Washington, D. C.
A NEW WEIGHTING COEFFICIENT FOR ADAPTIVE STATE ESTIMATION Ph.D. Thesis
Michael George Harris 1979 97 p
Avail: Univ. Microfilms Order No. 7924364

An adaptive filter for the continuous parameter vector case, using a finite bank of filters weighted by coefficients based on an estimated distance in the parameter space (rather than approximations to the conditional probability) is presented. The method requires the availability of an estimate of the parameter for use in the computation of the weighting coefficient. A description of an application to an aircraft estimation problem during some of the phases of the final approach is given. Results obtained from a digital simulation of the aircraft dynamics, and the adaptive filter using (microwave landing system) guidance data and on-board sensors are presented. A comparison of the adaptive filter and the least mean square error filter using simulation results is also made. Dissert. Abstr.

N80-13466 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE PERFORMANCE ESTIMATION OF AN AXIAL-FLOW COMPRESSOR STAGE USING THEORETICALLY DERIVED BLADE ELEMENT CHARACTERISTICS WITH EXPERIMENTAL COMPARISON Ph.D. Thesis

Ralph Raymond Jones, III 1979 252 p
Avail: Univ. Microfilms Order No. 7924114

A method is developed for the calculation of steady, quasi-three-dimensional, subsonic, compressible flow through a two-dimensional cascade of blades which includes the effects of viscosity. The prediction technique allows the calculation of the typical blade element characteristics of deviation angle and total pressure loss coefficient for a wide range of incidence angles. The spanwise performance of an axial-flow compressor stage is estimated by integrating the radial component of the momentum equation at the inlet guide vane exit/rotor entrance and rotor exit stations. A three stage axial-flow compressor with a design speed and mass flow rate of 17,000 RPM and 24.5 lbm/sec respectively, and a nominal pressure ratio of 1.2 per stage is used to evaluate the prediction technique. Dissert. Abstr.

N80-13471 Virginia Polytechnic Inst. and State Univ., Blacksburg.
AN ANALYTICAL INVESTIGATION OF THREE-DIMENSIONAL VIBRATION IN GEAR-COUPLED ROTOR SYSTEMS Ph.D. Thesis
John William Daws 1979 423 p
Avail: Univ. Microfilms Order No. 7924099

An analysis of three dimensional forced vibration response of gear coupled rotor systems is presented. The time varying nature of the gear mesh stiffness is developed and compared to other published results. Hibner's branching technique is applied to the gear mesh to produce three dimensional coupling. The proposed analysis technique was used to predict the forced response of a set of high speed gear coupled turborotors for sixteen discrete frequencies. Bearing force level data obtained from the manufacturer is presented. Dissert. Abstr.

N80-13475# Pratt and Whitney Aircraft Group, West Palm Beach, Fla.
DEVELOPMENT OF MAINSHAFT HIGH-SPEED CYLINDRICAL ROLLER BEARINGS FOR GAS TURBINE ENGINES Interim Report, 1 Apr. 1977 - 1 Oct. 1978
P. F. Brown, L. J. Dobek, J. D. Robinson, and J. R. Miner Oct. 1978 106 p refs
(Contracts N00140-76-C-0383; MIPR-FY-1455-76-00623)
(AD-A073381; FR-11453) Avail: NTIS HC A06/MF A01 CSCL 21/5

This combined analytical and experimental program is aimed at generating a manual that will permit the design of 3.0 MDN cylindrical roller bearings. The roller bearing analysis will be correlated with the results from a series of bearing tests designed to determine, by statistical methods, the effect of geometrical variables on bearing performance. An existing quasi-static design optimization system was previously upgraded and the basic analyses for use in developing a program to predict the dynamic behavior of roller bearing components was completed. A study identified a total of thirty separate bearing parameters that can influence roller skewing and skidding. Two groups of 124 mm roller bearing designs were then prepared using statistical design techniques and incorporating parameters from the list of thirty. Fabricated of full-scale bearing hardware was completed and testing was completed. Results indicate that roller end wear is significantly affected by roller corner radius runout. GRA

N80-13481# Oak Ridge National Lab., Tenn.
STATISTICAL TECHNIQUES FOR AUTOMATING THE DETECTION OF ANOMALOUS PERFORMANCE IN ROTATING MACHINERY
K. R. Piety and T. E. Magette (Tennessee Univ., Knoxville) 1979 24 p Presented at the CAM-1 Intern. Spring Seminar, New Orleans, 9 Apr. 1979
(Contract W-7405-eng-26)
(CONF-790435-2) Avail: NTIS HC A02/MF A01

