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NASA SP-7037 (89)

AERONAUTICAL ENGINEERING

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A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 89

NOVEMBER 1977

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (89)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 89

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1977 in

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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Special Bibliography* (NASA SP-7037) lists 538 reports, journal articles, and other documents originally announced in October 1977 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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

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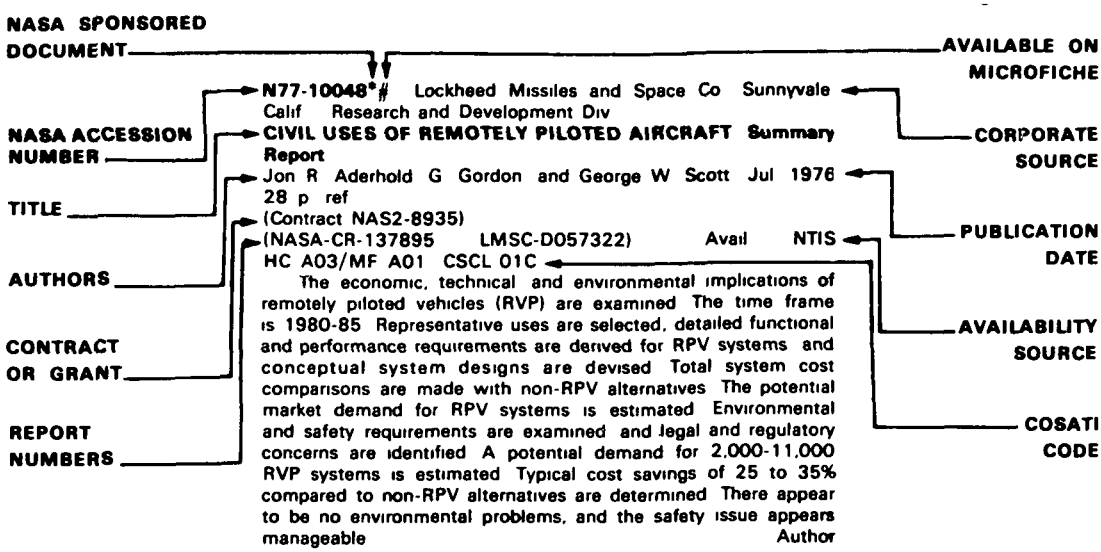

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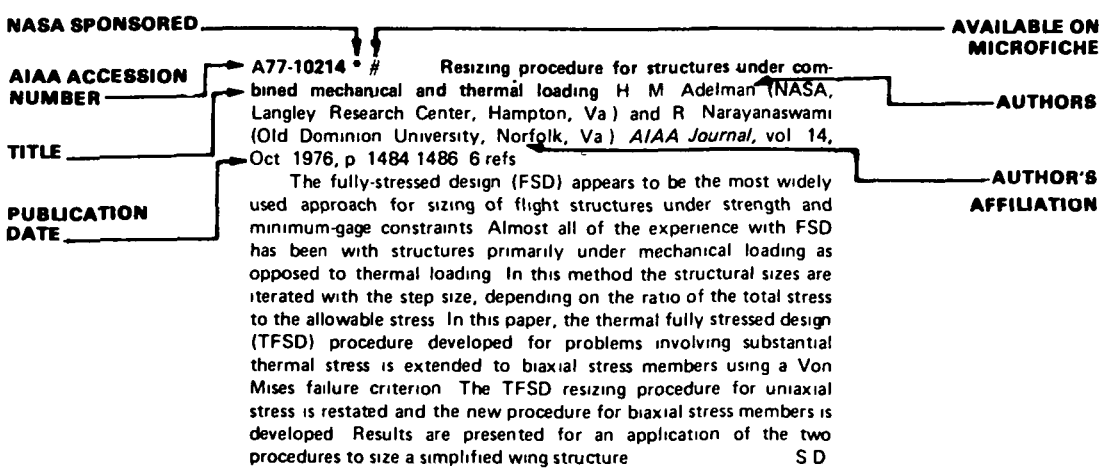

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 89)

NOVEMBER 1977

IAA ENTRIES

A77-40638 **Monitoring Concorde emissions.** H Segal (FAA, Office of Environmental Quality, Washington, D C) *(Air Pollution Control Association, Annual Meeting, 70th, Toronto, Canada, June 20-24, 1977, Paper 77-41 3) Air Pollution Control Association, Journal,* vol 27, July 1977, p 623-630 10 refs

The low-altitude emission plume of Concorde was investigated to determine any adverse effects on air quality at Dulles Airport and in the nearby Sterling Park Community resulting from its operation The change in pollutant concentrations from a single aircraft as it started, taxied, and took off was measured by six mobile air quality control stations and two vertical towers using continuously recording instruments coupled with high-speed chart recorders Preliminary results show that the average CO concentration of Concorde emissions is 1 7 times greater than that of any other aircraft monitored However, CO emissions from Concorde are undetectable at 2000 ft from the taxiing aircraft The single event emissions of Concorde contribute less than 0 1 ppm of CO to ambient air concentrations at locations as close as 200 ft from a taxiing aircraft Tower measurements show that the hot emission plume tends to lie close to the ground C K D

A77-40643 **Transmissometer measurement of particulate emissions from a jet engine test facility** D P Y Chang (California, University, Davis, Calif, USAF, Regional Environmental Health Laboratory, McClellan AFB, Calif) and B C Grems (USAF, Civil Engineering Center, Tyndall AFB, Fla) *Air Pollution Control Association, Journal,* vol 27, July 1977, p 673-675

An optical transmissometer was assessed as a possible means of monitoring potential mass emissions in turbojet test facilities Simultaneous cascade impactor samples and opacity measurements were used to determine the relationship between mass concentration and plume opacity A correlation coefficient of 0 87 was found in a least squares regression analysis of total mass concentration on optical density A better correlation coefficient was obtained when particles with diameters greater than 3 microns were excluded However, a successful correlation of total mass emissions rate with opacity is believed to be unlikely, even for smaller engines C K D

A77-40665 **Real time aerial reconnaissance using the return-beam vidicon** M J Cantella and R J Gildea *RCA Engineer,* vol 22, Apr -May 1977, p 30-35 7 refs USAF-supported research

Testing has established the return beam vidicon (RBV) as a feasible real-time reconnaissance sensor under a variety of flight profiles and visibility conditions, and especially in low-contrast conditions Advantages of the RBV include one foot resolution at 10,000 feet, 'snapshot' operation, in which exposure, readout, and erasure time intervals are segregated, slow-scan readout, electronic zoom, and automatic black level correction, allowing the camera to function in poor visibility The reconnaissance system consists of an airborne pod, mounted on an RF-4C aircraft, and a ground station to monitor and record data The ground station includes a cathode ray tube display and a primary recorder using an electron beam to record on 5-inch film J M B

A77-40700 * # **Computation of viscous transonic flow about a lifting airfoil** L Walitt (Numerical Continuum Mechanics, Inc, Woodland Hills, Calif), L S King (NASA, Ames Research Center, Moffett Field, Calif), and C Y Liu (California, University, Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Fluid and Plasmadynamics Conference, 10th, Albuquerque, N Mex, June 27-29, 1977, Paper 77-679* 11 p 33 refs

The Reynolds averaged Navier-Stokes equations are solved numerically for the viscous transonic flow about a stationary NACA 64A010 airfoil in free air This paper presents descriptions of the numerical method, turbulence models employed, and boundary conditions appropriate to simulation of free-air flight Computed results are presented for the airfoil at a free-stream Mach number of 0 8, angles of attack of 0 and 2 deg, and a Reynolds number based on a chord of 4 x 10 to the 6th For the lifting case, unsteady periodic motion was calculated along the aft portion of the airfoil and in its wake Recent experimental results obtained by Johnson indicate periodicity aft of the shock closely approximates the computed frequency, but the amplitude of the disturbances was significantly less than the calculated amplitude (Author)

A77-40703 # **Acoustic properties of pneumatic vortex sprayers (Akusticheskie svoistva vikhrevykh pnevmaticheskikh forsunok)** A N Belousov, Iu A Knysh, and S V Lukachev *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 17-22 7 refs In Russian

Experiments have shown that pneumatic vortex sprayers can be used to generate intense oscillations of velocity and pressure in the acoustic frequency range The frequency and amplitude of oscillations can be selected by varying the geometrical dimensions of the sprayers and their mode of operation It is shown that the level of sound pressure produced is sufficient to intensify mixing and combustion processes in the combustion chambers of gas turbine engines B J

A77-40708 # **Certain problems associated with the application of the transpiration cooling of gas turbine engine blades (Nekotorye problemy primeneniia poristogo okhlazhdeniia lopatok GTD)** V M Epifanov *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 42 47 12 refs In Russian

Attention is given to problems associated with the implementation of the transpiration cooling of turbine blades for cases of high temperatures of working fluid before the turbine Emphasis is on the augmentation of energy loss due to coolant injection, contamination of the pores by foreign particles carried in by the coolant and the working fluid, and the oxidation of the porous material and its mechanical properties B J

A77-40711 # **The effect of the structural features of a combustion chamber on the emission of toxic compounds (Vliianie konstruktivnykh osobennostei kamery sgoraniia na vykhod toksicheskikh soedinenii)** A V Ivliev, Iu A Knysh, and V P Lukachev *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 60-65 5 refs In Russian

Experiments were conducted investigating the influence of modifications in combustion chambers of gas turbine engines on completeness of combustion and the emission of toxic gases The

characteristics of the toxic exhaust gases of the NK-12CT gas turbine engine with two types of fuel sprayers were determined for the case of methane combustion It is shown that by replacing fluidic-gas sprayers with centrifugal sprayers, it is possible to reduce the emission of nitrogen oxides by 40-50% B J

A77-40712 # **Analytical construction of the throttle characteristic of a gas turbine engine (K analiticheskomu postroeniiu drossel'noi kharakteristiki GTD)** Iu V Kozhevnikov *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 66-71 In Russian

The problem of an analytical representation of the throttle characteristic of a gas turbine engine is examined with consideration of statistical data on engine parameters An optimal solution is obtained to the problem in the context of linear estimation theory The optimization criterion is a minimum estimate-error dispersion in an arbitrary regime with respect to the totality of engines of a given series B J

A77-40715 # **Statistical modeling of the optimal adjustment of the parameters of a gas turbine engine (Statisticheskoe modelirovanie optimal'noi otladki parametrov GTD)** Iu V Meluzov *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 83 88 5 refs In Russian

This paper examines digital statistical simulation of gas turbine engine tests in an investigation of the efficiency of adaptive algorithms of optimal estimation and correction Particular attention is paid to the identification of the dependence of engine characteristics on regulating elements and to the determination of the number of required corrections of engine characteristics as a function of the amount of a priori information on the distribution of engine parameters B J

A77-40721 # **Structural-logic diagram for ensuring high-rate products (Strukturno-logicheskaia skhema obespecheniia pokazatelei kachestva izdelii)** A S Shevelev *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 117-124 In Russian

The paper deals with the application of automation and computers to the development of technological processes in the aircraft industry Specifically, a structural-logic diagram, using which a functional connection can be established between design parameters and technological factors, is proposed as a means of obtaining reliable initial information for use in the development of automated and computer aided technological processes V P

A77-40725 # **Study of the inflow process to an air scoop with a screen, using an EGDA integrator (Issledovanie protsessa vtekaniia vozdushnogo potoka v vozdukhozabornik s ekranom metodom EGDA)** I A Grishin, V F Ivannikov, and E D Nesterov *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 134 137 In Russian

Using the EGDA 9/60 integrator, patterns of flows to a plane air scoop were obtained on electrically conducting paper at various distances between the scoop's axis and a screen The patterns are represented in the form of a grid composed of lines of flow and equipotentials The velocities at the grid nodes are determined by a method proposed by Fil'chakov and Panchishin (1961) The effect of injection of foreign matter is studied by analyzing the flow field in front of the scoop Means of reducing this effect are examined V P

A77-40726 # **Selection of an atomizer and its modes of operation for the removal of ice deposits, frost and frozen snow from aircraft surfaces (Vybor raspylitelia i rezhimov ego raboty dlia udaleniia ledianykh otlozhenii, inея i primerzshego snega s poverkhnostei samoleta)** M Ia Moroshkin, V N Smolin, Iu A Skobel'tsyn, and A F Komlev *Aviatsionnaia Tekhnika,* vol 20, no 1, 1977, p 137-140 In Russian

A77-40830 * # **Unsteady linearized transonic flow analysis for slender bodies** D D Liu (Northrop Corp , Hawthorne, Calif), M F Platzer (U S Naval Postgraduate School, Monterey, Calif), and S Y Ruo (Lockheed-Georgia Co , Marietta, Ga) *AIAA Journal,* vol 15, July 1977, p 966-973 29 refs Research supported by the Lockheed-Georgia Independent Research Program and Northrop Independent Research Program, Contract No NAS8-20082

An unsteady linearized formulation based on Oswatitsch-Keune's parabolic method is developed to analyze transonic flow past oscillating slender bodies In contrast to the widely used integral transform method, it is shown that all solutions can be derived by a simpler method directly in the physical plane By various expansion procedures, low-frequency solutions then are derived according to two clearly defined frequency ranges Adams-Sears' iteration is employed to account for the second-order effects Stability derivatives are compared with available theories and data It is found that the derivatives depend more sensitively on thickness than on the reduced frequency Finally, a critical assessment of the present method is given (Author)

A77-40834 * # **Expansion tunnel performance with and without an electromagnetically opened tertiary diaphragm** C G Miller (NASA, Langley Research Center, Entry Gas Dynamics Group, Hampton, Va) *AIAA Journal,* vol 15, July 1977, p 1045-1047

A study was conducted to examine the effect of synchronization of an electromagnetically opened tertiary diaphragm with flow arrival at the diaphragm on the pitot pressure measured at the test section of an expansion tunnel The effect of tertiary diaphragm pressure ratio (ratio of initial nozzle pressure to quiescent acceleration section pressure) on the pitot pressure time history is also determined The inadequacy of a pressure transducer protection arrangement used in previous expansion tube and expansion tunnel tests was revealed B J

A77-40901 # **Hot gas dynalpy test bench for model testing of jet or turbofan outlet systems** J Coste and P Broussaud (ONERA, Châtillon-sous Bagneux, Hauts de-Seine, France) *(Supersonic Tunnel Association, Semiannual Meeting, 46th, Columbus, Ohio, Sept 30-Oct 1, 1976) ONERA, TP* no 1977-7E, 1977 9 p

The hot gas dynalpy test bench which is described enables simulating directly the performance of jet engine exhaust nozzles and afterbodies with real gas duplicating real engine outflow conditions in dynalpy, composition, and temperature The compressed air supply, kerosene burner, the ducts for the primary (hot) and secondary (cold) air flows, and the pressure and temperature measurement arrangements are described Some models used in calibration tests are shown, and some tests results showing the thrust measurement repeatability on a given model are presented P T H

A77 40924 **Criteria for large scale fire testing of aircraft interiors** R B Williamson and H Hasegawa (California, University, Berkeley, Calif) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 32 p

Key considerations in designing aircraft fire safety include controlling the risk of fire outbreak, containing fire within interior spaces, maintaining structural integrity and air-worthiness during fires, and reducing the toxic threat of combustion products A test is developed for the containment of fire in interior spaces, similar to the standard fire containment test for building materials The test allows comparative data to be obtained on the fire resistance of newly-developed aircraft interior panels Toxic gas analyses and bioresponse data are also given, and calculations are made to determine the amount of time needed to burn through the test specimen, to reach excessive temperature levels on the back face of panels, and to reach untenable smoke conditions J M B

A77-40925 **The airport and fire from the airport fire chief's view** S U van der Meulen (Luchthaven Schiphol, Amsterdam, Netherlands) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 9 p

A77-40926 **Lessons from individual aircraft fire accidents TWA L1011 aircraft fire - Logan International Airport, Boston,**

Massachusetts, U S A , 20 April 1974 G H Tryon (National Fire Protection Association, Boston, Mass) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 7 p

A77-40927 An evaluation of worldwide transport aircraft fire experiences A F Taylor (Cranfield Institute of Technology, Cranfield, Beds , England) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 35 p 6 refs

This further study of turbine engined transport aircraft accidents has concentrated on 269 survivable accidents where there was either a post impact fire, major fuel spillage or an inflight fire involving the fuel An evaluation has been made of the effects on the final fatality rate of such parameters as fuel type, aircraft type and size, load factor, initial impact severity, phase of flight and type of flight The advantage of kerosine over wide cut gasoline is again confirmed and it is shown that the majority of people who die by the effects of fire do so in approach accidents but nevertheless in those involving comparatively few or no deaths directly due to the actual impact Turboprops and jets exhibit a different pattern of cause of death and although a higher proportion of turboprop accidents occur during the approach this does not account for the difference When considering fire alone the effects of aircraft age and type are small compared to the effects of fuel volatility (Author)

A77-40928 Crash management at airports J C Self (Aerospace Management Services International, Los Angeles, Calif) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 11 p

Meshing of community supported rescue agencies (mutual aid or civil defense organizations) and airport based crash rescue teams is discussed Generally an airport should concentrate on providing immediately needed services, such as prompt firefighting In accidents involving serious fire, for example, only sixty to ninety seconds may be available for evacuating the cabin Evacuation teams should arrive with the second wave of firefighting equipment and should be equipped to gain access to the cabin in the presence of fire damage and in any crash configuration, be able to work in a toxic atmosphere, and be trained in using backboard and other victim handling techniques Back up manpower should be capable of controlling crowds, manning first aid stations, and coordinating airport and community rescue services Creating a victim profile and a spectrum of hypothetical accidents is discussed, and a typical response system for an airport with two ambulances, a paramedic team, and one doctor is outlined The time periods needed to evacuate, triage, transport, and begin treatment of victims are also defined J M B

A77-40929 U S air carrier accidents involving fire /1965 through 1974/ R L Schleede (National Transportation Safety Board, Bureau of Aviation Safety, Washington, D C) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 24 p

A previous 10 year study (1955-1964) published by CAB is updated for the 1965 1974 period and although the number of people involved in certified air carrier aircraft accidents is found to have increased over the previous decade, the number killed in those accidents and the number of deaths due to fire have decreased Accident data is divided into categories according to the survivability of the accident (ranging from those incidents in which all occupants were killed, to those in which all injuries were minor), and the origin of the fire (in-flight, as a result of impact, or on-ground) Comparison between accident rates of U S air carriers in all operations and U S air carriers in passenger service is also made, with non passenger operations found to involve a greater incidence of fire accidents Previous suggestions for improving survival rates are recapitulated, including increasing strength of environmental structures and occupant restraints, developing of fuel inerting and fire suppression systems, reducing toxic fumes from burning cabin materials, improving evacuation procedures, and improving effectiveness of airport firefighting and rescue facilities Statistics are presented showing good improvement in some of the areas mentioned above J M B

A77-40930 Overseas National Airways DC-10-30 CF fire - November 12, 1975, JFK International Airport, New York, New York J W Hannan and A M Sloane (Port Authority of New York and New Jersey, New York, N Y) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 11 p

A77-40931 The airport and fire from the air carrier's view P R Powers (American Airlines, Inc , Flushing, N Y) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 9 p

The ability of airport firefighting crews to provide adequate protection and assistance to air carriers in the case of accidents involving fires or entailing risk of fire is assessed The performance of firefighting crews in four recent jet aircraft accidents is evaluated Problems arising from failure to designate authority and responsibility in firefighting efforts and difficulties in coordinating firefighting and rescue operations are discussed The need for strict standards regarding the training of firefighting and rescue personnel and equipment is stressed, together with the importance of developing plans for integrating available personnel and equipment in individual airports C K D

A77-40932 Vehicles and extinguishants (Les véhicules et les extincteurs) R Pizel (Aeroport de Paris, Service Etudes Securité, Orly Airport, France) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 9 p In French

Three fire-extinguishing foams used to combat aircraft fires are compared with respect to the quantities of precursor water and powder required for different categories of airports The three foams are a protein foam, an aqueous film-forming foam, and a fluoroprotein foam (FP 70) The properties of the fluoroprotein powder are examined Characteristics of the fire-fighting vehicles which transport the foam precursors are discussed, and powder and water delivery rates are examined Other topics, such as fire-fighting in a fog and the development of foam-delivering boats for use at airports adjacent to a body of water, are considered M L

A77 40933 Combined agent techniques and new agent developments W Mutzelburg (Flughafen Berlin Tegel, Berlin, West Germany) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13 17, 1976, Paper* 28 p In German

The use of suitable materials for the production of foam in aircraft fire-fighting applications is discussed, taking into account the definitions of terms employed in the description of the characteristics and the effectiveness of the extinguishing agent Details concerning the application of the various available agents are discussed and the effects produced by the different agents are compared A description is also presented of a new extinguishing agent which utilizes the heat of the fire for the foam generating process The agent consists essentially of a AFFF-Halon emulsion G R

A77-40934 The aircraft and fire from the fire protection engineer's view W H McClarran (Society of Fire Protection Engineers, Boston, Mass) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 10 p

Fire hazards associated with aircraft are described It is urged that materials used for interior finishing be tested in the actual environment and configuration in which they would occur in an aircraft Problems associated with jet fuels and the flammable oil used in hydraulic systems are examined, and the fire hazards caused

by combustibles in the form of maintenance materials, supplies, and passenger carry on luggage are discussed Design modifications that would reduce these hazards are considered M L

A77-40935 Extinguishants for aircraft fire fighting - Auxiliary fire suppressants S B Martin and R S Alger (Stanford Research Institute, Menlo Park, Calif) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 25 p 6 refs

Effective as it is against the class B fires that commonly result from aircraft mishaps, foam is not the whole answer Some kinematic situations often require the application of auxiliary agents This paper reviews recent test and evaluation work pertaining to the selection and effective use of auxiliary agents, including research with halocarbon and dry-chemical agents This review deals with three aspects of the fire suppression system (1) agents, (2) application equipment, and (3) operation techniques Specific emphasis is given to techno economic criteria for selecting agents to fit particular situations and to test methods for evaluating equipment and application techniques The significance of test results from kinematic fuel fires is discussed with respect to firemen training (Author)

A77-40936 Safety on board/evacuation procedures and training of cabin crew L Kozlowski (Swissair AG, Zurich, Switzerland) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 10 p

Survival in the case of aircraft accidents occurring at or near the airfield depends on seriousness of the emergency landing (fire, structural damage, gear collapse), the number of exits not blocked by fire, the adequacy of evacuation equipment and procedures, and efficiency of the ground rescue personnel and their fire fighting equipment Suggestions for improving evacuation procedures include use of slides that are functional under a variety of aircraft attitudes on crash, increased passenger briefing, and availability of ground equipment for speedy removal of passengers from aircraft with exits five meters above ground Furthermore, the number of cabin attendants should in general equal the number of exits, with an additional attendant provided to secure overwing life rafts Types of 'unprepared emergencies' (i e , those for which there is no time to secure cabin and passengers) and 'prepared emergencies' are listed, procedures to cope with these contingencies should be frequently rehearsed by cabin attendants J M B

A77-40937 * A composite system approach to aircraft cabin fire safety D A Kourtides, J A Parker, W J Gilwee, Jr , N R Lerner (NASA, Ames Research Center, Moffett Field, Calif), C J Hilado, L A LaBossiere (San Francisco, University, San Francisco, Calif), and M -T Hsu (San Jose State University, San Jose, Calif) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 49 p 20 refs

The thermochemical and flammability characteristics of two polymeric composites currently in use and seven others being considered for use as aircraft interior panels are described The properties studied included (1) limiting oxygen index of the composite constituents, (2) fire containment capability of the composite, (3) smoke evolution from the composite, (4) thermogravimetric analysis, (5) composition of the volatile products of thermal degradation, and (6) relative toxicity of the volatile products of pyrolysis The performance of high-temperature laminating resins such as bismaleimides is compared with the performance of phenolics and epoxies The relationship of increased fire safety with the use of polymers with high anaerobic char yield is shown Processing parameters of one of the bismaleimide composites is detailed (Author)

A77-40938 Aircraft fire fighting tactics - Handling of equipment A J Koppert (Ministerie van Verkeer en Waterstaat, Rijksluchtvaartdienst, The Hague, Netherlands) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 6 p

Rescue equipment and techniques in use at Dutch airports are discussed An inexpensive firefighting unit designed for single-man operation at the smallest airports is described, as well as a larger version of the same vehicle, employing a combination of premix and dry chemical extinguishing agents A medium-sized airport requires one of the larger vehicles and two foam tenders, while a large airport (such as the Schiphol Airfield) requires at least two sets of this equipment, operating from separate stations Use of monitors and hoselines in combatting open fuel fires is assessed, together with the special problems of engine and wheel fires Techniques for forcing entry into disabled craft and evacuating victims are considered, and a portable breathing apparatus permitting nine minutes of rescue work time inside a smoke-filled craft is described J M B

A77-40939 Lessons from individual aircraft fire accidents - Accident of the Boeing 707-PP-VJZ at Saulx-les-Chartreux, July 11, 1973 B V Hewes (National Fire Protection Association, College Park, Ga) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 7 p

A77-40940 The aircraft and fire from the pilot's view B V Hewes (International Federation of Air Line Pilots Association, London, England, Air Line Pilots Association, International, Washington, D C) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13 17, 1976, Paper* 6 p

An airline pilot is concerned with fire both in the air and on the ground Fortunately, in flight engine fires are very rare and it is hoped that with suitable improvements of cabin interiors the in flight fire hazard will soon be eliminated However, the situation regarding the crash fire is entirely different Experimentation with modified fuels has only had limited success The approaches which remain to reduce significantly the crash fire hazard involve crashworthy, fuel systems and improved fuel containment Such systems are now being retrofitted to helicopters and race cars with considerable success Airline pilots have requested that a similar system be designed for commercial aircraft G R

A77 40941 Handling aircraft accident/incident survivors and victims - Accountability techniques and body management G J Haas (Lee County, Div of Protective Services, Fla) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13 17, 1976, Paper* 13 p

The large number of victims involved in many aircraft accidents necessitates waiver of jurisdictional boundaries among rescue teams, more widespread use of trauma kits and multi casualty kits, and training of aircraft crash specialist teams in problems of extrication and handling of victims Training should emphasize the need to stabilize victims rather than treat them, tagging and classification of casualties to prevent duplication of victim evaluation, and the use of a 'triage' system, i e , separation of victims into three categories, from assumed fatalities to those requiring speedy treatment, to those not needing immediate attention The distinction between initial, intermediate, and advanced treatment is made, and co ordinating the removal of casualties by ambulance and the distribution of victims to hospitals is also discussed Procedures in body removal and identification are described, with attention given to the role of autopsies in the eventual determination of the causes of a crash J M B

A77 40943 Methods to measure aircraft fire fighting equipment capabilities G B Geyer (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13 17, 1976, Paper* 44 p

Foam dispensing systems employed in airport firefighting are analyzed The influence of nozzle shape and rate of discharge on the shape and depth of foam deposits is compared for protein foam and aqueous-film-forming foam (AFFF) Full-scale fire modeling experiments involving both types of foam are performed to determine the fire control time under various conditions, including foam application with an operator positioned on the monitor platform and using a hand-operated override system, application with a fireman positioned at the nozzle console to change foam pattern at the discretion of the nozzle operator, and application with an operator on the monitor platform using an electro-pneumatic monitor control Among the recommendations for improving performance are development of a foam range finder based on nozzle elevation and azimuth position, and use of devices to increase solution discharge rate Problems of visibility from the cab of the firefighting vehicle and the relative efficacy of protein foam and AFFF are also discussed J M B

A77-40944 **The airport fire defense - The basic mission and needs** R J Ferguson (British Airports Authority, London, England) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 10 p

The basic mission of airport fire defense involves the ability to respond to a fire within three minutes and preferably in less than two minutes, the maintanance of survivable conditions within the aircraft until fire control has been achieved, the creation of safe conditions for evacuation or rescue, and the effective transportation of casualities To fulfill this mission specialized equipment and training are needed Aspects of the basic mission and needs are discussed, and traits of airport accidents are considered M L

A77-40946 **Extinguishants for aircraft fire fighting foaming agents - Protein, fluoroprotein and AFFF** L R DiMaio (National Foam System, Inc , Lionville, Pa) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 12 p 8 refs

The three foams which are used as primary agents include a regular type involving protein, an aqueous film-forming foam, and a fluoroprotein type The regular protein-type mechanical foams, based on hydrolyzed protein, are and have been in use for over 30 years The AFFF or aqueous film forming foam makes use of fluorinated surfactants The fluoroprotein type is a protein based liquid which is modified by the addition of a selected fluorinated surfactant which bonds itself loosely to the protein to give the foam oleophobicity G R

A77-40947 **Improving fire prevention measures on board commercial transport aircraft (Comment s'améliore la securité contre l'incendie à bord des avions de transport public)** A Blavy (Societé Nationale Industrielle Aérospatiale, Suresnes, Hauts-de-Seine, France) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 8 p In French

Several aspects of fire control for commercial transport aircraft are considered with attention to measures that would reduce the likelihood of a fire starting, or would protect crew and passengers if a fire does start, or would facilitate fighting the fire The economics of fire control systems in general as well as space and weight constraints are considered The causes of onboard aircraft fires are discussed M L

A77-40948 **The aircraft and fire from the operator's view** J J Brenneman (United Airlines, Inc , San Francisco, Calif) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13 17, 1976, Paper* 10 p

A77-40950 **Balancing the costs of rescue services and fire fighting among different categories of airports (Equilibre des coûts des services de sauvetage et de lutte contre l'incendie entre les différentes categories d'aéroports)** F Ansart (Direction Generale de l'Aviation Civile, Service Technique de la Navigation Aerienne, Paris, France) *National Fire Protection Association, International Seminar on Aircraft Rescue and Fire Fighting, Geneva, Switzerland, Sept 13-17, 1976, Paper* 16 p In French

The difficulties that minor airports face in financing rescue services and fire fighting procedures suitable for the largest airplanes are examined, and the costs are analyzed with respect to traffic A method of balancing costs is proposed which is based on the total traffic of the airport as the total traffic is a determinant of its actual resources Cost efficiency optimization is considered M L

A77-41125 **TSDMA - A novel secondary radar (TSDMA - Ein neuartiges Sekundarradar)** U F A Fusban *Nachrichten Elektronik*, vol 31, June 1977, p 171, 172 In German

The Time Space Division Multiple-Access System (TSDMA) considered is a secondary radar system which is particularly suited for object identification in the case of an unexpected attack of low-flying aircraft The principles of operation of conventional secondary radar systems and the implementation of these principles are examined It is pointed out that the main problem concerning an employment of these systems is related to the danger of overinterrogation In the proposed system, discrete time-slots are assigned to the interrogators This approach is to prevent overinterrogation in crisis situations The described system can be termed four dimensional because it makes use of the time dimension, as the fourth dimension, in addition to the three spatial dimensions G R

A77-41268 # **Steady linearized aerodynamics II Supersonic (Aerodynamique stationnaire linearisée II - Supersonique)** D Homentcovschi (Bucuresti, Institutul Polytehnic, Bucharest, Rumania) *Archiwum Mechaniki Stosowanej*, vol 29, no 1, 1977, p 41-51 7 refs In French

Fluid-mechanics equations, written in distribution form, are used in studying the steady supersonic flow of a compressible fluid past a slender body The obtained integral equation allows the direct calculation of lift Attention is given to wings with and without subsonic trailing edges and to the case when the supersonic leading edge is reduced to a point In considering the case of a conical body, it is shown that if the supersonic leading edge cannot be reduced to a point, then the solution of the problem is obtained in an explicit form B J

A77 41270 # **Wave structure and density distribution in a nonstationary gas jet** I M Naboko, V V Golub, A V Eremin, V A Kochnev, and A A Kulikovskii (Akademiia Nauk SSSR, Nauchno Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *Archiwum Mechaniki Stosowanej*, vol 29, no 1, 1977, p 69-80 7 refs

The paper deals with the unsteady jet flow when the ratio of the nozzle exit stagnation pressure to the ambient pressure varies in a wide range A specific wave pattern during the initial stages of the supersonic outflow has been observed The observed wave pattern is found to depend on the physical properties of the particular gas Consideration is also given to time dependence of the flow structure and the density distribution in the unsteady jet The generalized data for the gas front along the flow are found to be in fair agreement with calculation by a spherical source model The time taken for the steady jet to be established as observed in the experiment is found to be an order of magnitude longer than that obtained by calculations (Author)

A77-41379 **Cost-benefit analysis for airport development** A H Stratford (Alan Stratford and Associates, Ltd , England) *Airport Forum*, vol 7, June 1977, p 59, 60, 62, 63 In English and German

Prime initial requirements for cost-benefit studies include a measurement of all the factors which are relevant to costs and revenue that are likely to arise from a project and its development It is generally necessary to estimate the costs and benefits under a series of alternative conditions Attention is given to the secondary effects from airport development, the setting up of the study program,

questions of cost estimation, the types of revenues, and the final analysis of cost-benefit relations G R

A77-41388 # **Programmable data logger for automatic test equipment (Programova merici ustredna AKZ)** J Stepanovsky *Zpravodaj VZLU,* no 1, 1977, p 7-16 In Czech

The paper describes a programmable data logger designed for use with test equipment for aircraft control systems A block diagram of the whole system is shown, and the individual parts of the system are described, which include a control block, address system, measuring block, auxiliary signal source, digital-analog converters, power supply, and control block Tables showing the accuracy characteristics of the system operating under different temperature conditions are given P T H

A77-41389 # **Software for automatic test equipment (Programove vybaveni AKZ)** J Stepanovsky *Zpravodaj VZLU,* no 1, 1977, p 17-21 In Czech

The programming characteristics of automatic test equipment for testing the individual systems of an aircraft are described Different types of programs are characterized, and the self-programming capability of the system is described The structure of the programming language is described, and some instruction formats and programming examples are illustrated P T H

A77-41390 # **Testing gyroscopic systems with automatic test equipment (Kontrola gyroskopickych pristroju pomoci automatickeho kontrolniho zarizeni)** K Horak *Zpravodaj VZLU,* no 1, 1977, p 23-30 In Czech

The article describes the procedures for carrying out tests of aircraft gyroscopic systems and their main components including the gyromagnetic compass, artificial horizon, and the compensation switch A block diagram of some of the test equipment is described, and some programming characteristics are discussed P T H

A77-41391 # **Measuring the motion of an aircraft with direct lift control during flight along the approach path (Mereni letounu s primym rizenim vztlaku pri letu po priblizovacim paprsku)** V Pokorny *Zpravodaj VZLU,* no 2, 1977, p 51-58 In Czech

The paper describes flight simulator measurements of an aircraft's motion during landing approach for an aircraft that has direct lift control realized by a simple coupling of spoiler and elevator deflections Measurements showed that this simple coupling results in an improvement in the accuracy of flight control on the approach path, especially under turbulent conditions Important factors on performance were differences in measurements on individual pilots, training, fatigue, and alcohol P T H

A77-41392 # **Analysis of identification errors in flight dynamics (Rozbor chyb identifikace v dynamice letu)** V Kocka *Zpravodaj VZLU,* no 2, 1977, p 59-64 9 refs In Czech

Three stages in identification and their variants used in flight dynamics as a method of identification of mathematical models of aircraft motions are characterized Random and systematic errors in two of these variants are analyzed In order to verify the insignificance of the values of the systematic errors in the output quantities, a means of selecting a control parameter is outlined A global statistical test for closeness of fit is proposed for verifying the identity of the values of the output quantities measured on the system and obtained on the model Specific properties of identification in flight dynamics are discussed P T H

A77-41394 # **Aircraft simulation on computer (Simulace letounu na cislicovem pocitaci)** J Homola *Zpravodaj VZLU,* no 2, 1977, p 73-79 11 refs In Czech

Some numerical methods used in digital flight simulation are described Simplified equations of aircraft longitudinal motion are given Examples of simulation of short-period oscillations of a small passenger aircraft and of a hypothetical supersonic aircraft are discussed The influence of the numerical method used and of the integration step on the accuracy of the solution is illustrated An organization scheme for a simulation program for real time solution of digital flight simulation problems is proposed P T H

A77-41450 **Some research problems on the fatigue of aircraft structures** W T Kirkby (Royal Aircraft Establishment, Farnborough, Hants, England) *Society of Environmental Engineers, Journal,* vol 16-2, June 1977, p 7-15, 24 15 refs

The principal aircraft design philosophies ('safe-life', 'fail-safe', and 'damage-tolerant design') have promoted various emphases on three areas of research into the fatigue of structures loading actions, cumulative fatigue damage, and monitoring and managing of fatigue life consumption Two investigations into loading actions are discussed, one studying atmospheric turbulence during low-level flights over land and sea, the other measuring severity of load experienced during different sorties Examples of research into cumulative fatigue damage behavior include tests of stress applied to aluminum alloy plates, the effect of surface cladding on nearly pure aluminum, prediction of crack growth under variable amplitude loading and under combined mechanical and thermal stress cycling Research in monitoring and managing of fatigue life consumption is illustrated by a study of structural loads incurred in landing large jet aircraft in relation to piloting technique, and development of means to indicate to the pilot, while airborne, the rate at which fatigue life is being consumed J M B

A77-41462 **Services and installations for aviation at airports and airfields of regional importance (Dienste und Anlagen fur die Luftfahrt auf Flughafen und Landeplatzen von regionaler Bedeutung)** Dusseldorf, Deutsche Gesellschaft fur Ortung und Navigation, 1977 83 p In German

The reported investigation is to provide an evaluation criterion concerning the future characteristics of the services and installations for the considered airports in the Federal Republic of Germany An evaluation scheme for the determination of the requirement threshold for services and installations for aviation is discussed, taking into account flight-operational aspects, the air traffic control service, the flight information service, the communications service, the navigation service, the weather service, aspects of air space supervision, and details regarding the evaluation scheme Attention is given to lighting systems, visual aids, instrument landing system installations, and VOR installations G R

A77-41473 **An LED numeric display for the aircraft cockpit** R N Tyte, J H Wharf, B Ellis (Royal Aircraft Establishment, Farnborough, Hants, England), T F Knibb, R G O'Rourke, and R M Gibb (Plessey Co, Ltd, Allen Clark Research Centre, Towcester, Northants, England) *IEEE Transactions on Electron Devices,* vol ED-24, July 1977, p 982-986 Research supported by the Ministry of Defence

This paper describes the construction and performance of an LED numeric display designed specifically for aircraft cockpit applications The display, using yellow or green LED chips, is a 4-character 7-bar numeric with 4-mm character height mounted in a hermetically sealed package to meet full military device specifications Legibility studies are reported for this display in ambient illuminations up to 100 000 lux, using different, comercially available contrast-enhancement filters The results show that the display is completely legible in the highest illumination for a relatively modest power consumption (Author)

A77-41547 # **Optimization of an oleo-pneumatic shock absorber of an aircraft during landing** C Venkatesan *Journal of Aircraft,* vol 14, Aug 1977, p 822, 823 5 refs

The paper describes the results of the application of an optimum design procedure for landing gears of the oleo-pneumatic type for an aircraft of the 5000-lb class Peak ground load is the performance index, the constraint is on the stroke of the shock absorber, the variable is the diameter of the orifice in the shock absorber For a given landing mode, it is observed from the transient of the ground load that there are two peaks in the response, the relative magnitudes

of which depend on the damping constant of the shock absorber In the optimum case, the magnitudes of the peaks are almost the same P T H

A77-41548 * # **Evaluation of flight spoilers for vortex alleviation** D R Croom (NASA, Langley Research Center, Hampton, Va) *Journal of Aircraft,* vol 14, Aug 1977, p 823-825

The paper describes the facilities and test procedures used in a series of wind-tunnel and full scale flight investigations of the effectiveness of flight spoilers currently existing on wide-bodied transport jet aircraft when used as trailing vortex hazard alleviation devices Examples of the results of such studies include the variation of trailing wing rolling moment coefficient with downstream distance behind a B-747 airplane model with various segments of its flight spoilers deflected 45 deg, and comparisons with models without spoilers deflected It is concluded that the existing flight spoilers on the B-747 are effective as trailing vortex attenuators P T H

A77-41549 # **Consideration of clogging in boundary-layer control system design** P Crimi *Journal of Aircraft,* vol 14, Aug 1977, p 825-827 8 refs

A model is proposed for the clogging mechanism of boundary layer control systems that employ suction through perforated surfaces The primary parameters are perforation size, particle size, boundary layer thickness and velocity profile, external flow static and dynamic pressures, and suction pressure An equation describes the limiting condition for no clogging of an individual particle, which is satisfied when the moment on a particle due to drag about the furthest downstream contact point is sufficient to overcome the moment due to the suction on the portion of the particle in the whole Curves for maximum suction for no clogging vs hole size were obtained from this condition for both laminar and turbulent boundary layers These results are applied to some specific systems, and it was found that clogging need not be a problem for boundary layer control used to prevent leading edge stall P T H

A77-41575 # **Aircraft aeromechanics (Aeromekhanika samoleta)** V V Andreevskii, V M Belokonov, A F Bochkarev, V I Klimov, L A Matveeva, V M Turapin, and M S Tuger Moscow, Izdatel'stvo Mashinostroenie, 1977 416 p 37 refs In Russian

Methods for calculating the trajectories of aircraft motion in flight, flight stability, and maneuverability (handling) are expounded First the aircraft is treated as a point of mass equal to the aircraft mass in free flight with forces applied (gravitational, aerodynamic, and propulsive thrust) Then motion of the center of mass is investigated in the ideal case Finally the aircraft is studied as a three-dimensional mass with disturbances in flight and control inputs taken into account Fuel consumption, take-off and landing characteristics, moments and their derivatives, longitudinal and lateral trim, stability and controllability with automatic controls functioning, spin, autorotation of the wing, aileron reversal, and airframe elasticity are among the topics treated R D V

A77-41636 **YC-15 in the air** H Field *Flight International,* vol 112, July 23, 1977, p 269-272

The McDonnell Douglas YC-15, developed for the U S Air Force's Tactical Air Command, delivers payloads twice those handled by the C-130 transport and has a range of 2,300 nautical miles Principal features of the YC-15 include need for a field length equal to half the C-130's, flight system controls located on the glareshield, leaving center panels free for engine instruments and pressurization controls, and Visual Approach Monitors (VAM), displays which monitor the conduct of STOL approach and landing The craft is adapted to both low-altitude low cruise velocities and a high-altitude cruise at Mach 0 68 Similar to VTOL craft, the YC-15's airspeed is primarily controlled by attitude, while altitude in the approach mode is governed by thrust Slope of descent is normally 6 degrees, but a slope of up to 9 degrees is attainable J M B

A77-41648 # **Operational reliability of aircraft powerplants (Ekspluatatsionnaia nadezhnost' aviatsionnykh silovykh ustanovok)** K P Alekseev Moscow, Izdatel'stvo Transport, 1976 160 p 27 refs In Russian

The book analyzes the fuel and lubrication systems of modern transport aircraft from the viewpoint of their operational reliability and safety, and also examines some general factors influencing the stability of powerplant operation The causes of engine fires are investigated and suitable preventative measures are discussed Methods for evaluating the safety margins of powerplants are described Special attention is given to the problem of bird collisions and means of alleviating their effects The reliability of an engine is estimated by means of partial relative indices, and the effect of engine reliability on safety and economy of flight is analyzed A general method for estimating the technical economic indices of an engine taking into account its reliability is set forth P T H

A77-41751 **Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers** Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977 138 p Members, $12 , nonmembers, $17

Numerous trends in research and development work on lighter-than air (LTA) craft and systems are surveyed, an updated LTA bibliography is included Semibuoyant LTA vehicles, hot air balloons, tethered aerostats, cargo airships, Naval support LTA craft, heavy lift airships, and metal-clad airship hulls are discussed The present and potential roles of universities in LTA research are dealt with Hypothetical concepts and theoretical investigation predominate in the contributions R D V

A77-41752 * # **Theoretical study of hull-rotor aerodynamic interference on semibuoyant vehicles** S B Spangler, C A Smith, and M R Mendenhall (Nielsen Engineering and Research, Inc , Mountain View, Calif) In Lighter Than Air Systems Technology Conference, Melbourne, Fla , August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 1-7 8 refs Contract No NAS2-9512 (AIAA 77-1172)

Theoretical methods are being developed to predict the mutual interference between rotor wakes and the hull for semibuoyant vehicles The objective of the investigation is to predict the pressure distribution and overall loads on the hull in the presence of rotors whose locations, tilt angles, and disk loading are arbitrarily specified The methods involve development of potential flow models for the hull alone in a nonuniform onset flow, a rotor wake which has the proper features to predict induced flow outside the wake, and a wake centerline specification technique which accounts for the reactions of the wake to a nonuniform crossflow The flow models are used in sequence to solve for the mutual influence of the hull and rotor(s) on each other and the resulting loads A flow separation model is included to estimate the influence of separation on hull loads at high sideslip angles Only limited results have been obtained to date These were obtained on a configuration which was tested in the Ames Research Center 7- by 10-Foot Low Speed Tunnel under Goodyear Aircraft Corporation sponsorship and indicate the nature of the interference pressure distribution on a configuration in hover (Author)

A77-41753 # **The inverse problem for axisymmetric aerodynamic shapes** M F Zedan and C Dalton (Houston, University, Houston, Tex) In Lighter Than Air Systems Technology Conference, Melbourne, Fla , August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 8-14 18 refs (AIAA 77-1175)

The flow of an incompressible fluid past an axisymmetric shape is considered in the form of the 'inverse problem' in hydrodynamics For a given pressure or velocity distribution, the appropriate body shape is determined iteratively The method of line sources and sinks is used to represent the body shape The procedure is simple and accurate and convergence is more rapid than that obtained by other investigators using surface-source distributions Examples chosen to

represent the method include spheres, Rankine bodies, a constant velocity body and an airfoil-shape axisymmetric body Results compare very well with exact solutions and with calculated results of others when comparison is possible (Author)

A77-41754 # **A lighter-than-air bibliography** D E Woodward and G E Wright, Jr (Association of Balloon and Airship Constructors, Rosemead, Calif) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 15-40 816 refs Research supported by the Association of Balloon and Airship Constructors (AIAA 77-1177)

This bibliography consists primarily of 'unpublished' material, including (1) proposals and contract reports, (2) technical investigations by or for manufacturers and users of LTA vehicles, (3) user organization training materials, specifications, and technical regulations, and (4) reports of inspections, acceptance tests, surveys, and accident investigations Wherever possible, availability of the items in the bibliography has been noted (Author)

A77-41755 # **A comparison of different forms of dirigible equations of motion** J R Pretty and R O Hookway (Martin Marietta Aerospace, Denver, Colo) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 41-47 8 refs (AIAA 77-1179)

Several formulations of airship equations of motion are currently in use in the LTA industry The most significant differences in the equations are due to (1) treating the apparent masses and apparent inertias as added masses or added inertias, or (2) treating them as aerodynamic acceleration reaction forces and moments Although there has been little opportunity to correlate the predicted LTA response with actual flight test data, the equations can be verified by examining the correlation between test data and predicted responses for submarines From this data it is concluded that approach (2) is correct Predicted responses of a dirigible represented by both sets of the equations are shown Better stability margins are predicted with approach (2) (Author)

A77-41757 # **Tethered aerostats - Technology improvements** H E Reed (Pan American World Airways, Patrick AFB, Fla) and J A Sechrist (RCA, Patrick AFB, Fla) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 53-57 (AIAA 77-1184)

The tethered aerostat system, known as Family II, developed by government and industry at the Range Measurements Laboratory, Patrick AFB, Florida has proven to be a major milestone in balloon technology The concepts and approaches that produced this system have led to the acceptability of the tethered aerostat as a meaningful and cost-effective tool by government and to its exploitation on a commercial basis This paper presents a summary of technology improvements aimed at reducing the airborne weight of the Family II system in order to increase its payload capability Principally covered is the design and development of a mooring system that eliminates the need for a metal mooring structure to be carried on-board the aerostat A comprehensive program to test and evaluate Kevlar, a high strength-to-weight fiber, as a tether material and to certify its operational use wil be discussed (Author)

A77-41758 # **The university's role in the new era of LTA technology and applications** E F Strother (Florida Institute of Technology, Melbourne, Fla) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 58-62 11 refs (AIAA 77-1187)

Universities often seem unsure of their proper role in the current LTA revival Uncertainty still exists in the non technical areas concerning economics, vested interests, and socio-political acceptance If developed in the private sector, LTA design will be rigidly constrained by economic boundary conditions, while military development would emphasize uniqueness of mission Universities offer both civil and military LTA developers a wide range of research and interdisciplinary benefits which are described in this paper Through a systems approach the objectivity of university research will provide valuable direction to the development and public acceptance of LTA concepts (Author)

A77-41759 # **Structural response of the Heavy Lift Airship /HLA/ to dynamic application of collective pitch** W N Brewer (Goodyear Aerospace Corp, Akron, Ohio) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 63-69 (AIAA 77-1188)

This paper presents results of a preliminary analysis of the dynamic response of the Heavy Lift Airship (HLA) to rapid application of collective pitch and to wheel loads induced in a symmetrical four-point landing condition Masses, springs and forcing functions are defined Natural frequencies and mode shapes are determined The response of the system to the forcing functions is determined first by analytical techniques (partially) and then by numerical integration of the equations of motion on a digital computer It is shown that no cables will go slack in the specified conditions but structurally significant excursions in the suspension system do occur (Author)

A77-41760 # **MATASS - Moored Airship Towed Array Sonar System** F D Buckley In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 70 80 (AIAA 77-1190)

MATASS is an independently produced concept formulation which assumes an ASW mission which an airship could perform, using a towed array sonar While monitoring the array, the airship remains moored to the array cable This permits a protracted Time On Station with minimal energy expenditure The minimal airship volume required to perform the mission is determined The effect of different propulsion engine installations on mission radius is determined For airships of larger than minimal volume, Loiter Time, free of the array, is determined for different loiter engine installations Conclusions and recommendations are presented for further investigation (Author)