The level of technology utilized in automated systems that monitor industrial rotating equipment and the potential of alternative surveillance methods are assessed. It is concluded that changes in surveillance methodology would upgrade ongoing programs and yet still be practical for implementation. An improved anomaly recognition methodology is formulated and implemented on a minicomputer system. The effectiveness of the monitoring system was evaluated in laboratory tests on a small rotor assembly, using vibrational signals from both displacement probes and accelerometers. Time and frequency domain descriptors were selected to compose an overall signature that characterizes the monitored equipment. Limits for normal operation of the rotor assembly were established automatically during an initial learning period. Thereafter, anomaly detection was accomplished by applying an approximate statistical test to each signature descriptor. DOE

N80-13485# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hardthausen (West Germany). Inst. fuer Chemische Antriebe und Verfahrenstechnik.
EXPERIMENTAL INVESTIGATION OF A SOLID FUEL RAMJET
Hendrik R. Lips, Robert H. Schmucker, and I. Lee Witbracht 1978 53 p refs
(DFVLR-FB-78-27) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 20.20

An experimental investigation of the internal ballistics, combustion efficiency, motor performance, and blow-off limits of a solid fuel ramjet motor was conducted in order to establish the design principles for the construction of a satisfactory combustor. In these connected-pipe test firings the effects of chamber pressure, air specific mass flow, burning time, flameholder design, inlet velocity, motor size, and fuel composition were investigated and correlations obtained. A simple theoretical model concerning flame stabilization, reattachment point and upper and lower combustion limits gives adequate agreement with the experimental test results. Author (ESA)

N80-13509 Virginia Univ., Charlottesville.
DYNAMIC ANALYSIS OF COMPLEX MULTI-LEVEL FLEXIBLE ROTOR SYSTEMS Ph.D. Thesis
Dennis Fuk-Kuen Li 1979 354 p
Avail: Univ. Microfilms Order No. 7928010

Theories were developed for calculating the vibrations of complex multicomponent flexible rotor systems based on the transfer matrix method and the component mode method. The methods were compared for accuracy and computational efficiency in the linear dynamic analysis of a two-spool gas turbine engine. The dynamic stiffness and damping matrices of a rotating flexible shaft element were studied. Based on this result, the modal representation of a rotor including the effects of shear deformation, dry hysteresis, and viscous internal friction was developed. The ability of the component mode method to analyze a wide spectrum of machinery was demonstrated by a nonlinear transient simulation of the two-spool gas turbine engine equipped with a squeeze film damper bearing, and by an unbalance response analysis of the space shuttle oxygen turbopump in which the dynamics of the rotor and the housing in all six spatial directions were considered. Dissert. Abstr.

N80-13527# Royal Aircraft Establishment, Farnborough (England).
THE IMPLEMENTATION AND PRACTICAL VERIFICATION OF A SUPERPOSITION METHOD FOR THE SOLUTION OF ELASTIC CRACK PROBLEMS
P. Bartholomew London HMSO Nov. 1978 20 p refs Presented at Inter. Conf. on Numerical Methods in Fracture Mech., Swansea, Engl., 9-13 Jan. 1978
(RAE-TM-Struct-940; BR66435) Avail: NTIS HC A02/MF A01

A superposition method which provides a practical and efficient way for solving linear elastic crack problems is demonstrated. The method approximates the linear elasticity solution over a substructure containing the crack tip by the superposition of appropriate singular stress fields and a relatively coarse finite element mesh. A hybrid variational principle is employed to ensure displacement compatibility between this substructure and adjoining ones employing finite elements alone. A key feature of the method is that it may be implemented by adding routines to existing finite element packages. The particular implementation discussed here is intended for use in the aircraft industry. Author (ESA)

N80-13694# Lincoln Lab., Mass. Inst. of Tech., Lexington.
NOVEL CERAMIC RECEIVER FOR SOLAR BRAYTON SYSTEMS
Philip O. Jarvinen 1979 7 p Presented at ASME Gas Turbine Closed-Cycle Session, San Diego, Calif., 12-15 Mar. 1979
(Contract ET-78-S-02-4878)
(COO-4878-3; CONF-790305-7) Avail: NTIS HC A02/MF A01

Receivers for solar thermal heated air Brayton power systems are discussed. The ceramic domed cavity receiver concept is examined. The development of a high temperature seal for the solar heating air cavity receiver is reported. Mechanical dome sealing methods for this purpose are reviewed and investigations to establish the technological foundation of the seal concepts by demonstrating that ceramic domes can be designed to support the combined pressure, thermal stress, and temperature loads of a heated air receiver are presented. A.W.H.