A77-41763 # **Semi-buoyant lifting body hybrid characteristics for advanced Naval missions** J W Lancaster (Goodyear Aerospace Corp, Akron, Ohio) In Lighter Than Air Systems Technology Conference, Melbourne, Fla, August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 99-110 Contract No N62269-76-C-0466 (AIAA 77-1194)

A summary of the results of the parametric Analysis and Conceptual design study of a Semi Air Buoyant (SAB) Lifting Body Vehicle for Advanced Naval Operations is presented The SAB is a VTOL vehicle which has full hover capability, 150 knot cruise speed, and can provide from 12 hours to 7 days endurance depending on speed, mission profiles and payload The ferry range is about 8000 nautical miles at the optimum range speed profile An IOC of 1990 appears achievable with low technical risk Operationally, the SAB would operate primarily in conjunction with surface assets (shipping convoys and task forces) to provide ASW and AEW screening protection The SAB is not deck-space constrained and has a special purpose support module for at sea replenishment Independent, shore based operations are also possible Time on station performance of one to three days can be achieved depending on range to station and speed profile on station (Author)

A77-41764 # **Metalclad airship hulls** V H Pavlecka (Turbomachines, Inc , Irvine, Calif) In Lighter Than Air Systems Technology Conference, Melbourne, Fla , August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 111-121. 6 refs Navy-supported research (AIAA 77 1196)

A range of five large Metalclad airship hulls was explored analytically for the determination of their structural weights as purely lifting hulls, at several altitudes and at maximum speed of 100 knots under the most severe gust moment exposure Exploration involved the determination of suitable Metalclad structures, hull pressures, metal skin thicknesses and their distribution, elastic interaction between skin and structure, internal gas containment means and study of methods of construction It was determined that Metalclad hulls can be designed and constructed economically, using simple cellular structures and can be expected to have extraordinarily low (weight)/(gross lift) ratios in all sizes of hulls (Author)

A77-41765 # **ZPG-X design and performance characteristics for advanced Naval operations** J W Lancaster (Goodyear Aerospace Corp , Akron, Ohio) In Lighter Than Air Systems Technology Conference, Melbourne, Fla , August 11, 12, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 122-133 6 refs Contract No N62269-76-M-4325 (AIAA 77-1197)

A summary of the results of a point design study of the ZPG-X (90 knot top speed, 5000 ft normal cruise altitude, and a 4000 n mi ferry range) Significant improvements in low speed and hover control result from the three propeller vectored thrust propulsion system The stern propulser includes a defected slip-stream control surface which provides control capability in hover, low speed - no wind conditions, and in statically heavy or light conditions Operationally, the ZPG-X could be employed in ship supported operations to provide ASW and AEW screening for shipping convoys and non-carrier task forces The low speed control capability allows towed array sensors to be used for passive ASW screening operations On-station times of one to two days can be achieved (Author)

A77-41774 **Use of changeover designs in subjective experiments** J A John (Southampton, University, Southampton, England) *Journal of Sound and Vibration,* vol 53, July 8, 1977, p 117-126 5 refs

In constructing a Latin square design, it is sought that the design should be balanced in the sense that, over the entire design, the stimuli are presented to subjects such that each stimulus is preceded by every other stimulus the same number of times Such a design is called a balanced changeover design This paper considers the concepts of balance and orthogonality associated with such design, and applies it to a subjective noise experiment, namely the comparison of the noise levels from a Boeing 707, a Concorde landing, a Concorde takeoff, and a DC8 B J

A77-41850 # **Market development problems for local service air carriers** J W Crichton (Bradley Air Services, Ltd , Carp, Ontario, Canada) *(Canadian Aeronautics and Space Institute, Annual General Meeting, Toronto, Canada, May 10-12, 1976) Canadian Aeronautics and Space Journal,* vol 23, July Aug 1977, p 212-216

The paper discusses some of the fundamental problems facing local service air carriers in Canada trying to establish a viable operation Some of these are the following (1) lack of clear definition, and hence government policy protection, (2) relatively unattractive markets, and (3) modern equipment capable of meeting service dependability requirements is expensive However, it is argued that in many situations a short haul service would provide benefits to the public, outweighing the disadvantages of possible increased block flying time and marginal inflight inconveniences Such benefits include larger and more convenient choice of flying times, non-rising air fares, and fuel savings Remedies suggested are (1) clarification of government policy with regard to local service operations, (2) cooperation among local service and regional and mainline carriers, and (3) development of the proper aircraft for short haul transport P T H

A77-41857 * # **Upper surface blowing aerodynamic and acoustic characteristics** D M Ryle, Jr , J A Braden, and J S Gibson (Lockheed Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics and NASA Ames Research Center, V/STOL Conference, Palo Alto, Calif , June 6-8, 1977, AIAA Paper 77-608* 15 p 13 refs Contracts No NAS1 13870, No NAS1 13871

Aerodynamic performance at cruise, and noise effects due to variations in nacelle and wing geometry and mode of operation are studied using small aircraft models that simulate upper surface blowing (USB) At cruise speeds ranging from Mach 50 to Mach 82, the key determinants of drag/thrust penalties are found to be nozzle aspect ratio, boattailing angle, and chordwise position, number of nacelles, and streamlined versus symmetric configuration Recommendations are made for obtaining favorable cruise configurations The acoustic studies, which concentrate on the noise created by the jet exhaust flow and its interaction with wing and flap surfaces, isolate several important sources of USB noise, including nozzle shape, exit velocity, and impingement angle, flow pathlength, and flap angle and radius of curvature Suggestions for lessening noise due to trailing edge flow velocity, flow pathlength, and flow spreading are given, though compromises between some design options may be necessary J M B

A77-41863 * # **Quantitative density visualization in a transonic compressor rotor** A H Epstein (MIT, Cambridge, Mass) *ASME, Transactions, Series A - Journal of Engineering for Power,* vol 99, July 1977, p 460-475 15 refs Grant No NGL 22-009-383

The flow in a 59-cm-diameter high work transonic compressor rotor has been visualized using a fluorescent gas, 2,3, butanedione, as a tracer The technique allows the three-dimensional flow to be imaged as a set of distinct planes Quantitative static density maps were obtained by correcting the images for distortion and nonlinearities introduced by the illumination and imaging systems These images and maps were used to analyze the three dimensional nature of the blade's boundary layer and shock system (Author)

A77-41929 # **The future of rotorcraft in aviation** J P Jones (Westland Helicopters, Ltd , Yeovil, Somerset, England) In The place of aviation in society, Proceedings of the Fifteenth Anglo American Aeronautical Conference, London, England, May 31-June 2, 1977 London, Royal Aeronautical Society, 1977 15 p

The evaluation concerning the future of rotorcraft takes into account the conventional helicopter, the supersonic rotor helicopter, the tilt (wing) rotor, and remotely piloted helicopters With respect to the conventional helicopter, it is expected that new developments will more than double its cost effectiveness The aerodynamic problems of the helicopter disappear if rotation at supersonic tip speeds is employed There are, however, problems of increased noise and power consumption for the supersonic rotor helicopter, which will probably limit its use to military applications Convertible rotorcraft have possibly the best technical chance of finding a civil market, but the investment requirements are high Remotely piloted helicopters require a long period of engineering development work, which will probably only be performed in connection with extended military service G R

A77-41930 # **Civil aviation activities in global perspective** J Lukasiewicz (Carleton University, Ottawa, Canada) and K W Studnicki-Gizbert (Canadian Transport Commission, Ottawa, Canada) In The place of aviation in society, Proceedings of the Fifteenth Anglo-American Aeronautical Conference, London, England, May 31 June 2, 1977 London, Royal Aeronautical Society, 1977 17 p 29 refs

A brief review is conducted of the major causes of the spectacular growth of aviation since 1945 The share of passenger and freight traffic that belongs to the air mode is examined, taking into account also a continental comparison which reveals the

predominance of North America in air travel The U S domination of the air transport is reflected even more strongly in the industrial sphere Attention is given to economic dimensions, the international aspects of air transportation and the aircraft production industry, questions of research and development, and general aviation and special civil applications of aircraft in agriculture It is pointed out that commercial air transportation appears currently to have entered a period of transition from fast growth to maturity The causes responsible for this change are analyzed G R

A77-41936 # **Canadian Forces Search and Rescue** H L King In The place of aviation in society, Proceedings of the Fifteenth Anglo American Aeronautical Conference, London, England, May 31 June 2, 1977 London, Royal Aeronautical Society, 1977 8 p

The Canadian Search and Rescue (SAR) organization is an outgrowth of the military air/sea rescue service which operated on an ad hoc basis in the coastal areas of Canada during World War II The SAR organization as authorized by Cabinet came into being in late 1947 The Canadian Forces is reponsible for coordinating and participating in SAR operations involving aircraft and vessels in distress within the Canadian areas of responsibility The Canadian Coast Guard, SAR provides the marine element for the national air sea rescue organization Attention is also given to problems of distress signal communication, legislative and juridical issues, the employment of electronic locator transmitters, a Search and Rescue Satellite System, computer assisted search planning, the major air disaster plan, and SAR statistics G R

A77-41938 # **Basic safety concepts** W Tye (Civil Aviation Authority, Airworthiness Requirements Board, London, England) In The place of aviation in society, Proceedings of the Fifteenth Anglo-American Aeronautical Conference, London, England, May 31-June 2, 1977 London, Royal Aeronautical Society, 1977 13 p

The safety of air transport is compared with that of other modes of travel, taking into account accident risks in general, the present safety level of air transport, the fatalities per billion passenger-miles, railway versus air transport, road versus general aviation, total fatalities, and injuries It is found that on a passenger-miles basis the number of fatalities in the U K is about twice the corresponding number for rail General aviation is clearly less safe than driving The practicality of improving air transport safety is investigated Attention is given to the economics of air safety, factors concerning risk taking, the effect of the press and of political pressures, the view of the public, and problems of private flying G R

A77-41946 # **The changing horizons for technical progress** L E Frisbee and R H Hopps (Lockheed-California Co , Burbank, Calif) In The place of aviation in society, Proceedings of the Fifteenth Anglo American Aeronautical Conference, London, England, May 31 June 2, 1977 London, Royal Aeronautical Society, 1977 23 p

Some of the most promising potential technological developments in the air transportation field are discussed, including improvements in airframe design, aircraft engines, and active controls hardware Major obstacles to these relatively short term developments are considered Special attention is given to the problem of fuel economy Technologies requiring a longer time-scale for research and development, including advanced turboprop engines, all wing concepts, and laminar flow control, are outlined The potential impact of hydrogen based power plants on the development of super- and hypersonic transports is examined C K D

A77-41960 # **The next SST - What will it be** L T Goodmanson and A Sigalla (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-797* 21 p 28 refs

Progress in technology is reviewed in order to make a prediction of the shape, features, operations, economics, and noise characteristics of the next generation of SST's Advances in aerodynamics, structures, propulsion, and jet noise control are examined, and examples of how they can integrate to form a complete airplane configuration meeting economic and noise requirements are shown P T H

A77-41961 # **Airframe/engine integration with variable cycle engines** J R Wilson and B R Wright (Lockheed California Co , Burbank, Calif) *American Institute of Aeronautics and Astronautics and Society of Automot Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-798* 8 p 5 refs

The paper studies the feasibility of using variable cycle engines, which have the ability to operate like turbofans during subsonic cruise and like turbojets at supersonic cruise, to regulate airflow and better match the engine with the inlet and reduce off-design penalties for second generation SST designs employing the over/under concept of engine installation A study of engine performance penalties related to inlet matching was performed on a advanced SST baseline aircraft with under/over nacelles containing VCE's with two different mixed compression inlet designs a translating centerbody axisymmetric inlet, and a two dimensional, articulated centerbody, vertical wedge Mission analyses show that the variable geometry features of VCE's allow engine airflow to be scheduled to match either type of inlet for minimum installations costs P T H

A77-41963 # **Propulsion designed for V/STOL** E G Smith (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-804* 9 p

Major design criteria for propulsion systems used in V/STOL aircraft are identified Among the topics discussed are take-off versus cruise thrust matching, take off/engine out landing thrust matching, control requirements for vertical take-off and for short take-off/vertical landing flight profiles, and engine-out safety Duty cycles for V/STOL propulsion systems are examined, together with the problems of inlet reingestion and pressure distortion C K D

A77-41968 # **The application of new technology for performance improvement and noise reduction of supersonic transport aircraft** P H Calder and P C Gupta (Rolls Royce /1971/, Ltd , Aero Div , Filton, England) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-830* 14 p 8 refs

Performance improvements and environmental considerations associated with intercontinental supersonic transport aircraft are discussed, with emphasis given to noise reduction features Present capacities of variable cycle engines, which can be throttled to achieve acceptable takeoff and flyover noise levels, are described, and further innovations to reduce noise are suggested These include increasing engine mass flow to decrease jet velocity at a given thrust level, development of silencing devices (e g an ejector to mix extra mass flow into exhaust before it leaves the engine, thus reducing its velocity and noise), and improvements in takeoff aerodynamics Cost, thrust, drag, and weight penalties are taken into account in considering airframe modifications, choice of inlet configurations and Mach cruise number, the merits of high bypass ratios, use of acoustic linings in turbojet exhaust, use of a dual exhaust stream with a nonconventional velocity profile, methods of increasing mass flow, turbine cooling, duct burning, and suppressor exhaust systems J M B

A77-41969 # **Advanced supersonic transport propulsion requirements** R W Hines (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11 13, 1977, AIAA Paper 77-831* 7 p 8 refs

One of the most promising propulsion systems (The Variable Stream Control Engine) for supersonic commercial transport application is reviewed The benefits of advanced propulsion technology, as

applied to the Variable Stream Control Engine, are presented on an overall systems basis showing the full impact on a supersonic transport airplane from an environmental, performance, and economic viewpoint The advanced propulsion program, required for the United States to maintain a competitive position in the future commercial airplane market, is also presented (Author)

A77-41970 # **Supersonic propulsion - 1970 to 1977** J N Krebs (General Electric Co , Aircraft Engine Group, Lynn, Mass) and R D Allan (General Electric Co , Aircraft Engine Group, Evendale, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-832* 7 p

In 1972 NASA initiated study programs to identify the required propulsion system and airplane technology necessary for an environmentally acceptable supersonic cruise vehicle The Advanced Supersonic Propulsion System Technology Studies at General Electric screened conventional turbojets, mixed flow and duct burning turbofans and variable cycle engines This resulted in the selection of a Variable Cycle Engine (VCE) concept that provides high airflow for low takeoff noise levels, using a co annular acoustic exhaust nozzle, and a cruise airflow matched to the airplane inlet flow schedule This VCE has been refined, and its mechanical design simplified to improve reliability and maintainability The propulsion system technology has improved to the point that definition of a second generation supersonic cruise aircraft propulsion system much improved from the 1971 GE4 turbojet is now possible (Author)

A77-41971 # **Technology status of jet noise suppression concepts for advanced supersonic transports** W T Rowe, E S Johnson, and R A McKinnon (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-833* 9 p

This paper presents one aircraft manufacturer's views on the technology status of three of the most promising exhaust nozzle designs meeting the noise constraints the coannular, the coannular with plug, and the retractable mechanical suppressor Each type is defined along with predicted operational characteristics Theoretical and test performance, for both thrust loss and noise suppression, are summarized Each of these three nozzles is combined with an appropriate engine, and is sized and integrated into a baseline Mach 2 2 supersonic transport to evaluate range performance The sensitivity of aircraft performance to changes in noise requirements is presented Also, the impact on performance for improved noise test results is summarized (Author)

A77-41972 # **Full authority digital electronic control /FADEC/ preliminary design overview for a variable cycle engine** B A Barclay (U S Naval Air Propulsion Test Center, Trenton, N J) and J C Richards (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-837* 10 p Contract No N00019-76 C-0423

A requirements analysis and a preliminary design of the control system for an advanced variable cycle engine has been conducted Through application of latest state-of-the-art electronics and complex control laws, the Full Authority Digital Electronic Control (FADEC) is shown to provide the capability necessary with significant advantage in life cycle cost, weight and reliability New techniques such as fault detection and compensation and hybrid electronic construction as well as advanced sensor, actuator and fuel system designs are employed to enhance the performance and reliability of the control system operating in the harsh engine environment (Author)

A77-41973 * # **Two-dimensional nozzle/airframe integration technology - An overview** G K Richey (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio), B L Berrier (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va), and J L Palcza (U S Naval Air Propulsion Test Center, Trenton, N J) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-839* 11 p 23 refs

The paper reviews the objectives and some of the accomplishments of a number of programs to develop nonaxisymmetric nozzle technology for future tactical aircraft applications Specific existing fighter aircraft model tests and preliminary studies are discussed which are designed to generate installed nozzle data, including the effects of thrust vectoring and reversal P T H

A77-41974 * # **Static performance of vectoring/reversing non-axisymmetric nozzles** C M Willard (McDonnell Aircraft Co , St Louis, Mo), F J Capone (NASA, Langley Research Center, Hampton, Va), M Konarski (General Electric Co , Cincinnati, Ohio), and H L Stevens (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-840* 13 p 8 refs

An experimental program sponsored by the Air Force Flight Dynamics Laboratory is currently in progress to determine the internal and installed performance characteristics of five different thrust vectoring/reversing non-axisymmetric nozzle concepts for tactical fighter aircraft applications Internal performance characteristics for the five non-axisymmetric nozzles and an advanced technology axisymmetric baseline nozzle were determined in static tests conducted in January 1977 at the NASA-Langley Research Center The non-axisymmetric nozzle models were tested at thrust deflection angles of up to 30 degrees from horizontal at throat areas associated with both dry and afterburning power In addition, dry power reverse thrust geometries were tested for three of the concepts The best designs demonstrated internal performance levels essentially equivalent to the baseline axisymmetric nozzle at unvectored conditions The best designs also gave minimum performance losses due to vectoring, and reverse thrust levels up to 50% of maximum dry power forward thrust The installed performance characteristics will be established based on wind tunnel testing to be conducted at Arnold Engineering Development Center in the fall of 1977 (Author)

A77-41975 # **Non-axisymmetric nozzle concepts for an F-111 test bed** D Bergman (General Dynamics Corp , Fort Worth, Tex), J L Mace (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio), and E B Thayer (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-841* 11 p 6 refs

The paper describes the objectives, plans, and accomplishments to date of a study to determine the capability of the F-111 to demonstrate two dimensional (nonaxisymmetric) nozzle technology, with emphasis on propulsion system design and modification Various types of two dimensional nozzles employing internal gas expansion and mixed gas expansion are being evaluated with regard to their effects on aircraft performance, i e , range, acceleration, and deceleration P T H

A77-41980 * # **Use of experimental separation limits in the theoretical design of V/STOL inlets** M A Boles (Indiana Institute of Technology, Fort Wayne, Ind) and N O Stockman (NASA, Lewis Research Center, Wind Tunnel and Flight Div , Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-878* 24 p 9 refs

Experimental data from several model inlets have been used to generate two parameters which are related to the limit of operation for inlet flow separation One parameter, called the diffusion ratio, is the ratio of the peak velocity on the inlet surface to the velocity at the diffuser exit and is related to the boundary-layer separation at low throat Mach numbers The other parameter, the peak Mach

number on the inlet surface, is related to the separation at high throat Mach numbers These parameters are easily calculated from potential flow solutions and thus can be used as a design tool in screening proposed inlet geometries Any of the geometric design variables can be analyzed by this technique, but, this paper is restricted to the consideration of the internal lip contraction ratio An illustrative example of an application to an inlet design study for a tilt nacelle VTOL airplane is presented The study will show what value of contraction ratio is required to meet the operating requirements yet allow the inlet to remain free of separation as indicated by the two separation parameters (Author)

A77-41981 # **An engineering approach to estimating propulsion contributions to system life cycle costs** F F Tolle (Boeing Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11 13, 1977, AIAA Paper 77-879* 8 p 7 refs

Propulsion systems contribute directly to fuel cost, and to engine acquisition and maintenance cost, their performance influences airframe weight and cost, and their reliability affects the numbers of systems needed to satisfy operational requirement These costs and their interactions are discussed Techniques relying primarily on engineering analysis are proposed to estimate the principle cost categories Acquisition cost estimates derive from an engine performance and weight estimating code, while maintenance costs are based on physics of failure, reliability theory and a maintenance simulation Applications to management of engine costs are outlined (Author)

A77-41983 # **Testing of propulsion system diagnostic equipment** T C Belrose (U S Army, Systems Concepts and Technology Div , St Louis, Mo) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-895* 8 p 9 refs

Judicious prior selection of diagnostic testing philosophy is juxtaposed to cut-and-try approaches, and preference is established for the former Several testing arrangements (in-flight engine condition monitoring system, automatic inspection diagnostic and prognostic system, flight data recording system, advanced diagnostic engine monitoring system, aircraft integrated data systems) adopted in the U S , UK, and West Germany are compared as to applicability, cost, and accuracy The amount of testing or proof needed prior to a decision of diagnostics, consistency of results from laboratory models to test cell work and actual aircraft tests, and cost control are viewed as important Field testing of a diagnostic testing approach as early as possible is recommended, with further logic refinements and final touches to be added in service R D V

A77-41984 # **New technology ATE in support of the YAH-64 advanced attack helicopter** D R Bartlett (RCA, Automated Systems Div , Burlington, Mass) and V F Cremonese (Hughes Helicopters, Culver City, Calif) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-896* 12 p

The U S Army advanced attack helicopter, YAH 64 is under development by Hughes Helicopters Avionic, air vehicle and mission subsystems of the YAH-64 present a broad spectrum of test requirements and will be supported at intermediate and depot levels using the Army's AN/USM 410 automated support system The AN/USM-410 is a new technology, general purpose ATE which uses its host computer to synthesize stimulus waveforms and analyze digital outputs from its sampled data measurement system Termed 'third-generation' ATE, the AN/USM-410 will be van-mounted for deployment at aviation intermediate level (Author)

A77-41985 # **Simulation of turbine engine operational loads** G M Mulenburg and J G Mitchell (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77 912* 10 p 8 refs

The Arnold Engineering Development Center (AEDC) has been working for four years on the definition and optimization of a new and unique test facility concept which will simulate flight maneuver loads on aircraft propulsion systems Contributions to the definition of test requirements have come from both the military and civil segments of the propulsion community This paper is intended as a progress report to interested parties and summarizes the planning and rationale which have led to the proposed facility performance and facility conceptual design The results of several Air Force and contractor studies are noted and the Turbine Engine Loads Simulator (TELS) is described (Author)

A77-41986 # **Engine design decisions impact aircraft life cycle costs** W Q Wagner (Teledyne CAE, Toledo, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-916* 9 p 11 refs Contract No F33657-75-C-0606

This paper discusses the concept of design to life cycle cost (DTLC) as applied to propulsion subsystems of military aircraft It describes the resources necessary for DTLC effort during various engine life cycles, emphasizing the need for engine oriented LCC models Two examples of DTLC applications are cited, a deployed engine component study and a concept phase selection task These results highlight the need for both early attention and 'front end loading' to reduce propulsion - subsystem-affected elements of aircraft life cycle cost (LCC) (Author)

A77-41989 # **Advanced design procedure for aircraft engine selection** J Eschweiler, F C Glaser, and R E Martens (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11 13, 1977, AIAA Paper 77-953* 10 p 7 refs

A systematic and economical program for engine and airframe selection for advanced fighter aircraft is discussed, with attention given to the interactions between performance requirements, life cycle cost, and effectiveness During initial concept formulation, performance and cost are used as criteria in design development, and a computer based technique is employed to select engine variables (airflow schedule parameters, overall pressure ratio, and turbine inlet temperature) which meet performance and cost specifications while also minimizing gross takeoff weight Life cycle cost, including development, investment and maintenance costs, is also analyzed, and a second computer program is used to determine the most cost effective design The available techniques for assessing engine production cost yield sufficiently accurate estimates, however, long range cost variations encountered in modifying turbine inlet temperature need to be lessened Finally, to determine effectiveness of the selected design, the engine duty cycle, simulations for usage definition, and the impact of mission and environmental changes on the life of components are studied J M B

A77-41990 # **Life considerations in the engine design process** R R Sellers and W F Zavatkay (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11 13, 1977, AIAA Paper 77 954* 4 p

Life criteria in the engine design process is composed of anticipated steady endurance and cyclic life requirements Actual usage often differs from the anticipated due to the changing mission priorities, tactics, and even system application The sensitivity of turbine airfoil life to changing utilization is illustrated Potential approaches to reduce engine sensitivity to more stringent usage than that anticipated during the design process are suggested (Author)

A77-41991 # **Simplified multi-mission exhaust nozzle system** D J Dusa and A McCardle (General Electric Co , Cincinnati,

Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-960* 6 p

For multi-mission aircraft applications, the exhaust nozzle operating conditions vary significantly during the mission In order to maintain high performance over the entire operating range of the aircraft the exhaust nozzle configuration becomes complex This complexity has a direct impact on weight, cost, and reliability Most current multi mission applications employ variable area convergent-divergent (C-D) nozzles to meet system requirements In the past, weight and performance have had the greatest influence on setting the exhaust nozzle design requirements However, cost has become a dominant factor in the procurement of weapon systems, therefore, a more balanced trade between life cycle cost, maintenance features, weight and performance is necessary in the selection process of exhaust systems A simplified variable area C-D exhaust nozzle system has been identified which addresses these factors This paper describes the design features of this simplified exhaust system and compares it with an existing exhaust system and other candidate simplified nozzles (Author)

A77-42000 # **The airjet distortion generator system - A new tool for aircraft turbine engine testing** B W Overall and R E Harper (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla , July 11-13, 1977, AIAA Paper 77-993* 9 p 6 refs

An airjet distortion generator system has been developed to produce steady-state total pressure distortion at the inlet of turbine engines The system employs a method of injecting controlled amounts of high-velocity secondary air counter to the primary airstream to effect a local total pressure decay Digital computer control provides an on-demand distortion pattern capability The AJDG system is described, and the pattern-generating logic is presented Operational characteristics, turbulence, cycle times, and distortion pattern fidelity are discussed An engine stability assessment with comparison of stability response to screens and airjet-produced inlet distortion is included (Author)

A77-42038 **The impact of the energy crisis on the demand for fuel efficiency - The case of general aviation** R B Archibald and W S Reece (U S Department of Labor, Bureau of Labor Statistics, Washington, D C) *Transportation Research,* vol 11, June 1977, p 161 165 17 refs

One of the most important questions accompanying the debate over energy policy is whether or not consumers will react to increased fuel prices by choosing more fuel efficient transportation modes This paper addresses this question by developing a theoretical rationale for the hypothesis that the energy crisis has induced an increase in the demand for fuel efficiency as a characteristic of aircraft and empirically tests this hypothesis with data from the U S general aviation market (Author)

A77-42039 **Doppler m l s - The landing guidance system for the future** J G Flounders (Plessey Co , Ltd , Weybridge, Surrey, England) *Electronics and Power,* vol 23, July 1977, p 556-558

The Doppler microwave landing system (D m l s) submitted by Great Britain to the International Civil Aviation Organization in response to their requirement for a new, nonvisual landing-guidance system is discussed Following a brief outline of the principle of operation of the D m l s , its advantages are examined The equipment is compact, can be quickly installed, and does not adversely affect the performance of existing instrument landing systems Its commutation is derived from the same crystal that controls the transmitter offset frequency, so that constancy of velocity is assured without necessitating critical adjustments in the field Since the D m l s technique uses sequential radiation of a uniform phase and amplitude along the elements of a linear array, there is great flexibility in the manner in which signals are processed The system can be adapted to handle a 360 deg azimuth signal with relative ease C K D

A77-42044 **The Analytical Maintenance ,Program - No more 'maintenance as usual'** C T Faulders, Jr (U S Navy, Naval Air Systems Command, Washington, D C) *Defense Management Journal,* vol 13, July 1977, p 15 21

The Analytical Maintenance Program adopted by the U S Naval Air Systems Command is described Included in the program are provisions for establishment of maintenance requirements and schedules for each type of aircraft, assignment of maintenance tasks to various levels of operation, and a monitor and correction capability to insure effectiveness A detailed division of maintenance responsibilities is given, and decreases in the frequency of depot maintenance and the number of depot maintenance tasks, as well as in the frequency and number of organizational maintenance interventions, are reported Suggestions for implementing analytical maintenance programs, including training of working engineers, coping with the shift from new to in-service aircraft maintenance, making the system cost effective, and emphasizing accountability of the various task forces, are also considered J M B

A77-42049 **Airport planning and economics - Some changing perspectives** J R Goodwin (FAA, Washington, D C) *Society of Automotive Engineers, Air Transportation Meeting, Washington, D C , May 10-12, 1977, Paper 770581* 6 p

Airport planners need to consider the effects of economic fluctuations on the accuracy of long-range projections of air traffic, and should plan adequate lead times for improving capacity in handling aircraft, passengers, baggage, and surface transport The FAA's Upgraded Third Generation Air Traffic Control System is discussed, and increased capacities attainable through its wake-vortex avoidance system, metering and spacing capability, and discrete address beacon system are mentioned Other problems confronting airport planners are considered, including the integration of public transport into airport transport systems, effects of environmental accountability legislation on airport development, and methods for choosing or arranging compromises between central, linear, or transporter design of airports J M B

A77-42050 **Wake turbulence detection and economic impact of proposed improvements** W D Wood and I G McWilliams (U S Department of Transportation, Transportation Systems Center, Cambridge, Mass) *Society of Automotive Engineers, Air Transportation Meeting, Washington D C , May 10-12, 1977, Paper 770583* 8 p 5 refs

Increased separations of aircraft following heavy jets, which have been mandated because of the threat posed by aircraft trailing wake vortices, have aggravated the problem of air traffic delays at some of the busier airports An extensive vortex measurement program at three major airports has provided the data base for the design of a Vortex Advisory System which will permit reduction of the vortex imposed separations under certain measurable wind conditions This system which promises to effect an appreciable reduction in traffic delay is currently undergoing testing at Chicago's O'Hare International Airport (Author)

A77-42052 # **Investigations on axial flow fan impellers with forward swept blades** K P Mohammed (Regional Engineering College, Calicut, India) and D P Raj (Indian Institute of Technology, Madras, India) *American Society of Mechanical Engineers, Applied Mechanics/Bioengineering/Fluids Engineering Summer Conference, Yale University, New Haven, Conn , June 15-17, 1977, Paper 77-FE-1* 7 p 6 refs Members, $1 50, nonmembers, $3 00

The forward swept blades are expected to reduce the accumulation of boundary layer fluid resulting from the effect of centrifugal forces, near the tip region of an axial flow impeller blade An experimental study was carried out on three sets of impeller blades with different forward sweep, keeping the blade element profile geometry the same It is seen from the comparison of the overall performance of the impellers with swept and unswept blades that the swept blades operate more efficiently than the unswept blades, especially at low volume flows Moreover, the blade element stall is delayed, if the blades are swept forward An analysis of the

experimental results shows that forward sweep effectively reduces the deteriorating effects of the radially outward boundary layer flow in the tip region (Author)

A77-42211 **Tracer decoder - A receiver for radio navigation relay systems** J D Last and E W Roberts (North Wales, University College, Bangor, Wales) *Radio and Electronic Engineer*, vol 47, June 1977, p 261-268 6 refs

Tracer is a retransmission system for radio navigation aids which uses a voice frequency communications channel to enable objects to be located and tracked remotely Its applications are to marine surveying, monitoring of seamarks and automatic vehicle location The paper describes a unit which accepts the signal transmitted over a link from a Tracer converter and extracts and displays the mobile's position Its novel features are its ability to indicate position after only one complete sequence of the navigation transmissions, permitting rapid multiplexing of many mobiles, and a frequency correction arrangement which allows the unit to process signals having frequency errors which would normally be unacceptable in high precision systems Both these techniques are finding applications in radio navigation receiving equipment (Author)

A77-42219 # **Methods and problems in practical aerodynamics /4th revised and enlarged edition/ (Metody i zadachi prakticheskoi aerodinamiki /4th revised and enlarged edition/)** D S Gorshenin and A K Martynov Moscow, Izdatel'stvo Mashinostroenie, 1977 240 p 15 refs In Russian

A collection of article outlining basic laboratory methods used in aerodynamics research is presented The theoretical basis of these methods is described, and techniques used in analyzing experimental data are presented Some individual topics include determination of shock wave velocity, investigation of the effects of the wing and fuselage designs on the aerodynamic characteristics of an air craft at subsonic speeds, determination of the pressure distribution on bodies in subsonic or supersonic flows, and calibration of air pressure sensors and micromanometers C K D

A77-42220 # **Design of wind measuring instruments (Proektirovanie vetroizmeritel'nykh priborov)** N G Protopopov Leningrad, Gidrometeoizdat, 1976 192 p 100 refs In Russian

The book is concerned with the design of wind measuring devices based on the use of rotating wind sensing elements The study of the design of the instruments is prefaced by a review of the basic characteristics of the wind field and methods of averaging the wind velocity The static and dynamic characteristics and the differential equations of rotating cup and screw anemometers and of wind vanes are studied This serves as the basis for recommendations on the design of sensors and anemometers Attention is focused on the analysis of both instrumental and methodological errors in measurements of wind parameters P T H

A77-42223 **The Falcon-50 dossier (Le dossier du Falcon-50)** J Morisset *Air et Cosmos*, vol 15, July 16, 1977, p 21 25 In French

Design features of the eight-passenger Falcon-50 are compared with those of the other aircraft in its class- notably Jetstar-II and Gulfstream-II Special attention is given to the design of the supercritical swept wing The aircraft, powered by three Garrett TFE 731-3 turbo-jet engines, will have a zero fuel weight of 10,250 kg (19,845 lb) and a range of 5745 km Certification is expected in 1978, with first deliveries in 1979 C K D

A77-42238 # **Jet engines for high supersonic flight speeds - Theoretical principles (Reaktivnye dvigateli dlia bol'shikh sverkhzvukovykh skorostei poleta - Osnovy teorii)** R I Kurziner Moscow, Izdatel'stvo Mashinostroenie, 1977 213 p 50 refs In Russian

The thermodynamic basis of jet engines for aircraft operating at high supersonic and hypersonic speeds is discussed Combination turbojet-ramjet engines are classified on the basis of a morphological analysis The cycles of different types of combination engines are described, and a method for calculating their parameters and characteristics is presented Guidelines for the selection of optimal parameters for hypersonic ramjet and combination turbojet-ramjet engines are given C K D

A77-42544 **The reduction of interference from large reflecting surfaces** E V Jull (British Columbia, University, Vancouver, Canada) and G R Ebbeson (Defence Research Establishment Pacific, Esquimalt, British Columbia, Canada) *IEEE Transactions on Antennas and Propagation*, vol AP 25, July 1977, p 565-570 11 refs Research supported by the Ministry of Transport of Canada

The use of corrugated surfaces to reduce interfering reflections from buildings, in particular instrument landing system (ILS) interference from hangars near airport runways, is proposed A numerical examination is made of the infinite comb grating under H-polarized plane-wave illumination with grating spacing of half a wavelength to a wavelength As with all periodic surfaces investigated, specular reflection can be completely converted to backscatter in the direction of incidence from the surface normal when that direction equals the inverse sine of the wavelength divided by twice the grating spacing and the corrugation depth is properly chosen Model measurements at 35 GHz on finned surfaces of finite size under nonplane-wave illumination verify that the surfaces behave essentially as predicted for the infinite comb The surfaces retain this behavior for frequencies within the ILS range and angles of oblique incidence less than about 10 deg Practical considerations in implementing these ideas are mentioned (Author)

A77-42562 # **Our next commercial transport Collisions of interest** H A Kimbriel (Colin, Hochstin Co , New York, N Y) *Astronautics and Aeronautics*, vol 15, July Aug 1977, p 48 53

Development of a new generation of 180-200 seat aircraft to replace obsolescent transcontinental and medium range transport craft during the era 1979 to 1985 is discussed Competing candidates, including new and derivative designs, are described, and estimates for cost of launching the new generation are formulated Engine/total aircraft price ratios, as well as time needed to obtain a return on investment, are considered Current routes of air carriers are characterized, and the necessary range flexibility for the new aircraft is specified Principal motivations for development of the new generation include elimination of craft that waste fuel and require high levels of maintenance, and accommodation of growth through procurement of new aircraft The effect of various projected carrier growth rates on the break even points of manufacturers and airlines is projected Financing of the new generation of craft is also considered, with emphasis on the role of government incentives, which may provide as much as 35% of investment costs J M B

A77-42564 **Measurement and prediction of structural and biodynamic crash-impact response, Proceedings of the Winter Annual Meeting, New York, N Y , December 5-10, 1976** Meeting sponsored by the American Society of Mechanical Engineers Edited by K J Saczalski (U S Navy, Office of Naval Research, Arlington, Va) and W D Pilkey (Virginia, University, Charlottesville, Va) New York, American Society of Mechanical Engineers, 1976 169 p Members, $10 00, nonmembers, $20

Attention is given to the analysis of general aviation aircraft structural crashworthiness, computer programs for the prediction of crash response and its experimental validation, a limiting performance technique for determining the optimum structural crash characteristics of vehicles, and the numerical prediction of head/helmut response Also considered are the numerical prediction of head/neck response to short-impact, head injury criteria and evaluation of protective head gear, and the measurement and prediction of spine, thorax and whole body occupant response B J

A77-42566 **A method of analysis for general aviation airplane structural crashworthiness** G Wittlin and M A Gamon (Lockheed California Co , Burbank, Calif) In Measurement and prediction of structural and biodynamic crash-impact response, Proceedings of the Winter Annual Meeting, New York, N Y , December 5 10, 1976 New York, American

Society of Mechanical Engineers, 1976, p. 63-81 9 refs US Department of Transportation Contract No FA75WA-3707

A method of analysis is presented for use in assessing general aviation airplane structural crashworthiness The method, based on a practical engineering approach to modeling vehicle structure, incorporating simplified mathematical representations as a means of determining crashworthiness capability, was developed and verified with the use of a full-scale helicopter crash test. This simplified and approximate approach is embodied in digital computer program KRASH Further substantiation of program KRASH's versatility and practicality in assessing vehicle structural crashworthiness for a wide range of structures was obtained in the analysis of an actual crash involving two rail cars In a current FAA-sponsored program KRASH has been modified for use in general aviation airplane structural crashworthiness preliminary design A description of the program modifications, an assessment of KRASH's capability to analyze general aviation airplane crashes, and an outline of the FAA-sponsored general aviation crashworthiness program are contained in this paper (Author)

A77-42758 * # **Flight data processing with the F-8 adaptive algorithm** G Hartmann, G Stein (Honeywell, Inc , Minneapolis, Minn), and K Petersen (NASA, Flight Research Center, Edwards, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 53-60 9 refs (AIAA 77-1042)

An explicit adaptive control algorithm based on maximum likelihood estimation of parameters has been designed for NASA's DFBW F-8 aircraft To avoid iterative calculations, the algorithm uses parallel channels of Kalman filters operating at fixed locations in parameter space This algorithm has been implemented in NASA/DFRC's Remotely Augmented Vehicle (RAV) facility Real-time sensor outputs (rate gyro, accelerometer and surface position) are telemetered to a ground computer which sends new gain values to an on-board system Ground test data and flight records were used to establish design values of noise statistics and to verify the ground-based adaptive software The software and its performance evaluation based on flight data are described (Author)

A77-42759 # **Command augmentation control laws for maneuvering aircraft.** R F Stengel, J R Broussard, and P W Berry (Analytic Sciences Corp , Reading, Mass) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 61-72 8 refs Contract No N0014-75-C-0432 (AIAA 77-1044)

Highly maneuverable aircraft must achieve good handling qualities for a wide range of flight conditions, and their flight control systems can assist in meeting this objective This paper presents an approach to designing command augmentation systems (CAS) that provide precision response to pilot commands and augment stability within a wide maneuvering envelope Using coupled dynamic models of the aircraft and modern control theory, equivalent 'Type 0' and 'Type 1' proportional integral control laws are formulated, and closed-loop response is demonstrated The CAS structures presented here afford a high degree of departure-resistance, as well as improved response for advanced command modes (Author)

A77-42767 * # **The terminal area automated path generation problem** C-C Hsin (Mitre Corp , McLean, Va) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 128-136 13 refs Navy NASA-supported research (AIAA 77-1055)

The automated terminal area path generation problem in the advanced Air Traffic Control System (ATC), has been studied Definitions, input, output and the interrelationships with other ATC functions have been discussed Alternatives in modeling the problem have been identified Problem formulations and solution techniques are presented In particular, the solution of a minimum effort path stretching problem (path generation on a given schedule) has been carried out using the Newton-Raphson trajectory optimization method Discussions are presented on the effect of different delivery time, aircraft entry position, initial guess on the boundary conditions, etc Recommendations are made on real-world implementations (Author)

A77-42772 * # **Active flutter control using generalized unsteady aerodynamic theory** J W Edwards (NASA, Flight Research Center, Edwards, Calif), J V Breakwell, and A E Bryson, Jr (Stanford University, Stanford, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 172-185 19 refs

This paper describes the application of generalized unsteady aerodynamic theory to the problem of active flutter control The controllability of flutter modes is investigated It is shown that the response of aeroelastic systems is composed of a portion due to a rational transform and a portion due to a nonrational transform The oscillatory response characteristic of flutter is due to the rational portion, and a theorem is given concerning the construction of a linear, finite-dimensional model of this portion of the system The resulting rational model is unique and does not require state augmentation Active flutter control designs using optimal regulator synthesis are presented (Author)

A77-42773 * # **Synthesis of active controls for flutter suppression on a flight research wing** I Abel, B Perry, III, and H N Murrow (NASA, Langley Research Center, Hampton, Va) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 186-194 13 refs Contract No NAS1-13541 (AIAA 77-1062)

This paper describes some activities associated with the preliminary design of an active control system for flutter suppression capable of demonstrating a 20% increase in flutter velocity Results from two control system synthesis techniques are given One technique uses classical control theory, and the other uses an 'aerodynamic energy method' where control surface rates or displacements are minimized Analytical methods used to synthesize the control systems and evaluate their performance are described Some aspects of a program for flight testing the active control system are also given This program, called DAST (Drones for Aerodynamics and Structural Testing), employs modified drone-type vehicles for flight assessments and validation testing (Author)

A77-42780 # **The effects of relative instrument orientation upon gravity gradiometer system performance** E J Pelka (Lockheed Missiles and Space Co , Sunnyvale, Calif) and D B DeBra (Stanford University, Stanford, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 247-255 9 refs USAF supported research (AIAA 77-1070)

Optimum relative orientations of three sensors (moving base gravity gradiometers) comprising a gradient measurement system are defined Two of the sensors are spinners, producing gradient measurements at double their spin frequency, the third is a torsion balance instrument measuring components of the gradient tensor at zero frequency Three spinning gravity gradiometers are shown to provide a minimum-error gradient estimate when the sensor spin axes form an orthogonal triad A fourth gradiometer would add redundancy and prevent mission loss due to failure of one instrument An optimum umbrella configuration for a four sensor system is described R D V

A77-42781 * # **Spacecraft flight control with the new phase space control law and optimal linear jet select** E V Bergmann, S R Croopnick, J J Turkovich, and C C Work (Charles Stark Draper Laboratory, Inc , Cambridge, Mass) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers

New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 256-266 9 refs Contract No NAS9-13809 (AIAA 77 1071)

An autopilot designed for rotation and translation control of a rigid spacecraft is described The autopilot uses reaction control jets as control effectors and incorporates a six-dimensional phase space control law as well as a linear programming algorithm for jet selection The interaction of the control law and jet selection was investigated and a recommended configuration proposed By means of a simulation procedure the new autopilot was compared with an existing system and was found to be superior in terms of core memory, central processing unit time, firings, and propellant consumption But it is thought that the cycle time required to perform the jet selection computations might render the new autopilot unsuitable for existing flight computer applications, without modifications The new autopilot is capable of maintaining attitude control in the presence of a large number of jet failures M L

A77-42784 * # **The aircraft energy efficiency active controls technology program.** R V Hood, Jr (NASA, Langley Research Center, Hampton, Va) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 279-285 9 refs (AIAA 77-1076)

Broad outlines of the NASA Aircraft Energy Efficiency Program for expediting the application of active controls technology to civil transport aircraft are presented Advances in propulsion and airframe technology to cut down on fuel consumption and fuel costs, a program for an energy efficient transport, and integrated analysis and design technology in aerodynamics, structures, and active controls are envisaged Fault-tolerant computer systems and fault-tolerant flight control system architectures are under study Contracts with leading manufacturers for research and development work on wing-tip extensions and winglets for the B-747, a wing load alleviation system, elastic mode suppression, maneuver-load control, and gust alleviation are mentioned R D V

A77-42785 # ***Flight control system of an advanced air superiority fighter*** C J Yi (Honeywell, Inc , Arlington, Va), R L Heimbold (Lockheed California Co , Burbank, Calif), R J Miller (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn), and E Rachovitsky (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 286-295 (AIAA 77 1079)

The synthesis of a flight control system for an advanced air superiority fighter equipped with jet flaps, and its flight simulator performance is reported in this paper Several control modes are designed to enhance performance in maneuvering flight Both sustained turn and maximum turn rate load factors are improved by deflecting the jet and maneuver flaps as a function of angle-of-attack The aircraft can attain more than one g deceleration by the proper deflection of jet and maneuver flaps Feasibility of the control modes was verified by a fixed-base pilot-in-the-loop simulation (Author)

A77-42786 # **Load factor response of digitally controlled aircraft** D A Keskar and G L Slater (Cincinnati, University, Cincinnati, Ohio) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 296-305 11 refs (AIAA 77-1080)

The effect of sampling rate on the stochastic response of a linear aircraft model and on the interaction of sampling rate selection with neglected dynamic modes in the control model is examined Control laws are computed from optimal discrete regulator theory using both the rigid body and structural mode assumption The conclusions are that for the aircraft under consideration the rigid body feedback laws are adequate to insure good system response at fast sampling rates However, at slow sampling rates less than about 10 cycles per second the rigid body feedback often yields an unstable closed loop system whereas an accurate control model can maintain good control characteristics (Author)

A77-42793 # **Adaptive fading memory filtering in a decentralized airborne tracking system** J M Nash (Orincon Corp , La Jolla, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 356-365 6 refs USAF supported research (AIAA 77-1088)

A computationally distributed estimation scheme is developed to provide accurate tracking of high velocity, maneuverable targets in a defensive air to air fire control application Widely separated sensors on a flexible aircraft are optimally integrated in a large computational network employing multiple Kalman filters De centralized performance of track updating and prediction is employed in conjunction with an integrated technique for optimally accommodating sensor misalignments Tracking system performance analyses are presented Data processing rates, sensor accuracies, misalignment effects, and adaptive fading memory filtering are studied parametrically in a set of scenarios for an advanced application (Author)

A77-42797 # **A two-level adaptive controller for application to flight control systems** P N Nikiforuk, M M Gupta (Saskatchewan, University, Saskatoon, Canada), and H Ohta In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 401 407 15 refs National Research Council of Canada Grants No A-5625, No A 1080 (AIAA 77-1092)

A design of a two-level adaptive flight controller for a STOL aircraft with unknown dynamics is described in this paper This approach appears to overcome some of the limitations that are inherent in the design of linear optimal and conventional adaptive controllers In particular, an adaptive observer with an exponential rate of convergence is developed for modeling the unknown plant dynamics Control at the first level is provided by an updated optimal controller, while that at the second level is provided by an error servo Some examples of simulation studies that were carried out for the pitch attitude control under two different conditions are given (Author)

A77-42798 * # **Information processing requirements for on-board monitoring of automatic landing** J A Sorensen and J S Karmarkar (Systems Control, Inc , Palo Alto, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 408 418 10 refs Contract No NAS1-13490 (AIAA 77 1093)

A systematic procedure is presented for determining the information processing requirements for on board monitoring of automatic landing systems The monitoring system detects landing anomalies through use of appropriate statistical tests The time to-correct aircraft perturbations is determined from covariance analyses using a sequence of suitable aircraft/autoland/pilot models The covariance results are used to establish landing safety and a fault recovery operating envelope via an event outcome tree This procedure is demonstrated with examples using the NASA Terminal Configured Vehicle (B-737 aircraft) The procedure can also be used to define decision height, assess monitoring implementation requirements, and evaluate alternate autoland configurations (Author)

A77-42804 # **A flight control system using the DAIS architecture** A P DeThomas and G M Lacy (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 460-466 5 refs (AIAA 77 1100)

A simulation of a flight control system using hardware and concepts of the Digital Avionics Information System (DAIS) to integrate flight control, navigation, communication and other subsys-

tems, is described Some of the modules included in the integration are computers, multiplex data bus hardware, controls and displays, and software The DAIS architecture is partitioned into traditional avionics functions having a dual-channel multiplex system with standby redundancy, and a flight control system which has quad-redundancy An asynchronous interface allows data transfer between systems Special-purpose interfaces and data handling equipment, such as a Digital Hardware Voter Monitor to select the lower median of input signals in failure detection, are considered, an advisory/caution panel to give the pilot access to flight control failure information is discussed Computer languages used, and the effects of the multiplex system on flight control system response are also assessed J M B

A77-42805 * # Application of microelectronic technology to general aviation flight control J A Sorensen, M G Tashker (Stanford Research Institute, Menlo Park, Calif), and D B DeBra (Stanford University, Stanford, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 467 474 9 refs Contracts No NAS2-9083, No NAS2-9382 (AIAA 77-1102)

This paper presents several different methods that can be used to determine the aircraft orientation (attitude) without direct measurement The methods combine state estimation techniques with measurements from solid state pressure sensors, accelerometers, and magnetometers to determine the aircraft state The paper demonstrates how the estimation algorithms were validated and compared using flight test data, and it presents results of performance sensitivity analyses of sensor error, modeling inaccuracies, and wind disturbance effects on the attitude estimation errors If implemented, the methods presented could make it possible to eliminate directional and vertical gyros and to change from many isolated sensors to an integrated, small, reliable sensing package for determining the aircraft state (Author)

A77-42806 # Automatic rollout control of the 747 airplane C J Cotter and G C Cohen (Boeing Co , Seattle, Wash) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 483-491 (AIAA 77-1104)

An automatic rollout control system has been developed for the Boeing 747 airplane The rollout control system consists of three independent channels which control the rudders and nose gear steering mechanism The action of the rudders and nose gear steering provides control of the lateral path of the airplane along the runway from touchdown to a safe taxi speed With the addition of this system the capability of the airplane will eventually be extended to operate in Cat IIIb conditions (less than 700 feet RVR, but not less than 150 feet RVR) This paper describes the system requirements, development of the control law, simulator results and flight testing of the rollout control system (Author)

A77-42808 * # Redundant integrated flight control/navigation inertial sensor complex R E Ebner and J G Mark (Litton Systems, Inc , Woodland Hills, Calif) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 503-511 Contract No NAS1-13847 (AIAA 77 1109)

A redundant strapdown inertial navigation system for integrated flight control/navigation use is described Design of the system, which consists of four tuned-gimbal gyros, eight accelerometers, and four processors, is discussed, with emphasis on its compact configuration (13 by 13 by 14 in), based on symmetry properties of an octahedron A matrix operator for least-squares combination of data from an arbitrary number of two-degree-of freedom gyros is derived, and general parity equations for error analysis are given Self-contained detection and isolation of a two-axis gyro failure is considered, system failure probability, which depends on component failure rates and self-correction capacities, is analyzed Test data, including typical parity equation responses during motion and simulated gyro and accelerometer failures, are also presented J M B

A77-42812 # Some analytical control laws for the design of desirable lateral handling qualities using the model matching method H Ohta, P N Nikiforuk, and M M Gupta (Saskatchewan, University, Saskatoon, Canada) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 548-557 16 refs National Research Council of Canada Grant No A-1080 (AIAA 77-1045)

In this paper two analytical designs are given for deriving desirable lateral handling qualities for an aircraft The transfer functions of the decoupled desirable model, which consists of the bank and sideslip angles to the aileron and rudder input, are selected according to the directional handling qualities criteria The control laws are derived using a model matching method and use the simplified dynamics of an aircraft Different types of aircraft with unacceptable handling qualities in the unaugmented condition are considered as examples The results of simulation studies which were performed to illustrate, as well as to compare the two control laws, are given (Author)

A77-42815 # A Schuler tuned vertical indicating system S J Monaco, D R Audley (U S Air Force Academy, Colorado Springs, Colo), and S Okubo (Okubo Instruments, Inc , Colorado Springs, Colo) In Guidance and Control Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers Conference Sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 213-222 6 refs (AIAA 77 1066)

A single-axis, gyroless, vertical indicating system has been designed and built which tracks the motion of the local gravity vector The objective of this effort was to demonstrate the feasibility of using this system in a low-cost, high reliability, medium-accuracy navigator This system is capable of sensing accelerations as small as 0001 g and uses only a compound pendulum and a rotor as its sensing elements both made with fused quartz suspensions Input linear accelerations normally causing the pendulum to rotate are sensed by the rotor and proportional signals are fed back to a torquing system to maintain the pendulum's vertical reference An output signal proportional to the tangential acceleration is also provided This paper discusses the design, development, and performance of this system in a research program for the Air Force Office of Scientific Research (Author)

A77-42816 # Cost effective design of an air transport flight control maintenance system E C Machacek and T E Foster (Rockwell International Corp , Collins Avionics Group, Cedar Rapids, Iowa) In Guidance and Control Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 475-482 5 refs (AIAA 77-1103)

The design philosophy used in developing MATE, a digital maintenance assessment system designed as an integral part of the triplex redundant, fail-operational, digital flight control evaluation system FCS-111X, is outlined The MATE system uses the same chassis, memory, power supply and functional elements as the basic autopilot computers It is based on a hybrid scheme incorporating both channelized and centralized structure Block diagrams of the system are provided, and specific cost/performance trade offs involved in the development of the system architecture and the choices between automatic and interactive testing and numeric or alphanumeric displays are discussed C K D

A77-43152 # Dive bombing simulation results using direct side force control modes R V Brulle (McDonnell Aircraft Co , St Louis, Mo) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers

New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 1-7 6 refs Contract No F33615 75-C-3070 (AIAA 77-1118)

A fixed base simulation study was conducted to investigate design criteria for direct side force control (DSFC) when used for dive bombing Three DSFC modes were simulated, a wings level turn and two lateral translation modes A fixed depressed reticle bomb sight, a modified fixed sight that was roll stabilized, and a future impact point (FIP) computing sight were used A control mode that rolled the aircraft about the bomb sight line of sight was implemented The DSFC wings level turn mode is the best for dive bombing No longitudinal coupling should exist when using DSFC, pilots can tolerate a positive roll coupling A lateral acceleration of about one g should be available for combat dive bombing using DSFC (Author)

A77-43153 # **Investigation of the vulnerability of powered-lift STOL's to wind shear** R H Hoh (Systems Technology, Inc , Hawthorne, Calif) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 8-13 10 refs (AIAA 77-1120)

The effect of wind shear on powered-lift STOL airplanes in the landing approach configuration was investigated via analysis and piloted moving-base simulation Starting with basic performance characteristics which were representative of an externally blown flap (EBF) or upper surface blowing (USB) STOL, several generic SCAS combinations were derived and tested These included augmentation systems which required frontside and backside piloting techniques A non-powered-lift STOL concept (De Havilland DHC-6 Twin Otter) was also tested as a basis of comparison for evaluation of accident potential Powered-lift airplanes were found to be inherently more vulnerable to horizontal wind shear than the non-powered-lift STOL (Author)

A77-43154 # **Flight test of stick force stability in attitude-stabilized aircraft** H A Mooij and M F C van Gool (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 14-19 12 refs (AIAA 77-1121)

Artificially generated positive stick force stability (PSFS) for control configured vehicle (CCV) systems with longitudinal flight control based on pitch-rate-command/attitude-hold (PRC/AH) is investigated It is found that PSFS reduces airspeed deviations from the reference speed at the cost of increased glide path deviations and increased pilot effort Airspeed deviation was reduced without a significant degradation penalty in glide path tracking and pilot effort (compared to neutral stick force stability) only at relatively modest PSFS levels Pitch rate per unit airspeed deviation is viewed as a better parameter than stick force per unit airspeed deviation for indicating PRC/AH flight control system PSFS, since side-sticks with various force-deflection relationships will probably be the rule in fly-by-wire systems R D V

A77-43155 # **Equivalent system approaches to handling qualities analysis and design problems of augmented aircraft** J Hodgkinson and W J LaManna (McDonnell Aircraft Co , St Louis, Mo) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 20-29 13 refs (AIAA 77-1122)

The equivalent system approach takes mathematical models of aircraft with complex stability and control augmentation systems and reduces them to simple low order form. This allows flying qualities analysis, design and real-time simulation with direct reference to familiar unaugmented dynamics A frequency response match of the low order transfer function by a direct search method is shown to reduce longitudinal dynamics effectively, and extension to lateral-directional dynamics is demonstrated In terms of equivalent parameters augmentation cannot only modify numerator in addition to denominator characteristics, but can also add high frequency lag originating from control system components (Author)

A77-43156 * # **Determination of longitudinal aerodynamic derivatives from steady-state measurement of an aircraft** V Klein (George Washington University, Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 30-36 6 refs Grant No NsG-1161 (AIAA 77-1123)

A method for the estimation of aerodynamic derivatives from steady-state symmetric flight data is developed The derivatives considered are the longitudinal static stability and control derivatives, damping derivatives due to tail, and the derivatives expressing the speed effect on the lift and pitching moment coefficients The method is an extension of the well known theory of longitudinal static stability and control, and corresponding flight data interpretation Measured data is assumed in the form of trim curves and lift vs angle of attack The expressions for the derivative estimates are in the form of algebraic relationships containing known constants, and directly or indirectly measured quantities (Author)

A77-43157 * # **Simplified unsteady aerodynamic concepts, with application to parameter estimation** W R Wells (Wright State University, Dayton, Ohio) and M J Queijo (NASA, Langley Research Center, Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 39-45 7 refs Contract No NGR-36-004-061 (AIAA 77-1124)

A simplified aerodynamic force model based on the physical principle of Prandtl's lifting line theory and trailing vortex concept has been developed to account for unsteadiness in the aircraft dynamics The wake is assumed to be compressed to a single shed vortex element of appropriate strength moving downstream at a speed sufficient to approximate the Wagner function Results are presented illustrating the ability of the simplified theory to duplicate exact solutions in unsteady aerodynamics Further, consideration is given to the utility of the model in a parameter identification application (Author)

A77-43158 * # **Prediction of elastic-airplane lateral dynamics from rigid-body aerodynamics** R L Swaim (Purdue University, West Lafayette, Ind) and G H Staab In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 46-55 7 refs Grant No NsG-4003 (AIAA 77-1125)

Control-configured vehicle technology has increased the demand for detailed analysis of dynamic stability and control, handling and ride qualities, and control system dynamics at the early stages of preliminary design and development For these early analyses an approximate, but reasonably accurate, set of equations of motion for elastic airplanes is needed Such a formulation is developed for the lateral dynamics of elastic airplanes It makes use of rigid-body aerodynamic stability derivatives and the antisymmetric elastic mode shapes and frequencies in formulating the forces and moments due to elastic motion Verification of accuracy was made by comparison with B-1 airplane dynamics obtained by other methods Frequencies and damping ratios of the coupled modes agree acceptably well with four antisymmetric elastic modes included (Author)

A77-43159 * # **Prediction of jump phenomena in rotationally-coupled maneuvers of aircraft, including nonlinear aerodynamic effects** J W Young, A A Schy, and K G Johnson (NASA, Langley Research Center, Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 56-63 6 refs (AIAA 77-1126)

An analytical method has been developed for predicting critical

control inputs for which nonlinear rotational coupling may cause sudden jumps in aircraft response The analysis includes the effect of aerodynamics which are nonlinear in angle of attack The method involves the simultaneous solution of two polynomials in roll rate, whose coefficients are functions of angle of attack and the control inputs Results obtained using this procedure are compared with calculated time histories to verify the validity of the method for predicting jump-like instabilities (Author)

A77-43161 * # **A wind tunnel technique for determining stability derivatives from cable mounted aeroelastic models** R M Bennett, M G Farmer (NASA, Langley Research Center, Hampton, Va), R L Mohr, and W E Hall, Jr (Systems Control, Inc , Palo Alto, Calif) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 72-80 13 refs (AIAA 77-1128)

System identification techniques in common use for extracting stability derivatives from flight test data have been adapted for application to data obtained from aeroelastically-scaled flutter models flown in a wind tunnel on a cable mount system The concept has been applied with reasonable success to data from rigid models of a Space Shuttle Orbiter and a fighter tested in the NASA Langley transonic dynamics tunnel Further application of this technique should permit extraction of derivatives that include scaled flexibility effects, thereby obtaining additional information from the testing of expensive flutter models (Author)

A77-43163 # **Application of a computer program system to the analysis and design of supersonic aircraft** W A Sotomayer and T M Weeks (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 90-99 21 refs (AIAA 77-1131)

Methods for the preliminary analysis and design of supersonic aircraft intended for operation during the 1990 time period pose a problem for computational methods presently in use Many of these aircraft exhibit a high degree of configuration blending to achieve the required performance Using a computational system developed by Boeing and NASA a modeling technique was developed by Boeing and NASA to analyze highly blended aircraft configurations A method to calculate leading edge thrust for highly swept wings is also presented and applied For the aircraft configurations considered it was found that good overall agreement between test and theory can be obtained (Author)

A77-43164 * # **Further observations on maximum likelihood estimates of stability and control characteristics obtained from flight data** K W Iliff and R E Maine (NASA, Flight Research Center, Edwards, Calif) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 100-112 13 refs (AIAA 77 1133)

A maximum likelihood estimation method for flight test data is described Flight results based on 3000 maneuvers from 30 aircraft on the effect of resolution and sampling rate on the estimates, on understanding the discrepancies previously observed in the magnitude of the Cramer-Rao bounds, on the scale effects on the derivative estimates obtained from dynamic aircraft flight maneuvers, and on the analysis of lateral-directional maneuvers obtained in turbulence, are presented (Author)

A77-43165 # **Identification of aircraft stability and control derivatives in the presence of turbulence** K Yazawa (National Aerospace Laboratory, Tokyo, Japan) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 113-123 12 refs (AIAA 77 1134)

A study has been made of method of extracting aircraft stability and control parameters from flight data acquired in the atmospheric turbulence The effects of turbulence were evaluated by a Monte Carlo simulation in order to provide a statistical analysis of the accuracy of identification of the parameters Two methods of identification were evaluated The first was the output error method using the modified Newton Raphson technique The second was a filtering error method for reducing gust effects This method relates directly the output error method with the equation error method by filter gain K and it provides statistical information of the process and measurement noise The results from the Monte Carlo simulation showed that the parameters given by the output error method has large standard deviations due to the atmospheric turbulence The application of the filtering error method improved the estimation accuracy under the same turbulence conditions This method was applied for an actual flight data (Author)

A77-43166 * # **Maximum likelihood estimation of aerodynamic derivatives for an oblique wing aircraft from flight data.** R E Maine (NASA, Flight Research Center, Edwards, Calif) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 124 133 5 refs (AIAA 77 1135)

There are several practical problems in using current techniques on 5-degree-of-freedom equations to estimate the stability and control derivatives of oblique wing aircraft from flight data A technique has been developed to estimate these derivatives by separating the analysis of the longitudinal and lateral-directional motion without neglecting cross-coupling effects This technique was used on flight data from a remotely piloted oblique wing aircraft The results demonstrated that the relatively simple approach developed was adequate to obtain high quality estimates of the aerodynamic derivatives of such aircraft (Author)

A77-43167 # **Practical applications of parameter identification** D R Frei (Grumman Aerospace Corp , Bethpage, N J) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 134 147 11 refs (AIAA 77-1136)

A modified maximum-likelihood parameter-estimation technique was developed at Grumman and applied to the F-14 and the Shuttle Training Aircraft (STA) The algorithm operated in an interactive mode, providing for control of the number of active parameters and state equations, while the program was running Initial F 14 work was for trimmed level flight STA flight data were analyzed in both forward and reverse-thrust modes, providing reliable derivatives during flight development tests Lateral-directional derivatives were extracted from F-14 high angle of attack maneuvers, from 7 5 to 36 degrees Work done to date with this program employed a linear model, no data smoothing techniques, and normal stability and control flight test maneuvers The program provided a rapid and reliable method of determining aircraft stability and control derivatives in a flight test environment (Author)

A77-43174 * # **Recent ground-based and in flight simulator studies of low-speed handling characteristics of supersonic cruise transport aircraft** W D Grantham and L T Nguyen (NASA, Langley Research Center, Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 206 218 6 refs (AIAA 77-1144)

Several advanced arrow-wing concepts have evolved from NASA's Supersonic Cruise Aircraft Research (SCAR) Program Evaluations of the low-speed handling characteristics of these configurations have been conducted at Langley Research Center using a fixed base ground simulator with a visual landing scene A brief in flight simulation program was also conducted using Calspan's Total In Flight Simulator (TIFS) in order to provide (1) points of reference for interpretation of the ground simulator results, (2) data for control-system design tradeoffs, and (3) data on effects of

real world visual height cues and cockpit motion cues not available in the fixed base simulation The more significant results of these studies are presented (Author)

A77-43175 * # **A study of key features of random atmospheric disturbance models for the approach flight phase** R K Heffley (Systems Technology, Inc , Mountain View, Calif) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 219-228 10 refs Contract No NAS2-7926 (AIAA 77-1145)

An analysis and brief simulator experiment were performed to identify and classify important features of random turbulence for the landing approach flight phase The analysis of various wind models was carried out within the context of the longitudinal closed-loop pilot/vehicle system The analysis demonstrated the relative importance of atmospheric disturbance scale lengths, horizontal versus vertical gust components, decreasing altitude, and spectral forms of disturbances versus the pilot/vehicle system Among certain competing wind models, the analysis predicted no significant difference in pilot performance This was confirmed by a moving base simulator experiment which evaluated the two most extreme models A number of conclusions were reached attitude constrained equations do provide a simple but effective approach to describing the closed-loop pilot/vehicle At low altitudes the horizontal gust component dominates pilot/vehicle performance (Author)

A77-43176 # **An evaluation of vortical wake hazard separation distances for military aircraft** M W M Jenkins and R T Meyer (Lockheed Georgia Co , Marietta, Ga) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 229-238 22 refs USAF-sponsored research (AIAA 77 1146)

This study defines separation criteria for USAF aircraft during landing Existing theoretical methods and data were used herein and the results were conditioned by published flight test and pilot-in the loop simulation data The results are presented as a suggested Interim Advisory for USAF operational aircraft when flying in the terminal area (Author)

A77-43188 * # **Aerodynamic characteristics of supersonic fighter airplane configurations based on Soviet design concepts** M L Spearman, R H Fournier, and M Lamb (NASA, Langley Research Center, High-Speed Aerodynamics Div , Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 339-344 (AIAA 77-1162)

The aerodynamic, stability, and control characteristics of several supersonic fighter airplane concepts are examined The configurations, which are based on Soviet design concepts, include fixed-wing aircraft having delta wings, swept wings, and trapezoidal wings, and a variable wing-sweep aircraft Each concept employs aft tail controls The concepts vary from lightweight, single-engine, air superiority, point interceptor, or ground attack types to larger twin-engine interceptor and reconnaissance designs Analytical and experimental results indicate that careful application of the transonic or supersonic area rule can provide nearly optimum shaping for minimum drag for a specified Mach number requirement In addition, through the proper location of components and the exploitation of interference flow fields, the concepts provide linear pitching moment characteristics, high control effectiveness, and reasonably small variations in aerodynamic center location with a resulting high potential for maneuvering capability (Author)

A77-43191 # **Hi-fidelity airplane simulation model** H Yoshino (Boeing Commercial Airplane Co , Seattle, Wash) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 365-373 8 refs (AIAA 77-1166)

A three-degree-of-freedom airplane model with separate wing body and tail components is developed for use in real-time digital computer simulations A local kinematic angle of attack rate is defined for both the wing and the tail, these variables are combined at the airplane's center of gravity Thus, localized effects of wing wake and downwash, engine exhaust, wind, and structural elasticity can be assessed to obtain more accurate formulation of the dynamic derivatives (e g , lift, drag, pitching moment) of the various aero dynamic surfaces Simulations performed are found to yield very close correlation with data from flight test records Besides this increased accuracy in simulation, the model should give insight into basic design problems and allow more rigorous treatment of spatially-related effects J M B

A77-43192 # **Identification of aircraft aerodynamic characteristics at high angles of attack and sideslip using the estimation before modeling /EBM/ technique** S Ramachandran, H Schneider, J D Mason, and H L Stalford (Dynamics Research Corp , Wilmington, Mass) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 374 385 13 refs Navy supported research (AIAA 77-1169)

This paper presents the EBM technique for aircraft parameter identification in stall/poststall flight regime This method uses a unique two-step approach The first step is the model independent estimation of states and aerodynamic forces and moments using a nonlinear spline estimation method In the second step, the angles of attack and sideslip and control input space is divided into several small subspaces Data from all flights that fall within the chosen subspace is used in modeling the force and moment coefficients The state and control dependent model is obtained using Stepwise Multiple Linear Regression (SMLR) The technique is demonstrated for a light jet trainer aircraft (Author)

A77-43194 # **A new approach to model structure identification** P H Fiske and C F Price (Analytic Sciences Corp , Reading Mass) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8-10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics Inc , 1977, p 401-409 23 refs (AIAA 77-1171)

The purpose of model structure identification is to determine which model among a given class of models best represents a physical system of interest In this paper, a new technique for attacking this problem is developed using an extended Kalman filtering approach The details of the procedure are described and results are presented which indicate a significant improvement over classical least squares methods It is anticipated that this new approach will significantly improve the capability to identify dynamic airframe model structures from test data (Author)

A77-43196 * # **Recent research on aerodynamic characteristics of fighter configurations during spins** E L Anglin (NASA, Langley Research Center, Hampton, Va) In Atmospheric Flight Mechanics Conference, Hollywood, Fla , August 8 10, 1977, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 416 426 12 refs (AIAA 77-1163)

The NASA Langley Research Center is currently conducting a stall/spin research program to define fighter aerodynamics applicable during developed spins and to develop analytical methods to use such measured aerodynamics for theoretically calculating spin motions Some static, forced-oscillation and continuous rotation aerodynamic data have been measured for several current fighter models at developed spin angles of attack The paper discusses these aero dynamic data and illustrates both the extremely nonlinear depen dence of such data on several variables and the correlation that exists between the three types of measured aerodynamics The current analytical methods for using these aerodynamics to calculate spin

motions are discussed and correlated with experimentally obtained spins (Author)

A77-43197 # **Direct-force flight-path control - The new way to fly** J H Watson and J D McAllister (General Dynamics Corp , Fort Worth, Tex) *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Hollywood, Fla , Aug 8-10, 1977, Paper 77-1119* 9 p 6 refs

The decoupling of an aircraft's attitude from its flight path vector makes it possible to maximize tracking time and reduce the control problem from a second-order to a first-order task Direct force flight-path control opens up an entirely new group of concepts, some of which have been developed and recently flight tested The control modes have been evaluated and cataloged, identifying the most probable application of each Some flight-path modes lend themselves to enhancing manual operation while others are useful in automatic integrated fire/flight control systems Clearly, direct-force flight-path control is the new way to fly, offering improved manual flying qualities and more effective weapon delivery capabilities (Author)

A77-43198 * # **Load distribution on a close-coupled wing canard at transonic speeds** B B Gloss and K E Washburn (NASA, Langley Research Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Hollywood, Fla , Aug 8-10, 1977, Paper 77 1132* 10 p 15 refs

This paper reports on a wind tunnel test where load distributions were obtained at transonic speeds on both the canard and wing surfaces of a closely coupled wing-canard configuration The investigation included detailed component and configuration arrangement studies to provide insight into the various aerodynamic interference effects for the leading-edge vortex flow conditions encountered Data indicate that increasing the Mach number from 0 70 to 0 95 caused the wing leading edge vortex to burst over the wing when the wing was in the presence of the high canard For some of the outboard span locations, the leading-edge vortex reattachment streamline intersects the wing trailing edge inboard of these span locations, thus, the Kutta condition was not satisfied In general, the effect of adding a canard was to reduce the lift inboard and somewhat increase the lift outboard similar to the trends that would have been expected had the flow been attached (Author)

A77-43199 # **Design and flight test of a decoupled velocity control system for VTOL landing approach** J V Lebacqz (Calspan Corp , Buffalo, N Y) and R T N Chen (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Hollywood, Fla , Aug 8 10, 1977, Paper 77 1143* 9 p 14 refs Contract No N0019 73 C 0504

The design and flight evaluation of a control system aimed at augmenting and partially decoupling the longitudinal and vertical velocity responses of a VTOL airplane in descending decelerating landing approach is described A summary of the implicit model following optimal control design procedures is given, followed by a description of the system design using these techniques Flight test results for this control system in the form of pilot ratings and performance/work load measures, from an experiment which considered several types of control systems and display presentations, are then discussed (Author)

A77-43201 # **Development of an integrated fire/flight control system for a high-performance fighter aircraft** J H Watson and G J Komechak (General Dynamics Corp , Fort Worth, Tex) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Hollywood, Fla , Aug 8-10, 1977, Paper 77-1078* 6 p

The extremely difficult pilot task of accurately controlling gun fire and weapon delivery under severe dynamic fighter engagement conditions has led to the development of an automatic integrated fire/flight control system (IF/FCS) This development has been made possible through formulation of a comprehensive, real time digital simulation model that demonstrates the inter-relationship of the components of the system and permits pilot-in-the-loop development and evaluation A director fire control system is required along with coupled interface circuits to condition and shape the steering command signals to the aircraft's flight control system Simulation evaluations of the IF/FCS show great promise for significantly increasing fighter weapon-delivery capability (Author)

A77-43329 # **New aircraft airfoils I (Nowe profile lotnicze I)** Z Brodzki *Technika Lotnicza i Astronautyczna*, vol 32, June 1977, p 10 14 In Polish

The most recently developed supercritical airfoils for transonic aircraft, the new GA(W) series of airfoils for light general aviation, and new profiles developed for helicopter rotor blades are described and illustrated Relations between drag, lift, and Mach number are plotted for the airfoils Wind tunnel testing, use of cryogenic wind tunnels rounding of the airfoil tip, flaps down aerodynamic performance of supercritical airfoils, effect of Re on lift and on pressure distribution, and lift as a function of angle of attack or of drag are dealt with The performance of families of supercritical airfoils is compared Results are based on computer-aided airfoil design R D V