N80-13742*# Oklahoma Univ., Norman.
JET TRANSPORT PERFORMANCE IN THUNDERSTORM WIND SHEAR CONDITIONS
John McCarthy, Edward F. Blick, and Randall R. Bensch Dec. 1979 63 p refs
(Contract NAS8-31377)
(NASA-CR-3207) Avail: NTIS HC A04/MF A01 CSCL 04B

Several hours of three dimensional wind data were collected in the thunderstorm approach-to-landing environment, using an instrumented Queen Air airplane. These data were used as input to a numerical simulation of aircraft response, concentrating on fixed-stick assumptions, while the aircraft simulated an instrument landing systems approach. Output included airspeed, vertical displacement, pitch angle, and a special approach deterioration parameter. Theory and the results of approximately 1000 simulations indicated that about 20 percent of the cases contained serious wind shear conditions capable of causing a critical deterioration of the approach. In particular, the presence of high energy at the airplane's phugoid frequency was found to have a deleterious effect on approach quality. Oscillations of the horizontal wind at the phugoid frequency were found to have a more serious effect than vertical wind. A simulation of Eastern flight 66, which crashed at JFK in 1975, served to illustrate the points of the research. A concept of a real-time wind shear detector was outlined utilizing these results. Author

N80-13879*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTAL STUDY OF ACOUSTIC LOADS ON AN UPPER-SURFACE-BLOWN STOL AIRPLANE CONFIGURATION
Conrad M. Willis and James A. Schoenster Dec. 1979 57 p
(NASA-TP-1577; L-13167) Avail: NTIS HC A04/MF A01 CSCL 20A

Fluctuating pressure levels were measured on the flap and fuselage of an upper-surface-blown jet-flap airplane configuration in a wind tunnel. The model tested had turbofan engines with a bypass ratio of 3 and a thrust rating of 10 kN. Rectangular nozzles were mounted flush with the upper surface at 35 percent of the wing chord. Test parameters were flap deflection angle, jet impingement angle, angle of attack, free-stream velocity, spanwise location of the engine, and jet dynamic pressure. Load levels were high throughout the jet impingement region, with the highest levels (about 159 dB) occurring on the fuselage and near the knee of the flap. The magnitude of the forward-velocity effect appeared to depend upon the ratio of free-stream and jet velocities. Good agreement was obtained between fluctuating pressure spectra measured at jet dynamic pressures of 7 and 22 kPa when the spectra were scaled by nondimensional functions of dynamic pressure, velocity, and the empirical relationship between dynamic pressure and overall fluctuating pressure level. Author

N80-13880*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF SOUND LEVEL FLUCTUATIONS ON ANNOYANCE CAUSED BY AIRCRAFT-FLYOVER NOISE
David A. McCurdy Dec. 1979 40 p refs
(NASA-TP-1576; L-13181) Avail: NTIS HC A03/MF A01 CSCL 20A

A laboratory experiment was conducted to determine the effects of variations in the rate and magnitude of sound level fluctuations on the annoyance caused by aircraft-flyover noise. The effects of tonal content, noise duration, and sound pressure level on annoyance were also studied. An aircraft-noise synthesis system was used to synthesize 32 aircraft-flyover noise stimuli representing the factorial combinations of 2 tone conditions, 2 noise durations, 2 sound pressure levels, 2 level fluctuation rates, and 2 level fluctuation magnitudes. Thirty-two test subjects made annoyance judgements on a total of 64 stimuli in a subjective listening test facility simulating an outdoor acoustic environment. Variations in the rate and magnitude of level fluctuations were found to have little, if any, effect on annoyance. Tonal content, noise duration, sound pressure level, and the interaction of tonal content with sound pressure level were found to affect the judged annoyance significantly. The addition of tone corrections and/or duration corrections significantly improved the annoyance prediction ability of noise rating scales. Author

N80-13881*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ASSESSMENT AT FULL SCALE OF EXHAUST NOZZLE TO WING SIZE ON STOL-OTW ACOUSTIC CHARACTERISTICS
U. VonGlahn and D. Grosbeck 1979 27 p refs Presented at 98th Meeting of the Acoustical Soc. of Am., Salt Lake City, 26-30 Nov. 1979
(NASA-TM-79279; E-215) Avail: NTIS HC A03/MF A01 CSCL 20A

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

N80-13882*# Hamilton Standard, Windsor Locks, Conn.
ADVANCED TURBO-PROP AIRPLANE INTERIOR NOISE REDUCTION-SOURCE DEFINITION Final Report
B. Magliozzi and Bennett M. Brooks Oct. 1979 90 p refs
(Contract NAS3-20614)
(NASA-CR-159668) Avail: NTIS HC A05/MF A01 CSCL 20A