A77-43330 # **Runway length as a basic criterion in analyzing the development of classification of Polish technical civil airfields (Dlugosc drogi startowej jako podstawowe kryterium w analizie rozwoju klasyfikacji technicznych polskich lotnisk cywilnych)** B Rzeczynski *Technika Lotnicza i Astronautyczna*, vol 32, June 1977, p 22-24 13 refs In Polish

A77-43331 # **A review of methods enabling increased service lives of high-thermal-load turbojet propulsion plants (Przeglad metod umozliwiajacych zwiekszanie resursu wysoko obciazonych cieplnie zespolow silnikow turboodrzutowych)** J Borgon *Technika Lotnicza i Astronautyczna*, vol 32, June 1977, p 25-27 6 refs In Polish

A77-43332 # **Tilt rotor V/STOL aircraft technology** L Kingston and J DeTore (Bell Helicopter Textron, Fort Worth, Tex) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 14 p 41 refs

This paper summarizes current tilt rotor technology and discusses the operational concept of this class aircraft The basis for selecting the tilt rotor from a spectrum of V/STOL aircraft options spanning the subsonic speed range is presented The development of tilt rotor technology starting with the XV-3 Convertiplane program is reviewed resulting in a summary of the rationale behind the configuration of the XV-15 Descriptions of the XV-15 aircraft and its present program are included Future applications are discussed and the role of an operational demonstrator aircraft is identified Conclusions are presented concerning projected tilt rotor productivity, current tilt rotor technology status, and future steps (Author)

A77-43333 # **Energy aspects of VTOL aircraft in comparison with other air and ground vehicles** W Z Stepniewski *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 23 p 12 refs

VTOL and rotorcraft are compared to alternate forms of cargo/passenger transportation in terms of total flight time and total fuel needs in the aggregate, specific impulse, weight/equivalent drag ratio, weight/seat-available ratio, energy/passenger seat and energy/passenger-mile ratios, and load factors Ways of improving fuel use in flight and hover are surveyed, and the TH-100 tandem passenger helicopter concept is examined Indirect fuel and energy consumption (in manufacturing of vehicles, maintenance of ways/roads, repair) is taken into account in the comparisons Optimizations of energy consumption and direct operating cost are illustrated Advantages of rotorcraft in agriculture, police patrol, forestry, rescue, and oil rig support are noted, but attention is drawn to the

trend of oil-rig location further offshore at distances where helicopter effectiveness and reliability diminish R D V

A77-43334 # **Rotor ice protection systems** D R Shepherd (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 20 p 5 refs

Practical experience with tests of unprotected and protected rotor systems under natural icing conditions is taken into account in a review of the operating principles of cyclic rotor ice protection systems A noncritical region of the icing envelope within which unprotected rotor systems would be safe subject to flight precautions and limitations, and positive ice protection systems could allow relaxed flight restrictions, is identified Testing results based on spray rig tests are found inadequate R D V

A77-43335 # **High-speed helicopter impulsive noise** C R Vause, F H Schmitz, and D A Boxwell (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 13 p 13 refs

Forward flight impulsive noise data from a 1/7 scale UH-1H model rotor have been gathered in an acoustically treated wind tunnel and are compared with full-scale acoustic flight-test data for the same helicopter Good agreement between model and full-scale waveforms and peak pressure amplitudes is noted when key performance parameters are matched and the data are acoustically scaled In-plane acoustic-radiation characteristics of the model data are presented for variations in thrust, advance ratio, tip-path-plane angle, and advancing-tip Mach number The acoustic waveform exhibits changes in character as advancing-tip Mach number is increased, becoming almost discontinuous at high advancing-tip Mach numbers This step increase in acoustic pressure correlates with schlieren photographs of a periodic pressure wave which radiates from the advancing rotor blade to the acoustic far field (Author)

A77-43336 # **Dynamics of a small helicopter with a high capacity rescue hoist.** H Weiss and J Stoppel (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 15 p

It is found that in spite of the relatively low gross weight (2300 kg), the BO 105 helicopter with its hingeless rotor system is able to operate a rescue hoist of 2 m eccentricity and a cable load of 270 kg Using a simple isolator, consisting of a very soft spring without an additional damping device, there are theoretically no limitations on cable length The existing limitation on cable length (30 m) is imposed by practical considerations Theoretical studies and extensive flight tests have proved that there is no danger of self-excited oscillations in the entire operating range B J

A77-43337 # **Trailing vortex wake structure** R G Sampson (Royal Military College of Science, Shrivenham, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 13 p 11 refs

The wake trailed by a half-wing mounted in an open-jet wind tunnel has been studied over a transverse plane five chords downstream Vorticity contours show a well defined tip vortex, together with a diffuse vortex sheet which contains a significant portion of the circulation Calculations of the roll-up of a sheet of line vortices is shown to represent the shape of the experimental vorticity contours, and the tip vortex strength, very well In addition, the velocity distribution within the tip vortex is shown to compare well with a logarithmic circulation distribution for a turbulent line vortex (Author)

A77-43338 # **Effects of the airfoil choice on rotor aerodynamic behaviour in forward flight** J Renaud and F Nibelle (Societe Nationale Industrielle Aerospatiale, Marignane, Bouches du Rhône, France) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 13 p 40 refs

A description is presented of the capabilities and limitations of the computational methods currently used in a French aerospace company for the study of the aerodynamic characteristics of airfoils and rotors The aerodynamic field of the rotor is considered, taking into account the induced downwash distribution, unsteady processes, the acceleration doublet method, the dynamic stall, and the airfoil operating range Computational methods employed in connection with studies of airfoil aerodynamics include a method for subcritical compressible fluids, a method reported by Bauer et al (1972) for studies concerning supercritical flow, and the incompressible inverse method developed by Morchoisne (1974) Attention is also given to the experimental evaluation of conventional airfoils and rotor applications G R

A77-43339 # **The investigation of some unusual handling characteristics of a light autogyro** J Przybylski, R L Toms, and I C Cheeseman (Southampton, University, Southampton, England) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 24 p 9 refs Research supported by the Royal Aeronautical Society

The report describes an investigation undertaken to diagnose the failure of the main rotor blade of a single seat autogyro A crack through the wood part of a composite plywood/steel rotor and non-response of the machine to nose down pitch inputs on the cyclic pitch at some rotor rpm values were investigated for possible effects of aeroelastic forces Blade bending frequencies with/without rotation, possible cases of disastrous root stresses, and loss of control in pitch were looked into Coincidences of flapping natural frequencies excited by low-order aerodynamic imputs can combine to bring about pronounced blade excursions from undeflected shape near the propeller and rudder, with hazards of blade strike R D V

A77-43340 # **Is the pilot necessary in a light observation helicopter** I C Cheeseman (Southampton, University, Southampton, England) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 8 p 7 refs

Replacement of the pilot's function by a monitored computer control in a surveillance helicopter normally carrying a pilot and an observer is studied Reduction of the helicopter mass and consequent savings in fuel consumption are simulated, using an existing craft as the model Computer requirements for the control of the helicopter are reviewed a redundant system of digital autopilot controls is proposed as a feasible and economical possibility Cases in which failure of the computerized guidance system or incapacitation of the observer takes place are discussed In addition to providing lower weight and fuel consumption, the computer controlled helicopter could be redesigned to decrease effective drag, furthermore, the computer controls may be integrated into the maintenance system to decrease down-time J M B

A77-43341 # **Flight evaluation of a highly cambered tail rotor** C V Cook (Westland Helicopters, Ltd , Yeovil Somerset, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 8 p Research supported by the Ministry of Defence (Procurement Executive)

A flight evaluation of a highly cambered tail rotor blade has demonstrated improvements in low speed handling qualities and performance when compared with the performance of a standard symmetrical section blade In hover and low speed flight thrust increases of 35% before the onset of stall were being observed (Author)

A77-43342 **Damage tolerant design for helicopter structural integrity** I M Polley (RAF, Directorate of Aircraft Engineering, London, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 9 p

Views of the Royal Air Force are presented concerning the need to implement a damage tolerant design philosophy wherever possible Suggestions are made regarding various research activities which would be of direct relevance for achieving a higher assurance of structural integrity for the whole of the required life of the aircraft structure It is considered highly desirable to obtain a fatigue resistant helicopter structure with a good economic life before repairs become necessary The structure should be damage tolerant, so that any fault, without regard to its cause or time of occurrence during the life of the helicopter, will be found by routine inspection before the strength of the structure falls to an unacceptable level G R

A77-43343 **Cabin noise reduction - Use of isolated inner cabin** J S Pollard and J W Leverton (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 11 p

A soundproofing system for helicopter cabins is described Standard helicopter soundproofing, which uses fiberglass bags, is reviewed and found to be insufficient for some transport helicopter applications Tests indicate that the standard transmission barriers and absorption materials may reduce mid and high-frequency noise, but for lower frequencies involving airframe vibration, damping (e g honeycomb) materials may be more efficacious An inner cabin soundproofing treatment that uses panels incorporating acoustic foam as well as damping materials is described This scheme is found to yield considerable improvement in noise reduction throughout the frequency range, however, to attain cabin noise levels comparable to those mandated for commercial airliners, additional sound-proofing, especially in the region of the windows, is necessary J M B

A77-43344 **The noise protection area as a criterion for the problem of aircraft noise during the take-off of VTOL aircraft** V Nitsche (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 12 p 5 refs

The restricted noise area stipulated by German law for aircraft noise is computed for VTOL take-offs, with computation of noise-optimal VTOL trajectories and the effect of a simplification of common engine noise characteristics on such take off trajectories The noise restricted area, with noise index 67 dBA as boundary, is extended in the study because maximum perceived noise levels greater than 95 dBN can be detected outside that area Vertical ascent to 80 m height followed by a subsequent transition climb on a flight path angled 0 deg is found optimal for a constant number of flights per unit time R D V

A77-43345 **Design philosophy for helicopter rotor heads** R Mouille (Societe Nationale Industrielle Aerospatiale, Marignane, Bouches du-Rhône, France) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 19 p

The main rotor head represents a very significant element of the helicopter structure in connection with its weight, its cost of production, and its operating costs Advances in rotor head design which lead to a reduction in weight and cost and to an improvement of performance are, therefore, of great interest Approaches for obtaining better rotor head design concepts are discussed, taking into account a two-bladed 'see-saw' main rotor system and systems with more than two blades New technologies which are currently available are related to a use of titanium, dry self-lubricating bearings, and bearings made of laminated elastomer A description is presented of a number of rotor head concepts which have been studied, giving particular attention to the 'Starflex' rotor head and its in flight behavior G R

A77-43346 **A revaluation of helicopter main rotor noise** J W Leverton, B J Southwood, A C Pike, and M A Woodward (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 10 p 5 refs Research supported by the Ministry of Defence

The investigation considered is based on the results obtained in an extensive series of tests in which a full size rotor was run in an inverted (up-side-down) mode Attention is given to the rotor noise characteristics, the correlation of test data, broadband noise, rotational noise, and overall noise properties Effects of projected blade thickness on broadband noise and higher harmonic rotational noise are discussed G R

A77-43347 **Test of a convertible aircraft rotor in the modane large wind tunnel** M Lecarme (Societe Nationale Industrielle Aerospatiale, Marignane, Bouches-du Rhône, France) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powdered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 10 p

The reported tests were conducted in connection with a preliminary project concerning the development of a light convertible aircraft fitted with two tilting rotors In 1975, conventional tests related to the study of the helicopter and the aircraft configuration were conducted As a result of the tests, the blades were rebuilt with certain structural modifications In 1976, tests involving the aircraft configuration were conducted A photogrammetric process was employed to determine the distortion of a turning blade An investigation was carried out regarding the process of transition from the helicopter to the aircraft configuration G R

A77-43348 **Wind tunnel testing of model rotors at RAE Farnborough** A Anscombe, A P Cox, R J Marshall (Royal Aircraft Establishment, Farnborough, Hants , England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 12 p

A description is presented of the current state of the test facilities in the case of a 24 ft diameter open-jet wind tunnel which had been selected for a series of test programs involving a model of a hingeless rotor The design of the rotor test rig is considered along with the model blades and the present test program The instrumentation of the test rig is also discussed, taking into account the strain-gauge system, aspects of data processing and recording, and the control instrumentation Attention is given to the possibilities and limitations of the considered wind tunnel in connection with testing to be conducted at high Mach and Reynolds numbers G R

A77-43349 **Meeting the maneuverability requirements of military helicopters** S Attlfellner and W Sardanowsky (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 19 p

The mission success and even the survival of the helicopter in a conflict environment depends upon its ability to escape the numerous threats present To this end extreme nap of the earth flight is used in order to utilize the cover afforded by trees, buildings and general terrain features This extreme NOE flight requirement places heavy demands upon the maneuverability and controllability of the helicopter because of operation in close proximity to ground and obstacles An examination of the maneuvering requirements of NOE flight was conducted in order to provide a base for the selection of helicopter design parameters to meet them The examination was based upon flight experience with the BO-105 helicopter under simulated tactical conditions and calculations with the Dynamic

Flight Simulation Program The results show the importance of a judicious selection of rotor dynamic parameters for safety of flight and control response optimization in NOE operations by helicopters (Author)

A77-43350 # **Rotor isolation of the hingeless rotor BO-105 and YUH-61A helicopters** R A Desjardins and W E Hooper (Boeing Vertol Co , Philadelphia, Pa) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 14 p 11 refs

This paper presents the development of an improved rotor isolation system (IRIS) applied to hingeless rotors to minimize helicopter vibrations It describes specific design features required to achieve an exceptionally high degree of isolation in a compact environment where severe restrictions are placed on size, weight and range of available motion The analysis, bench tests and full scale flight tests show a significant reduction of N/REV as well as 2N/REV vibration with no interference to the agility and handling qualities of the aircraft (Author)

A77-43351 # **The flow over a helicopter blade tip in the transonic regime** F X Caradonna (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) and J J Philippe (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 12 p 9 refs (ONERA, TP No 1976-115)

A combined experimental computational investigation of transonic flow on an advancing rotor has been performed The test model is a modified Alouette II tail rotor instrumented with absolute pressure transducers The computational model is the two dimensional transonic small disturbance equation The agreement between computation and experiment is good The results obtained show that unsteadiness is an important part of the problem Unsteady lifting computations indicate the possibility of loads different from those observed usually in steady flows The computations also show a great sensitivity to angle of attack variations (Author)

A77-43352 # **Rotor response prediction with non-linear aerodynamic loads on the retreating blade** J J Costes (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 9 p 12 refs (ONERA, TP No 1976 116)

A method of calculating the loads on rigid blades with allowance for nonlinear aerodynamic loads due to high angle of attack on the retreating blade is described It is based on the acceleration potential method whereby the blade is regarded as a surface of pressure discontinuity This is further simplified by representing the blade as a lifting line on the 25 percent chordwise position and by assuming the blade motion is a known periodic function The lift is sought in the form of a linear combination of prescribed functions of time and blade radius Incidence is handled by means of the effective Prandtl incidence Lift histories computed in this manner show better agreement with experimental data than linear computations P T H

A77-43353 # **Investigation of a helicopter manoeuver demand system** H -J Bangen, W Hoffmann, H Seelmann (Dornier System GmbH, Friedrichshafen, West Germany), and H Leyendecker (Deutsche Verschungs und Versuchsanstalt fur Luft und Raumfahrt, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 14 p

The fly-by-wire maneuver demand system is expected to permit exact control of the helicopter under extreme mission conditions The system delivering this maximum capability the so-called nominal maneuver demand system is allowed to gradually degrade down to a minimum level of performance This is called the minimal system, with the minimum level of system performance being defined by flight safety requirements This paper describes an experimental system currently being developed for integrated helicopter guidance and control in bad weather conditions B J

A77-43354 # **Development, fabrication and testing of a hybrid composite tailboom for BO 105** H Bansemir and R T Schulz (Messerschmidt Bolkow Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22 1976, Paper* 22 p 9 refs

A77-43355 # **Some aspects of mechanical instability problems for a fully articulated rotor helicopter** P Bellavita, C Giorgi, and M Galeazzi (Costruzioni Aeronautiche Giovanii Agusta S p A , Cascina Costa, Italy) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 40 p 6 refs

Helicopter instability, particularly ground resonance, is studied using a combination of the method of Floquet and a direct integration method, which involves variable coefficients representing mechanical components and permits simulation of the landing dynamics The combined method is applied to a model hydraulic damper, the model's behavior is investigated by systematic variation of individual components, such as geometry, valve flow, support stiffness, and spring hysteresis A flow chart for a computer program which approximates an equilibrium of flows and loads for the system is given Properties of elastomeric materials suitable for damper applications, including shear stress and hysteresis phenomena, are also evaluated These analysis of the damping system lead to a design proposal which involves a hydraulic piston damper lacking calibrated valves but having an open orifice coupled to the structure via elastomeric material J M B

A77-43356 # **Ship landing trials with the BO 105** D Bender (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 16 p

Helicopter testing and pilot training for landing helicopters on shipboard platforms at various ship speeds and in a variety of weather conditions (sea state, wind direction, wind force) are described An on land rolling platform employed for tests and training under controlled conditions is described and illustrated Experience with 90 landings on board vessels at sea is described and summarized Alternating main rotor shaft bending moment, bending moment on rear port undercarriage cross tube, tailboom vertical bending moment, and vertical acceleration under pilot's seat are plotted vs angle of roll during touchdown R D V

A77-43357 # **Dynamic problems of unmanned tethered rotor platform Sea-Kiebitz with special regard to the landing** W Benner (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 8 p

The dynamics of an unmanned rotor observation platform tethered from a surface vessel, the pronounced influence of the tethering cable on the system dynamics, and advantages of a tethered rotor-lift/hover platform are discussed This 'Sea Kiebitz' system greatly increases the radar horizon and surface surveillance capability of the tethering vessel, while eliminating interference from masts and masthead antennas, mission height is 300 m, radar horizon about 60 km Automatic cable tension control, system dynamics in takeoff and ascent/loitering and surveillance/hauldown and landing, and system performance at high winds and high seas are dealt with R D V

A77-43358 # **HIFLAS - Helicopter infrared flight command and landing system** W Dieter and U Rathmann (Elektronik System GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 14 p

The HIFLAS avionics package for all weather military helicopter operation with enroute navigation and no assistance from ground is described The package includes a BNS self contained navigation system, FLIR equipment for low altitude and nap of-earth flying with forewarning of obstacles (including wires) and landing aids, and integrated display of all data including FLIR video Package structure, imaging sensor requirements, low-light optics (including imaging charge-coupled devices), symbol layout and information display spectrum, flight command modes (vertical and horizontal display modes), and detection range of representative ground obstacles are dealt with Possible future additions to the open-ended HIFLAS concept are indicated R D V

A77-43359 # **An experimental study on a combined outside world/instrument display for helicopter operation at night and in bad weather** R Beyer (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugfuhrung, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 18 p

Helicopter test flights were performed by pilots using either conventional guidance instruments and visual assessment of meteorological conditions or a combined outside world and instrument display Features of the combined outside world instrument display system are described Factors taken into account in the 48 experimental flights run included roughness of the terrain and the pilot's knowledge of the course In addition, velocity, altitude, roll and pitch angles, and roll, pitch, and yaw rates were monitored Results indicate that with adequate training pilots were able to operate the helicopters equally well whether using visual assessment of meteorological conditions and conventional instruments or the combined display system alone Thus, the combined outside world instrument display may be a feasible guidance system for use during bad weather or night flights J M B

A77-43360 # **Ballistic and impact resistance of composite rotorblades** K Brunsch and P M Wackerle (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 30 p 6 refs

It has been found that the majority of rotor blade failures is related to an unforeseen occurrence of damage or to unexpected defects Such damage can be produced in connection with impacts involving moving or stationary barriers, birds, bullets, hail, and small particles A comparison of the properties of the materials employed for rotor blades shows the superiority of fiber reinforced plastics over metals with respect to dynamic resistance Attention is given to aspects of design and production technology, the influence of stress concentration on rotor blade fatigue life, the propagation of cracks caused by an impact on rotor blades, a fatigue test conducted with a tail rotor blade which had been damaged by a bullet, and an impact test involving tail rotor blades in contact with wooden rods G R

A77-43361 # **Environmental reliability testing of helicopter systems** B M M Faulkner (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 22 p

A description is presented of the environmental reliability tests conducted with the Westland WG 13, Lynx helicopter The objec tives of reliability testing are examined, taking into account questions regarding the choice of a test rig framework, the selection of environmental conditions, and the choice of systems under test Previous reliability tests discussed are related to autopilot/autostabilizer systems, a section of aircraft fuselage including all pilots controls, and a joint Anglo-French reliability trial Lynx reliability tests were carried out during the development phase from 1972 to 1974 and in connection with the production phase which began in 1976 G R

A77-43362 * # **Recent developments in rotary-wing aeroelasticity** P Friedmann (California, University, Los Angeles, Calif) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 35 p 65 refs Army-supported research, Grant No NGR 05-007-414

The purpose of this review is to present the research done in rotary wing aeroelasticity during the past eight years in a unified manner The following topics are reviewed with considerable detail (1) recent development in the aeroelastic modeling of the coupled flap-lag-torsional problem in hover (2) effect of unsteady aerodynamics on the coupled flap lag-torsional aeroelastic problem in hover (3) the coupled flap-lag and the coupled flap-lag-torsional problem in forward flight (4) complete rotor and coupled rotor fuselage aeroelastic problems including both hingeless and teetering rotors (Author)

A77-43363 # **A model for wind-tunnel rotorcraft research - Model design and test objectives** B Gmelin (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 17 p 9 refs

Factors underlying the design of components for a rotorcraft wind-tunnel test stand are discussed Transferability of the data to full-scale helicopters, using model scaling laws, is investigated The rotor drive system, geometrical scaling, handling of dimensionless ratios (Reynolds and Froude numbers, density and elasticity ratios), wind-tunnel interference effects, hover testing, and details of the wind-tunnel test program are covered An outline of future DFVLR rotorcraft wind-tunnel test programs is presented R D V

A77-43364 # **Recent experience in the testing of a generalized rotor aeroelastic model at Langley Research Center** C E Hammond and W H Weller (U S Army, Air Mobility Research and Development Laboratory, Hampton, Va) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 20 p 8 refs

The use of aeroelastically scaled helicopter rotor wind-tunnel models in establishing or verifying the dynamic characteristics of new or existing rotor designs is discussed A model, termed the generalized rotor aeroelastic model (GRAM), which has been developed for testing aeroelastically scaled rotor models is described, and the utility of the model in being able to test a variety of rotor systems to meet a broad range of test objectives is demonstrated through presentation of data from recent tests Data are presented from tests of an AH-1G Cobra model to determine whether or not the two-blade teetering rotor can experience stall flutter, tests of two wide chord teetering rotors to evaluate the effect of the wide chord on blade loads and rotor performance, and tests of a new four-blade flex hinge rotor configuration to provide information for the designer relative to its dynamic characteristics Recent tests of a variable geometry rotor are also described although final data are currently unavailable Since the GRAM was developed for testing in a wind tunnel which has the capability of using Freon-12 as a test medium, some of the advantages of Freon 12 for testing of aeroelastically scaled models are also discussed (Author)

A77-43365 # **Studies on rotor and flight dynamics of a horizontally stoppable hingeless rotor aircraft** H Huber and H Krafka (Messerschmitt Bolkow Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept. 20-22, 1976, Paper* 21 p

The concept of a V/STOL aircraft with two horizontally stoppable rotors in a side-by-side arrangement is described, and some initial investigations on the control and stability of the aircraft during transition and conversion phases are reported These studies included isolated rotor tests to determine the influence of rotor thrust, flight speed, and rotor speed, and tests on the whole aircraft to study the trim characteristics in the level flight speed range from hover to 250 km/h and the full rotor speed range Theoretical results on the aircraft lift slope, pitch rate damping, static longitudinal stability, and speed stability are given Results of dynamic simulations of transition and conversion are presented P T H

A77-43366 # **Aircraft of wide speed and manoeuvering range** G Kannamuller and E Oberdorffer (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 15 p 8 refs

The technical concept of an aircraft of wide speed and maneuvering range is described The three main features are (1) shrouded, single stage fan with horizontal rigid intake, (2) thrust vectoring by an efficient deflector system, and (3) optimal integration of thrust deflector and wing Four different thrust deflector systems under consideration and six possible configurations for the propulsion system are briefly described Brief comments on various aspects of operational capabilities of the aircraft are made P T H

A77-43367 # **The shrouded tail rotor 'Fenestron'** M Lafargue (Societe Nationale Industrielle Aerospatiale, Division Helicoptères, Paris, France) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 18 p

Advantages of a shrouded rotor integrated into the tail fin ('Fenestron' configuration) are reviewed, and a description is given of two Aerospatiale rotorcraft incorporating that feature All-weather flight safety, vulnerability to small arms fire and encounters with trees, noise abatement and comfort enhancement, protection of the tail rotor against foliage, stones, curious or incautious bystanders at landings, maneuverability and flying/handling qualities, weight and cost, hover performance, and design simplifications in the shrouded tail rotor vehicles are described Advantages of an antitank rotorcraft loitering under foliage cover with tail rotor so protected are pointed out R D V

A77-43368 # **Helicopter icing - A problem to be defined** H B Lake (RAF, London, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 8 p

The status of research on helicopter icing and de icing is surveyed, and found to lack credible supporting theory or acceptable data base More progress has been made on combatting windshield icing, some progress on dealing with engine icing and ice ingestion, but the problem is 'not defined' in the case of rotor icing Meteorological understanding of low-altitude ice and snow is inadequate, the amount of icing that a rotor can tolerate is still obscure, and empirical data on 100%/min increases in the torque on unprotected rotors during icing are unsettling Radar and atmospheric sampling probes of ice clouds do not yield reliable data Problems in all-weather certification of rotors and helicopters are discussed, with particular emphasis on pressures exerted on certification engineers by project managers R D V

A77-43369 # **A model for windtunnel rotorcraft research - Ground resonance investigations** H -J Langer, R Schroder (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany), and F Kiessling (Deutsche Forschungs- und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Aeroelastik, Gottingen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 12 p

To describe mathematically the ground resonance of a simulated rotorcraft, a system having equivalent vibration characteristics is defined and analyzed Natural frequencies, eigenforms, generalized mass, and damping values are determined experimentally for the rotor support stand For the rotor itself, a transfer matrix is used to calculate the natural lagging frequency of the blade, the state variables for the equation of motion are determined using an equivalent rotor system for simplicity An equation of motion for the ground resonance which takes into account both rotor and support-stand vibrations is then obtained The combination of experimental and analytical evaluation is found to yield good predictions of the simulated rotorcraft's stability J M B

A77-43370 # **The relative importance of acoustic sources generated by helicopter rotors in high speed flight** S E Wright *Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20 22, 1976, Paper* 16 p 8 refs

A simple easy to use linear source theory is described This theory represents most of the essential radiation properties of sources in arbitrary motion, including circular and helical motion appropriate to hover and forward flight Possible sources of helicopter noise in high speed flight are then assessed, with particular reference to blade displacement, steady blade forces, unsteady blade forces and fluid stresses It appears that unsteady blade forces are the most likely source of rotor noise, at least for present day forward flight speeds (Author)

A77-43371 # **Main and tail rotor interaction noise during hover and low-speed conditions** E Laudien (Messerschmidt Bolkow Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, European Rotorcraft and Powered Lift Aircraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper* 16 p 12 refs

A measured spectrum of a BO 105 rotorcraft in partial power descent is illustrated and analyzed Flight conditions and recording of impulsive noise signals, and effect of light wind and partial power descent on hover flight, are discussed Interaction noise resulting from intersection of the tip vortex from a preceding blade by the main rotor blade in hover flight under light wind was investigated Analysis of recorded noise signals revealed up to 20 tail rotor harmonics for tail rotor interaction noise, and over 50 harmonics for main rotor impulsive noise R D V

A77-43393 **XF-19 EW suite** R Hartman *Military Electronics/Countermeasures*, vol 3, July 1977, p 13, 18, 69, (3ff)

Electronic warfare (EW) hardware organization in the projected XF-19 U S STOL fighter-bomber is described and characterized The XF-19 is designed for forward area tactical interception of hostile aircraft and missles, or for tactical close air support, with capability of operating from unimproved/minimal/damaged runways, or small ships The phased array IR warning system, rack-mounted placement of EW modules, responses to hostile treats, detect/preamp/presort equipment, jamming and smart chaff dispensing, and anti-track laser systems are outlined Limitations imposed by aircraft blind spots, volume and weight penalties, and exorbitant sensitivity (with indiscriminate acquisition of threats and swamping of the system) are considered, in addition to difficulties in transferring signal information and commands to the jammer R D V

A77-43399 **National Airlines Fuel Management and Allocation Model** D W Darnell (National Airlines, Inc , Miami, Fla) and C Loflin *Interfaces* vol 7, Feb 1977, p 1 16

The Fuel Management and Allocation Model determines the optimal strategy for fueling aircraft and can be used to support both short and long-term planning It has been used operationally by the Fuels Management and Flight Control Departments of National Airlines for over two years, resulting in multi million dollar savings

The model specifies the best fueling station and vendor for each flight, based on prices, availability, fuel burn, flight data, and cost of tankerage The model also uses extensive sensitivity analysis techniques to alert management as to when a new policy may be required (Author)

A77-43468 # **Determination of the components of the specific force of a gravimeter for the general case of a moving base (Opredelenie sostavliaiushchikh udel'noi sily gravimetra v obshchem sluchae podvizhnogo osnovaniia)** E N Bezvesil'naia and S L Riabykin (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR) *Vychislitel'naia i Prikladnaia Matematika,* no 30, 1976, p 147-153 In Russian

Equations are presented for the components of the specific force of a gravimeter which are pertinent to an aviational gravimetric system which can be used in the determination of gravitational anomalies The functional subsystems of the gravimetric system consist of the gravimeter, stabilization system, navigation system, altimeter, and computer M L

A77-43576 The electromagnetic autonavigation system /the EMAN system/ (Das Elektromagnetische Autonavigationssystem /EMAN-System/) A Seeger *Ortung und Navigation,* no 2, 1977, p 1 10 In German

An apparatus used for electromagnetic direction and velocity determination is described The principle of its operation involves the Hall effect and induction The device is intended for use in flights that would require readjustment of the magnetic compass gyro scopic compass system, or in situations when that system is not convenient M L

A77 43577 Automatic correction of position error by means of a digital correlation of surface structures (Automatische Korrektur von Positionsfehlern durch digitale Korrelation von Oberflachenstrukturen) Mr Hessel and Mr Eckl (Messerschmitt Bolkow-Blohm GmbH, Munich, West Germany) *Ortung und Naviga tion,* no 2, 1977, p 63-89 17 refs In German

A navigation system is considered which involves the com parison of actual images of the earth's surface features with reference images Location would be determined by the correlation maximum A simulation procedure is described which would determine the characteristics of such a system, choose a suitable correlation algorithm, and estimate the necessary computational and storage capacity The results of this simulation procedure are presented M L

A77-43578 The vehicle mapping device FKG-1, a device for indicating the location of land vehicles and helicopters on the map (Das Fahrzeugkartengerat FKG-1, ein Gerat zur Anzeige des Standortes von Landfahrzeugen und Hubschraubern in der Karte) K Ramsayer (Stuttgart, Universitat, Stuttgart, West Germany) *Ortung und Navigation,* no 2, 1977, p 91 95 In German

A77-43598 # **Reduction of exhaust smoke from gas-turbine engines by using fuel emulsions II** C A Moses (Southwest Research Institute, San Antonio, Tex) *Comoustion Institute, Fall Meeting, La Jolla, Calif , Oct 18-20, 1976, Paper 76-34* 27 p 27 refs Contracts No N00150-74-C-1717, No N68335-76-C-1136

A stabilized low-internal-phase-ratio emulsion of water in oil is used to promote abatement of exhaust smoke from on-ground gas turbine test engines The emulsifying mechanism, which involves selective vaporization of the internal phase during the period of droplet heating, followed by a sudden lowering of pressure, is described, a variety of water/fuel ratios are studied, with the aim of providing the maximum smoke reduction while retaining high combustor efficiency Emulsions composed of 15% and 30% water/ fuel ratios are tested throughout the engine power range, and smoke reductions are observed at all power points The greatest reductions are noted at the highest power points where the smoke problem is greatest Combustion efficiency is calculated, and found to be minimal at full power, but significant at lower power levels Data on gaseous exhaust emissions are also given J M B

A77-43604 # **Theory of automatic aircraft power plant control Air-breathing engines (Teoriia avtomaticheskogo upravleniia silovymi ustanovkami letatel'nykh apparatov Upravlenie VRD)** Iu S Belkin, L N Getsov, Iu V Kovachich, Iu A Litvinov, T S Mart'ianova, S A Sirotin, G P Stepanov, A V Forafontov, and A A Sheviakov Moscow, Izdatel'stvo Mashinostroenie, 1976 344 p 134 refs In Russian

Theoretical methods used to study the dynamics of aircraft power plants and to analyze possible automatic control systems for aircraft engines are presented Mathematical models of power plants with gas turbine engines of different types are outlined The methods used to investigate control systems for power plants with jet engines in single-shaft, double-shaft or by pass configurations are given, and results are reported Characteristics of hydraulic, electronic, combined control systems and of on-board computer systems are reviewed, and approaches used in assessing the reliability of these systems are discussed C K D

A77-43610 # **Unsteady processes in aircraft piston compressors (Nestatsionarnye protsessy v porshnevykh kompressorakh letatel'nykh apparatov)** B M Ryzhov Moscow, Izdatel'stvo Mashinostroenie, 1976 180 p 18 refs In Russian

Unsteady thermodynamic processes taking place in aircraft piston compressors are discussed The energy parameters, operation and vacuum regime of piston compressors and the kinematics and construction of the crankshaft-swashplate mechanism are examined A method for analyzing the energy parameters of a pneumatic piston compressor is presented C K D

A77-43612 # **Low-temperature heat pipes for aircraft (Nizkotemperaturnye teplovye truby dlia letatel'nykh apparatov)** V G Voronin, A V Reviakin, V Ia Sasin, and V S Tarasov Moscow, Izdatel'stvo Mashinostroenie, 1976 200 p 31 refs In Russian

The theoretical basis of heat and mass transfer processes in low-temperature heat pipes operating at temperatures from minus 200 to plus 300 C is presented Methods used to predict the parameters of heat pipes with different configurations and different conditions of operation are outlined The construction and control of heat pipes are discussed, and present and possible future applications of heat pipes in aircraft and spacecraft in heat regulation air conditioning, and life support systems are considered C K D

A77-43617 # **Chemical power sources in aviation (Khimicheskie istochniki toka v aviatsii)** V A Prituliuk Moscow, Voenizdat, 1976 88 p 9 refs In Russian

The principles of operation and construction of different types of primary and secondary cells used in ground support activities in aviation are reviewed These include manganese-zinc, silver-zinc, acid, and alkali nickel-cadmium cells The performance characteristics of each type of cell are presented, and the advantages and applications of each cell are discussed Undesirable properties are described, and means of eliminating or mitigating them are considered C K D

A77-43619 # **Equivalent testing of gas turbine engines (Ekvivalentnye ispytaniia gazoturbinnykh dvigatelei)** N D Kuznetsov and V I Tseitlin Moscow, Izdatel'stvo Mashinostroenie, 1976 216 p 73 refs In Russian

The problem of estimating and increasing the service life of gas turbine engines is the subject of this book The relevant thermomechanical properties of engine materials are studied, and methods of measuring, predicting, and increasing the service life of individual engine components are examined These investigations serve as a basis for planning programs of equivalent accelerated tests of gas turbine engines for service life P T H

A77-43657 **Aviation system planning** D L Rubin (COMSIS Corp , Wheaton, Md) *Transportation Engineering,* vol 47, June 1977, p 16 18 8 refs *Research supported by the U S* Department of Transportation and Federal Highway Administration

The approach which has been used by the State of Maryland in planning for future airport needs is described Airports are considered as competitive attractions, and aircraft and air passenger forecasts are generated on the basis of the socioeconomic characteristics of small geographic units Aircraft and air passengers are assigned to airports by computer modeling techniques C K D

A77-43726 * # **Minimum required capture radius in a coplanar model of the aerial combat problem** J V Breakwell (Stanford University, Stanford, Calif) and A W Merz (Aerophysics Research Corp , Mountain View, Calif) *AIAA Journal,* vol 15, Aug 1977, p 1089 1094 5 refs Contract No NAS2 9223

Coplanar aerial combat is modeled with constant speeds and specified turn rates The minimum capture radius which will always permit capture, regardless of the initial conditions, is calculated This 'critical' capture radius is also the maximum range which the evader can guarantee indefinitely if the initial range, for example, is large A composite barrier is constructed which gives the boundary, at any heading, of relative positions for which the capture radius is less than critical (Author)

A77-43727 * # **Optimization of flexible wing structures subject to strength and induced drag constraints** R T Haftka (Illinois Institute of Technology, Chicago, Ill) *AIAA Journal,* vol 15, Aug 1977, p 1101-1106 13 refs Grant No NsG 1266

An optimization procedure for designing wing structures subject to stress, strain, and drag constraints is presented The optimization method utilizes an extended penalty function formulation for converting the constrained problem into a series of unconstrained ones Newton's method is used to solve the unconstrained problems An iterative analysis procedure is used to obtain the displacements of the wing structure including the effects of load redistribution due to the flexibility of the structure The induced drag is calculated from the lift distribution Approximate expressions for the constraints used during major portions of the optimization process enhance the efficiency of the procedure A typical fighter wing is used to demonstrate the procedure Aluminum and composite material designs are obtained The tradeoff between weight savings and drag reduction is investigated (Author)

A77-43735 * # **A computationally fast one-dimensional diffusion-photochemistry model of SST wakes** G L Matloff and M I Hoffert (New York University, New York, N Y) *AIAA Journal,* vol 15, Aug 1977, p 1205-1207 14 refs Grant No NsG 1298

A computational technique applicable to analysis of supersonic transport (SST) wake photochemistry and diffusion is presented Sensitivity studies of SST effluent effects upon ozone depletion are facilitated by the computational rapidity of the method The article compares results from other studies and predictions of some variables related to global NOx input Results indicate that the NO/NO2 ratio in an SST wake at photochemical equilibrium is a sensitive function of photolysis rates R D V

A77-43737 * # **Low Reynolds number flow past a blunt axisymmetric body at angle of attack** A Kumar (NASA, Langley Research Center, Hampton, Va , National Research Council, Washington, D C) *AIAA Journal,* vol 15, Aug 1977, p 1212-1214 8 refs

Low Reynolds number flow of an ideal gas over a blunt axisymmetric body of large half-angle at small angles of attack is investigated, for the case of laminar hypersonic flow Time varying viscous shock layer equations describing the flowfield are obtained from the full Navier-Stokes system by keeping terms to second order in the inverse square root of Re in both viscous and inviscid regions, the equations are valid for moderate to high Re Drag, skin friction, and heating rates were obtained at small (or zero) angles of attack Conditions experienced by planetary entry probes during the high-altitude (early) legs of an atmospheric entry trajectory are pertinent to the problem R D V

A77-43771 * **Linear regulator design for stochastic systems by a multiple time-scales method** D Teneketzis and N R Sandell, Jr (MIT, Cambridge, Mass) *IEEE Transactions on Automatic Control,* vol AC 22 Aug 1977, p 615 621 32 refs Grant No NGL 22-009-124, Contract No E(49 18) 2087

This short paper develops a hierarchically structured, suboptimal controller for a linear stochastic system composed of fast and slow subsystems It is proved that the controller is optimal in the limit as the separation of time scales of the subsystems becomes infinite The methodology is illustrated by design of a controller to suppress the phugoid and short period modes of the longitudinal dynamics of the F-8 aircraft (Author)

A77-43832 # **Blast from aircraft guns at subsonic and supersonic speeds** D G Mabey and D S Capps (Royal Aircraft Establishment, Bedford, England) In International Symposium on Ballistics, 3rd, Karlsruhe, West Germany, March 23 25, 1977, Proceedings Pfinztal, West Germany, Institut fur Chemie der Trieb- und Explosivstoffe, 1977, p B6 1 to B6-14 11 refs

There is currently considerable interest in the influence of gun blast on military aircraft but few reliable measurements are available to the aircraft designer A theory to estimate the approximate level and duration of these blast loads for both static and moving aircraft was outlined by Smith at a previous conference (1974) This paper presents a brief outline of the theory and summary of wind tunnel measurements made to verify it In the experiment, a 7 62 mm caliber rifle was fired in the RAE 3 ft x 3 ft wind tunnel over the speed range from M = 0 to 1 8, and over a wide range of static pressures (representing altitude variations) The blast wave arrival times and the local static pressure ratios were measured by transducers mounted on an adjacent plate, offset at spacings of 10, 20, and 30 calibers These measurements were generally well correlated by Smith's theory, both with respect to the variation of speed and pressure However, downstream of the muzzle discrepancies between the measurements and the theory increased with speed, particularly when the plate was closest to the gun (Author)

A77-43923 # **Convective heat and mass transfer in a hypersonic near wake (Konvektivnyi teplomassoobmen v giperzvukovom blizhnem sledе)** L I Skurin and A V Iurkov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) In Heat and mass transfer - V, All-Union Conference on Heat and Mass Transfer, 5th, Minsk, Belorussian SSR, May 17 20, 1976, Proceedings Volume 1, Part 2 Minsk, AN BSSR Institut Teplo i Massoobmena, 1976, p 140 147 In Russian

Some aspects of calculating the viscous near wake behind a hypersonic blunted body are examined, treating the disturbed area as a gas mixture formed by physicochemical transformations The near wake is a relatively narrow region characterized by pronounced changes in the direction of the lines of flow in the presence of strong viscosity effects It is proposed to simplify the calculations by assuming that dynamic and thermal effects, rather than the effects of chemical reactions, influence the pressure distribution, the mean mass velocity, and enthalpy, and to calculate these characteristics without allowance for physicochemical transformations, substituting a certain effective flow of a perfect gas for the actual source V P

A77-43928 **Study of a nonisothermal axisymmetric near wake (Issledovanie neizotermicheskogo osesimmetrichnogo blizhnego sleda)** V E Aerov B A Kolovandin, G G Starobinets, N N Luchko, and Iu M Dmitrenko (Akademiia Nauk Belorusskoi SSR, Institut Teplo i massoobmena Minsk, Belorussian SSR) In Heat and mass transfer V, All Union Conference on Heat and Mass Transfer, 5th, Minsk, Belorussian SSR, May 17 20, 1976, Proceedings Volume 1, Part 2 Minsk AN BSSR Institut Teplo- i Massoobmena 1976, p 192 196 In Russian

A mathematical model and numerical solution method for a nonisothermal turbulent jet flow with zero excess momentum are presented The motor is located on the axis of symmetry of the resistance source consisting of a body of revolution To determine initial conditions and to verify the solution, an experimental study of the near region of an axisymmetric nonisothermal turbulent wake with zero excess momentum was carried out P T H

A77-43993 # **Calculation of radiant cooling of air behind intense shock waves using mean optical characteristics (Raschet radiatsionnogo okhlazhdeniia vozdukha za sil'nymi udarnymi volnami s ispol'zovaniem srednikh opticheskikh kharakteristik)** V P Zamuraev, I I Maslennikova, and R I Soloukhin (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) In Heat and mass transfer - V, All-Union Conference on Heat and Mass Transfer, 5th, Minsk Belorussian SSR May 17-20, 1976, Proceedings Volume 8 Minsk, AN BSSR Institut Teplo- i Massoobmena, 1976, p 196-205 8 refs In Russian

The mean absorption coefficients of air are calculated for the temperature range 10,000 20,000 K and at pressures of 0 1-100 atm These mean coefficients are used to calculate the radiant cooling of air behind shock waves at velocities of 12 and 18 km/s and static pressures of 10 to the -3rd to 10 to the -5th atm B J

A77-44078 **Monolithic wing design.** M A Bogomol'nyi *(Aviatsionnaia Tekhnika,* vol 19, no 4 1976, p 17 22) *Soviet Aeronautics,* vol 19, no 4, 1976, p 11-15 8 refs Translation

A swept monolithic wing with longitudinal spar webs, subjected to a constant distributed force is examined A steepest descent algorithm is proposed for determining the number of webs and the web and skin thicknesses (variable over the wing span) for which the weight, deflection, the induced stresses in the skin, and the shear stresses in the webs satisfy the design constraints (derived in the form of inequalities) The results of a numerical solution to the problem of analytical wing design are examined, along with means of reducing computer time V P

A77-44079 **Analytic design of flight vehicle alighting gear with random scatter of initial conditions and structural parameters** A I Bogomolov, Iu P Gorshenin, A V Svilin, and T K Sirazetdinov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 23 26) *Soviet Aeronautics,* vol 19, no 4, 1976, p 16 19 Translation

A77-44083 **Determining gas turbine engine tolerance monitoring parameters** Iu V Kozhevnikov and M Kh Bikchantaev *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 53 59) *Soviet Aeronautics,* vol 19, no 4, 1976, p 42-47 Translation

In the present paper, the tolerances of gas turbine engine parameters are determined from the condition of least total losses Formulas for calculating the probability of erroneous and correct acceptance-inspection solutions are proposed, along with formulas for the normal error distribution The special case of determining parameter tolerances from the condition of least measurement error probability is discussed V P

A77-44085 **The aircraft cabin as a temperature-controlled plant** V I Krutov and A V Shcherbakov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 63-67) *Soviet Aeronautics,* vol 19, no 4, 1976, p 51-53 Translation

A system of differential equations describing the thermal processes occurring in the passenger compartment is derived The number of equations in this system depends on the number of wall and equipment elements with identical heat accumulating and insulating properties, that must be taken into consideration in each case An operator relation, written in dimensionless form, which describes the dependence of the compartment temperature on perturbing factors is obtained The relation yields the general and particular (with specific assumptions) transfer functions of the mathematical model of the compartment The use of the transfer functions is demonstrated The results are useful in designing aircraft temperature regulating systems V P

A77-44086 **Influence of flight vehicle mission on optimal GTE powerplant parameters** V G Maslov, S K Bochkarev, and V S Kuz'michev *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 68-74) *Soviet Aeronautics,* vol 19, no 4, 1976, p 54 59 6 refs Translation

The dependence of accepted criteria for evaluating the engine/aircraft system on the gas-turbine engine parameters is examined Equations relating the weight, cost-effectiveness, and air technical criteria to the specific weight and specific fuel consumption of gas-turbine engines are derived, along with equations interrelating the optimal engine parameters for various evaluation criteria and various flight ranges V P

A77-44087 **Empennage snapthrough stability and vibrations in supersonic flow** V A Pavlov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 75 78) *Soviet Aeronautics,* vol 19, no 4, 1976, p 60-62 5 refs Translation

'Snapping vibrations' are understood to mean a type of natural vibrations associated with the transition from subcritical to supercritical stable equilibrium and vice versa The vibrations are associated with forces acting at the middle surface of the tail unit that arise in the presence of simultaneous deformations of the vertical fin and (deviated) rudder The analysis of the stability of tail surfaces and their snapping vibrations, carried out in the present paper, leads to differential equations, with nonlinear potential and kinetic energy terms, which are solved by the Bubnov-Galerkin method The solutions of the vibration and stability equations are used to determine the critical flow rate at which snapping vibrations may set in V P

A77-44088 **On invariance of the disturbed longitudinal motion of VTOL airplane with vectored control system** V I Pentiukhov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 79-81) *Soviet Aeronautics,* vol 19, no 4, 1976, p 63 65 Translation

The thrust-vector control system discussed was developed, on the basis of a combinational principle proposed by Petrov (1967), for controlling the longitudinal motion of VTOL aircraft The transfer coefficients of the system are determined which ensure invariance of normal acceleration and angle of pitch and also the simultaneous invariance of the angle of pitch and normal acceleration with respect to vertical gusts The obtained value of the transfer coefficients are shown to be functions of the aerodynamic characteristics of the VTOL aircraft, of the time constant of the lift engines, and the flight altitude and velocity V P

A77-44091 **Construction of stable programmed flight vehicle motion** V A Sgilevskii *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 92 97) *Soviet Aeronautics,* vol 19, no 4, 1976, p 74 78 Translation

The equations of flight-vehicle motion programmed with allowance for deviations are derived The conditions for programmed flight stability are analyzed on the basis of a Liapunov function The equations derived are written in generalized parameters characteristic of a large family of flight vehicles and engines V P

A77-44094 **Analysis of slightly-conical small-aspect-ratio wings beyond the proportional limit** V G Shataev and A S Kretov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 106-111) *Soviet Aeronautics,* vol 19, no 4, 1976, p 86-90 7 refs Translation

A variational technique is proposed for nonuniformly heated thin-walled stub wings allowance for the nonlinearity of the stress-strain diagrams of the load-carrying members The method is based on the assumption that the cross-section contour is nondeformable and that the skin and spar webs operate in shear and the longitudinal ribs in tension Numerical example computations show that the approximation accuracy improves with increasing plastic deformation V P

A77-44097 **Influence of middle-surface curvature on stress state of low-aspect-ratio wing** V L Glezer, A I Danilin, and V A Komarov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 123-125) *Soviet Aeronautics,* vol 19, no 4, 1976, p 100-102 7 refs Translation

The influence of a curved middle surface is evaluated by applying the finite element method to a set of programs for simulating the wing geometry It is shown that this curvature leads to appreciable symmetry breakdown in the stress distribution between the upper and lower panels of the wing Possible reasons for this phenomenon are examined It is shown that calculations with allowance for middle-surface curvature lead to improved agreement with the experiment V P

A77-44100 **Analytic construction of 'aerodynamic profile' curves** E M Shanin and V A Osipov *(Aviatsionnaia Tekhnika,* vol 19, no 4, 1976, p 132-135) *Soviet Aeronautics,* vol 19, no 4, 1976, p 110-113 Translation