Acoustic pressure amplitudes and phases were measured in model scale on the surface of a rigid semicylinder mounted in an acoustically treated wind tunnel near a prop-fan (an advanced turboprop with many swept blades) model. Operating conditions during the test simulated those of a prop-fan at 0.8 Mach number cruise. Acoustic pressure amplitude and phase contours were defined on the semicylinder surface. Measurements obtained without the semi-cylinder in place were used to establish the magnitude of pressure doubling for an aircraft fuselage located near a prop-fan. Pressure doubling effects were found to be 6dB at 90 deg incidence decreasing to no effect at grazing incidence. Comparisons of measurements with predictions made using a recently developed prop-fan noise prediction theory which includes linear and non-linear source terms showed good agreement in phase and in peak noise amplitude. Predictions of noise amplitude and phase contours, including pressure doubling effects derived from test, are included for a full scale prop-fan installation. Author

N80-13887# National Gas Turbine Establishment, Pyestock (England).

A REVIEW OF THE RESEARCH AT NGTE CONCERNING THE EFFECTS OF FLIGHT ON ENGINE EXHAUST NOISE

W. D. Bryce London Sep. 1978 76 p refs

(NGTE-R-78007; BR65126) Avail: NTIS HC A05/MF A01

The problem of explaining the changes in engine exhaust noise when going from static to flight conditions has puzzled research workers for some years. Various experimental research programs which were carried out in regards to this topic over the last five years are reviewed. The step-by-step progress which was made in the analysis of the problem is described and the results from some recent tests are presented. Flight tests indicate that the engine noise reduces in the rear arc, but at 90 deg to the engine axis and in the forward arc the engine noise is increased. Wind tunnel results and static tests are used to characterize jet noise and internally generated engine noise. Analysis indicates, based on a model of the mechanisms dominating engine exhaust noise, that acoustic and aerodynamic effects arising from installation configurations of engines in aircraft consitute the main features responsible for this noise increase in flight. Author (ESA)

N80-13986*# Boeing Commercial Airplane Co., Seattle, Wash.

ECONOMIC STUDY OF MULTIPURPOSE ADVANCED HIGH-SPEED TRANSPORT CONFIGURATIONS Final Report

Nov. 1979 61 p refs

(Contract NAS1-14623)

(NASA-CR-159126; D6-48725) Avail: NTIS HC A04/MF A01 CSCL 05C

A nondimensional economic examination of a parametrically-derived set of supersonic transport aircraft was conducted. The measure of economic value was surcharged relative to subsonic airplane tourist-class yield. Ten airplanes were defined according to size, payload, and speed. The price, range capability, fuel burned, and block time were determined for each configuration, then operating costs and surcharges were calculated. The parameter with the most noticeable influence on nominal surcharge was found to be real (constant dollars) fuel price increase. A change in SST design Mach number from 2.4 to Mach 2.7 showed a very small surcharge advantage (on the order of 1 percent for the faster aircraft). Configuration design compromises required for an airplane to operate overland at supersonic speeds without causing sonic boom annoyance result in severe performance penalties and require high (more than 100 percent) surcharges. A.R.H.

N80-13988# Committee on Science and Technology (U. S. House).

OVERSIGHT: FAA R AND D PROGRAMS

Washington GPO 1978 82 p refs Hearing before Subcomm. on Transportation, Aviation and Weather of the Comm. on Sci. and Technol., 95th Congr., 2d Sess., 24 Aug. 1978

(GPO-38-212) Avail: Subcomm. on Transportation, Aviation and Weather

Major research and development projects related to increased automation in air traffic control, aircraft capacity, airspace use, and safety levels are considered as well as the rationale and timing of new technology. Particular emphasis is given to the use of microwave landing systems, the discrete address beacon system, and the automated traffic advisory and resolution service. The problems of California airports and collision avoidance are explored. A.R.H.

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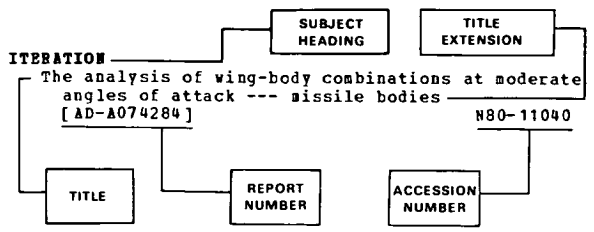

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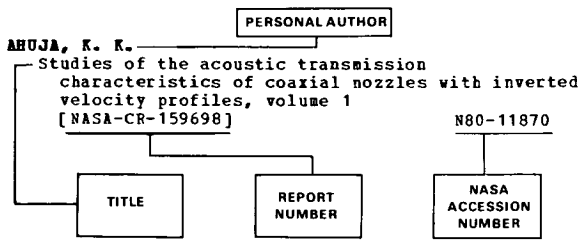

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