Analytical methods of designing plane contours from the prescribed geometrical characteristics, on the basis of a family of strophoidal curves are discussed A simple method of controlling the shape of curves is proposed, and a technique for shaping airfoil surfaces by deforming the cross sections is demonstrated V P

A77-44291 # **Simulation and data analysis of a scanning laser Doppler velocimeter system for sensing aircraft wake vortices** J A L Thomson and J C S Meng (Physical Dynamics, Inc , Berkeley, Calif) In Minnesota Symposium on Laser Anemometry, Bloomington, Minn , October 22-24, 1975, Proceedings (A77-44283 20-35) Minneapolis, University of Minnesota, 1976, p 231-276 5 refs

The paper discusses the spectral signal characteristics of coaxial scanning laser Doppler velocimeter systems which are relevant to the modeling of the response of such systems to simulated and actual aircraft vortex wakes transported through the atmosphere Some examples of the analysis of the measurements on real and simulated wakes are presented P T H

A77-44294 * # **Wind tunnel flow seeding for laser velocimetry applications** M K Mazumder, C W Blevins, and K J Kirsch (Arkansas, University, Little Rock, Ark) In Minnesota Symposium on Laser Anemometry, Bloomington, Minn , October 22-24, 1975, Proceedings Minneapolis, University of Minnesota, 1976, p 327-341 12 refs Grant No NGL-04-001-007

Flow-seeding requirements for wind tunnel studies of subsonic and transonic flow fields are discussed with reference to laser velocimeter applications Design of an aerosol generator with an output flow rate of 60 scfm is presented The generated aerosol is fairly monodisperse, tracer particle diameter can be varied from 0 2 to 0 5 micron, and seeding density can be varied from 100 to 10,000 particles/cu sec Experimental data on the use of this aerosol generator with various aerosol injection mechanisms indicate that the method is suitable for wind tunnel flow seeding (Author)

A77-44295 * # **Development of a controllable particle generator for LV seeding in hypersonic wind tunnels** W V Feller (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va) and J F Meyers (NASA, Langley Research Center, Instrument Research Div , Hampton, Va) In Minnesota Symposium on Laser Anemometry, Bloomington, Minn , October 22-24 1975, Proceedings Minneapolis, University of Minnesota, 1976 p 343-357 7 refs

The paper describes the considerations that went into the development of a controllable particle generator for laser velocimeter seeding in a hypersonic wind tunnel operating at 3 45 million N/sq m, 533 K, and stream speed of about 1000 m/sec Operating conditions determined the choice of a silicone oil as the material, and the requirement that the particle follow the flow within a certain accuracy range put constraints on the allowable particle size range The principle of the particle generating device chosen was that of the LaMer generator, in which a liquid is first vaporized mixed with the carrier gas, and then condensed under carefully controlled conditions Preliminary results of studies on the effect of various apparatus parameters on the particle median diameter are given P T H

A77-44301 * # **Modular high accuracy tracker for dual channel laser Doppler velocimeter** J D Fridman R M Young, R E Seavey (Raytheon Equipment Development Laboratories, Sudbury, Mass), and K L Orloff (NASA, Ames Research Center, Moffett Field, Calif) In Minnesota Symposium on Laser Anemometry, Bloomington, Minn , October 22-24, 1975, Proceedings Minneapolis, University of Minnesota, 1976, p 485-503 5 refs

In the study described, a scanning dual channel cross beam laser Doppler velocimeter (developed for measuring simultaneously the two orthogonal components of flow velocity and turbulence intensity) was used to measure the instantaneous velocity characteristics of a model helicopter rotor and in a vortex wake survey experiment on a Boeing 747 aircraft model Particular attention is given to a special purpose dual loop frequency tracker developed to track and demodulate 10 microsecond wide pulse burst Doppler signals with a study cycle of 25% (or narrower signals at a higher duty cycle) generated by the laser Doppler velocimeter V P

A77-44304 * # **Laser velocimeter turbulence spectra measurements** J C F Wang (General Electric Co Schenectady N Y) In Minnesota Symposium on Laser Anemometry, Bloomington Minn , October 22-24, 1975, Proceedings Minneapolis, University of Minnesota, 1976 p 538-567 5 refs Contract No NAS1-12895

A unique laser velocimeter system employing a digital frequency-counter has been developed by the General Electric Company's Corporate Research and Development under sponsorship of NASA/Langley This system has been successfully developed for measurements of turbulence spectra in jet exhaust flows This paper describes the LV spectra data acquisition system and discussions on the important parameters in the spectra analysis procedure Results from computer simulation and actual jet flow tests are reported Reasonable agreement was obtained between the experimental measurements and the predictions from error analysis of the LV processor (Author)

STAR ENTRIES

N77-28061*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
COMPARISON OF VGH DATA FROM WIDE-BODY AND NARROW-BODY LONG-HAUL TURBINE-POWERED TRANSPORTS
John A Zalovcik Joseph W Jewel Jr and Garland J Morris Washington Jul 1977 41 p refs
(NASA-TN-D-8481 L-11381) Avail NTIS HC A03/MF A01 CSCL 02A

Data are presented on incremental normal accelerations due to gusts operational maneuvers and check flight maneuvers derived gust velocities and the airspeed and altitude operating practices of one type of wide body long haul transport airplane flown by five airlines on international routes These data are compared with VGH data obtained from long haul narrow body transport airplanes also flown over international routes Author

N77-28063*# Rail Co Baltimore, Md
MAINTENANCE COST STUDY OF ROTARY WING AIRCRAFT
Jun 1977 159 p
(Contract NAS2-9143)
(NASA-CR-152003) Avail NTIS HC A08/MF A01 CSCL 05C

The feasibility was studied of predicting rotary wing operation maintenance costs by using several aircraft design factors for the aircraft dynamic systems The dynamic systems considered were engines drives and transmissions rotors and flight controls Multiple regression analysis was used to correlate aircraft design and operational factors with manhours per flight hour and equations for each dynamic system were developed Results of labor predictions using the equations compare favorably with actual values F O S

N77-28064# Naval Aviation Integrated Logistic Support Center, Patuxent River Md
PROCEDURE FOR THE DEVELOPMENT OF NAVAL AVIATION MAINTENANCE OBJECTIVES
William F Lavallee Philip Seidenberg Walter J Light Brian P Sneade and James E Ervin 18 Feb 1977 34 p refs
(AD-A038201, NAILC-03-47X) Avail NTIS HC A03/MF A01 CSCL 15/5

This document describes a methodology for developing Naval Aviation Maintenance Objectives These objectives when accomplished are intended to provide for an effective aviation maintenance establishment in support of naval aviation and the Chief of Naval Operations objective of fleet readiness through the 1977-1985 time frame GRA

N77-28065 California Inst of Tech Pasadena
EXPERIMENTAL INVESTIGATION ON AXISYMMETRIC TURBULENT WAKES WITH ZERO MOMENTUM DEFECT Ph D Thesis
Hiroshi Higuchi 1977 225 p
Avail Univ Microfilms Order No 77-3131

An experimental investigation of a turbulent axisymmetric wake with zero momentum defect was carried out The experiment was conducted in a low speed wind tunnel with a circular tube mounted parallel to the stream A controlled amount of air was injected into the stream at the end of the model to cancel the drag produced by the turbulent boundary layer on the model The measurements on the mean flow and the fluctuation quantities were carried up to 90 diameters downstream By adjusting the strength of the injection, the behavior of the pure wake the coflowing jet and the matched injection were examined and the selfsimilar properties both in the mean velocity and the turbulent intensity were found to exist in these cases Rapid decays of the centerline velocity and the maximum turbulent intensity were observed in the matched injection case The effect of the initial condition was studied by artificially thickening the boundary layer on the model and it was observed that the wake relaxes into the final decay law sooner Dissert Abstr

N77-28066 Tennessee Univ , Knoxville
A NEW METHOD TO CALCULATE THE VORTEX STRENGTH AND LOCATION OF SLENDER WINGS WITH FLOW SEPARATION Ph D Thesis
Dieter Kurt Nowak 1976 207 p
Avail Univ Microfilms Order No 77-3671

Vortex shedding from side and leading edges of slender wings at angles of attack is examined A flow model was developed that allows the calculation of the strength and location of the edge vortices from parameters obtained by linear potential flow theory The Polhamus leading edge suction analogy and the Betz vortex laws were used The model was applied to the case of a slender delta wing Special emphasis was placed upon experimental information concerning the vortex shedding The evaluation included water tunnel experiments The flow model is based on an analogy between the sharp edge in potential flow without separation and the edge vortex in a flow with edge separation and subsequent reattachment Dissert Abstr

N77-28067*# Scientific Translation Service Santa Barbara Calif
LIFT CALCULATION AND FLOW MECHANISMS WHEN THE MAXIMUM LIFT IS EXCEEDED
Peter Jordan Washington NASA Jun 1977 52 p refs Transl into ENGLISH from Luftfahrt-Forsch (Munich) v 16, no 4 p 184-193
(Contract NASw-2791)
(NASA-TT-F-17429) Avail NTIS HC A04/MF A01 CSCL 01A

Flow observations and recordings of unsteady flow processes over straight and twisted wings were performed for one profile and a Reynolds number of 200 000 The foundations are laid for calculating the lift distributions which must be supplemented with systematic measurements Author

N77-28068*# Illinois Univ Urbana Dept of Aeronautical and Astronautical Engineering
PROGRAM MANUAL FOR THE EPPLER AIRFOIL INVERSION PROGRAM
William G Thomson May 1975 54 p
(Grant NGR-14-005-144)
(NASA-CR-153928 UILU-ENG-75-0504, AAE-75-4) Avail NTIS HC A04/MF A01 CSCL 01A

A computer program is described for calculating the profile of an airfoil as well as the boundary layer momentum thickness and energy form parameter The theory underlying the airfoil inversion technique developed by Eppler is discussed A R H

N77-28069*# Illinois Univ Urbana-Champaign Aeronautical and Astronautical Engineering Dept
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 13 1-PERCENT-THICK, HIGH-LIFT AIRFOIL
Kenneth R Sivier Allen I Ormsbee, and Randal W Awker Apr 1974 38 p refs Presented at Business Aircraft Meeting Wichita Kans 2-5 Apr 1974, sponsored by Soc Automotive Eng
(Grant NGR-14-005-144)
(NASA-CR-153937, SAE-740366) Avail NTIS HC A03/MF A01 CSCL 01A

Low speed sectional characteristics of a high lift airfoil are studied and a comparison is made of those characteristics with the predictions of the theoretical methods used in the airfoil's design The 13 1 percent-thick UI-1720 airfoil was found to achieve the predicted maximum lift coefficient of nearly 2 0 No

upper-surface flow separation was found below the stall angle of attack of 16 degrees it appeared that stall was due to an abrupt leading edge flow separation Author

N77-28070*# Mississippi State Univ Mississippi State Dept of Aerophysics and Aerospace Engineering
A HIGH REYNOLDS NUMBER NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS IN STREAM FUNCTION-VORTICITY FORM M S Thesis
John H Bearden Aug 1977 50 p refs
(Grant NGR-25-001-055)
(NASA-CR-153933) Avail NTIS HC A03/MF A01 CSCL 01A

Problems encoutered in investigations of high Reynolds number, incompressible flow are reviewed A numerical solution computer program was modified to solve the stream function-vorticity form of the Navier-Stokes equations Using a body fitted coordinate system with a U-shaped outer boundary a simulation of incompressible flow at a Reynolds number of one million and a body angle of attack of zero was achieved Author

N77-28073*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
REYNOLDS NUMBER EFFECTS ON THE AERODYNAMIC CHARACTERISTICS OF IRREGULAR PLANFORM WINGS AT MACH NUMBER 0 3
Robert L Kruse George H Lovette and Bernard Spencer Jr (NASA Langley Res Center) Jul 1977 422 p refs
(NASA-TM-X-73132 A-6599) Avail NTIS HC A18/MF A01 CSCL 01A

The subsonic aerodynamic characteristics of a series of irregular planform wings were studied in wind tunnel tests conducted at M = 0 3 over a range of Reynolds numbers from 1 6 million to 26 million/m The five basic wing planforms varied from a trapezoidal to a delta shape Leading edge extensions added to the basic shape varied in approximately 5 deg increments from the wing leading edge sweep-back angle to a maximum 80 deg Most of the tests were conducted using an NACA 0008 airfoil section with grit boundary layer trips Tests were also conducted using an NACA 0012 airfoil section and an 8% thick wedge In addition the effect of free transition (no grit) was investigated A body was used on all models Author

N77-28075# Aeronautical Research Council London (England)
THE CHARACTERISTICS OF A FAMILY OF ROOFTOP AEROFOILS DESIGNED AT THEIR DRAG-RISE CONDITION IN VISCOUS, COMPRESSIBLE FLOW PART 2 OFF DESIGN CONDITIONS
B G J Thompson and S W Cosby (Short Brothers and Harland Ltd Belfast) 1975 29 p refs Supersedes RAE-TR-72142 and ARC-34467
(ARC-CP-1321 RAE-TR-72142 ARC-34467
ISBN-011-470931-9) Avail NTIS HC A03/MF A01 HMSO £1 50 PHI

The problems of computing and of presenting off-design variations of profile drag for the new family of rooftop aerofoils described are examined by considering as a typical example a 50% rooftop section designed at a Mach number of 0 7 and having a thickness-chord ratio of 0 1 Profile drag results are presented as a set of polar curves of c sub d vs c sub l for a range of Mach numbers and as contours of c sub d in the c sub l -m plane Boundaries for rear separation drag rise, and peak local Mach number equal to 1 2 are shown For sections of given thickness-chord ratio and Mach number the present results indicate that the minimum drag anywhere along the flight locus m squared c sub l = constant is obtained by choosing the particular section which has its design point on this locus Author

N77-28076# Aeronautical Research Council London (England)
DEVELOPMENTS IN THE LIFTING SURFACE THEORY TREATMENT OF SYMMETRIC PLANFORMS WITH A LEADING EDGE CRANK IN SUBSONIC FLOW
B L Hewitt and W Kellaway 1975 51 p refs Supersedes ARC-33412
(ARC-CP-1323 ARC-33412 ISBN-0-11-4709335) Avail NTIS HC A04/MF A01, HMSO £2 00 PHI

An attempt was made to develop a subsonic lifting surface theory method capable of calculating convergent loading solutions for symmetric planforms with a leading edge crank A trace was made of the time history of thought and method development at B A C which connects the successful treatments of regular and cropped delta type planforms Finally some mention is made of possible future generalisations of the basic cranked planform method Author

N77-28077# Aeronautical Research Council London (England)
LOW-SPEED WIND-TUNNEL TEST OF A TWO-DIMENSIONAL WING FITTED WITH TWO PLAIN DIFFERENTIALLY-DEFLECTED TRAILING-EDGE FLAPS
John Mckie (RAE Farnborough Engl) 1975 39 p refs Supersedes RAE-TR-74174 and ARC-35971
(ARC-CP-1326 RAE-TR-94174 ARC-35971
ISBN-011-470936-X) Avail NTIS HC A03/MF A01 HMSO £1 80 PHI

Chordwise pressure distributions were measured at several spanwise stations on a two dimensional model wing fitted with a plain hinged, trailing edge flap at a Reynolds number of 1 9 million based on chord The flap was divided into two parts and was deflected to a maximum of 5 deg When the flaps were deflected differentially the transition from a pressure distribution characteristic of the flaps deflected configuration to one characteristic of te flaps up situation took place within a spanwise distance of about 10% of the chord The length was independent of the angle of incidence Integrations for sectional normal force indicated however that modifications to the local circulation caused by a discontinuity in angle of flap deflection were apparent more than one chord distance away from the flap junction Author

N77-28078# Aeronautical Research Council London (England)
MEASUREMENTS OF PRESSURE DISTRIBUTION ON A HALF-MODEL WING-BODY COMBINATION OF 55 DEG SWEEP OVER A WIDE RANGE OF REYNOLDS NUMBER
K G Winter (RAE Bedford Engl) and J B Moss (RAE Bedford Engl) 1975 157 p refs Supersedes RAE-TR-74149 and ARC-35978
(ARC-CP-1328, RAE-TR-74149 ARC-35978
ISBN-011-470938-6) Avail NTIS HC A08/MF A01 HMSO £4 90 PHI

The tests were made in a 8ft x 8ft wind tunnel mainly at a Mach number of 0 55 where a range of Reynolds number based on wing chord of 2 to 27 million was obtained for the pressure plotting station situated at about two thirds span Limited tests were also made at a Mach number of 0 8 and at supersonic speeds For angles of incidence for which the upper surface pressure distribution is of the design type changes in Reynolds number do not produce changes in character of the flow The lift developed depends upon the trailing edge boundary layer thickness and can be increased considerably by the action of vortex generators At higher angles of incidence the pressure recovery at the trailing edge is strongly influenced by the boundary layer condition The results at supersonic speeds illustrate some features of shock wave boundary layer interaction Author

N77-28079# Aeronautical Research Council London (England)
INTERFERENCE PROBLEMS ON WING-FUSELAGE COMBINATIONS PART 1 LIFTING UNSWEPT WING ATTACHED TO A CYLINDRICAL FUSELAGE AT ZERO INCIDENCE IN MIDWING POSITION
J Weber (RAE Farnborough Engl) 1975 45 p refs Supersedes RAE-TR-69130 and ARC-31532
(ARC-CP-1331 RAE-TR-69130 ARC-31532
ISBN-011-470941-6) Avail NTIS HC A03/MF A01 HMSO £1 60 PHI

The incompressible flow field past a single straight vortex line which crosses a cylindrical circular fuselage at right angles was studied In particular the downwash induced in the plane through the vortex and the axis of the fuselage was determined numerically The results are used to solve the design problem for an unswept wing of infinite aspect ratio for which the chordwise load distribution is given and the spanwise distribution in the presence of the fuselage is required to be constant It is shown

how the interference effect varies with the ratio R/c between the body radius and the wing chord and with the spanwise distance from the junction A modification of existing methods for calculating the spanwise load distribution of wing-fuselage combinations is suggested to take account of the body interference with the chordwise load distribution Author

N77-28080# Aeronautical Research Council, London (England)
INTERFERENCE PROBLEMS ON WING-FUSELAGE COMBINATIONS PART 2 SYMMETRICAL UNSWEPT WING AT ZERO INCIDENCE ATTACHED TO A CYLINDRICAL FUSELAGE AT ZERO INCIDENCE IN MIDWING POSITION
J Weber (RAE Farnborough Engl) and M G Joyce (RAE Farnborough Engl) 1975 71 p refs Supersedes RAE-TR-71179 and ARC-33437
(ARC-CP-1332, RAE-TR-71179 ARC-33437
ISBN-011-470942-4) Avail NTIS HC A04/MF A01, HMSO £2 30 PHI

The incompressible flow field past a single straight infinitely long source line which crosses a circular cylindrical fuselage at right angles was studied In particular the streamwise velocity component induced in the plane through the source line and the axis of the fuselage and the streamwise and circumferential velocity components induced on the surface of the fuselage were determined numerically The results are used to determine the interference effect on the displacement flow past an unswept wing of infinite aspect ratio attached to a cylindrical fuselage It is shown how the interference effect varies with the ratio R/c between the body radius and the wing chord Author

N77-28081# Aeronautical Research Council, London (England)
INTERFERENCE PROBLEMS ON WING-FUSELAGE COMBINATIONS PART 3 SYMMETRICAL SWEPT WING AT ZERO INCIDENCE ATTACHED TO A CYLINDRICAL FUSELAGE
J Weber (RAE Farnborough Engl) and M Gaynor Joyce (RAE Farnborough, Engl) 1975 83 p refs Supersedes RAE-TR-73189 and ARC-35413
(ARC-CP-1333 RAE-TR-73189 ARC-35413
ISBN-011-470943-2) Avail NTIS HC A05/MF A01 HMSO £2 60 PHI

The interference effect on the incompressible displacement flow past a swept wing attached to a cylindrical fuselage in midwing position is studied It is shown how this varies with the angle of sweep with the section shape and with the ratio R/c between the body radius and the wing chord To reduce the amount of computation only wings of constant chord and constant section shape are considered For these wings the results can easily be derived from the velocity field past a single kinked swept source line in the presence of a fuselage The streamwise velocity component induced in the plane through the source line and the axis of the fuselage and the streamwise and circumferential velocity components induced on the surface of the fuselage were determined numerically, and the values are tabulated It is shown by comparison with results from other methods that, by means of these tables, good estimates of the interference velocity can be derived also for tapered wings
Author

N77-28082# Aeronautical Research Council London (England)
INTERFERENCE PROBLEMS ON WING-FUSELAGE COMBINATIONS PART 4 THE DESIGN PROBLEM FOR A LIFTING SWEPT WING ATTACHED TO A CYLINDRICAL FUSELAGE
J Weber (RAE Farnborough, Engl) and M Gaynor Joyce (RAE Farnborough Engl) 1975 59 p refs Supersedes RAE-TR-73190 and ARC-35294
(ARC-CP-1334 RAE-TR-73190 ARC-35294
ISBN-011-470944-0) Avail NTIS HC A04/MF A01 HMSO £2 20 PHI

The incompressible flow field past a circular cylindrical fuselage and a kinked infinite swept vortex which lies in a plane through the axis of the fuselage was studied Values for the downwash in the plan and on the surface of the fuselage were determined numerically The values are tabulated for four angles of sweep 0 30 45, and 60 degrees The results are used to design wings of constant chord and infinite aspect ratio, attached to a cylindrical fuselage in midwing position for which the chordwise load distribution is given and the spanwise distribution in the presence of the fuselage is required to be constant It is shown how the interference effect varies with the angle of sweep with the ratio R/c between the body radius and the wing chord with the spanwise distance from the wing body junction and with the thickness of the wing Author

N77-28083# Weapons Research Establishment Salisbury (Australia)
CALCULATION OF PRESSURE DISTRIBUTIONS ON TWO AXISYMMETRIC BOATTAILED CONFIGURATIONS
M K Haselgrove Feb 1977 19 p refs
(WRE-TR-1779(W) AR-000-518) Avail NTIS HC A02/MF A01

Computer programs are used to calculate the pressure distributions on two axisymmetric boattailed configurations in inviscid incompressible flow Realistic results are obtained in the base region by extending the body surface to simulate the surface streamline separating from the base The results show that a favorable pressure gradient is created by replacing the rear portion of a boattail by a cylindrical section, and conversely an adverse gradient on a boattail is strengthened by the presence of a large sting on wind tunnel models Author

N77-28086*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A COMPARISON OF THE EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF AN OBLIQUE WING WITH THOSE OF A SWEPT WING
Edward J Hopkins and Sam C Yee (ARO Inc Moffett Field, Calif) Jun 1977 483 p refs
(NASA-TM-X-3547 A-6894) Avail NTIS HC A21/MF A01 CSCL 01A

Force and moment characteristics were measured for two trapezoidal oblique wings and a conventional swept wing mounted on a body of revolution at Mach numbers from 0 25 to 2 0 Both oblique wings had the same planform, but differed in profile and flexibility One of the oblique wings was made of solid steel and had a maximum thickness-to-chord ratio of 4 percent The other wing was built up by taking an aluminum wing and adding epoxy material to the upper surface to increase the maximum thickness-to-chord ratio to 8 2 percent The aspect ratio for both oblique wings when swept 45 deg and for the swept wing with 45 deg of sweep, was 4 1 Data were obtained at unit Reynolds numbers ranging from 3 3 to 8 2 million per meter and were compared with previously obtained data on the aluminum wing before it was built up with epoxy Wing flexibility designed into the aluminum and built-up aluminum oblique wings increased the range of lift coefficients from 0 30 to 0 70 over which the pitching-moment curves were linear However, flexibility did not improve the linearity of the rolling-moment curves and produced sizable side forces At a Mach number of 0 95, the trapezoidal oblique wing had little or no improvement in the lift/drag ratios over those for a conventional swept wing of the same aspect ratio sweep, and profile Author

N77-28087*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COMPARISON OF JET MACH NUMBER DECAY DATA WITH A CORRELATION AND JET SPREADING CONTOURS FOR A LARGE VARIETY OF NOZZLES
Donald E Groesbeck, Ronald G Huff, and Uwe H VonGlahn Washington Jun 1977 300 p refs
(NASA-TN-D-8423 E-8561) Avail NTIS HC A13/MF A01 CSCL 01A

Small-scale circular noncircular single- and multi-element nozzles with flow areas as large as 122 sq cm were tested with cold airflow at exit Mach numbers from 0 28 to 1 15 The effects of multi-element nozzle shape and element spacing on jet Mach number decay were studied in an effort to reduce the noise caused by jet impingement on externally blown flap (EBF)

STOL aircraft The jet Mach number decay data are well represented by empirical relations Jet spreading and Mach number decay contours are presented for all configurations tested
Author

N77-28088*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AERODYNAMIC PERFORMANCE OF 0 4066-SCALE MODEL OF JT8D REFAN STAGE WITH S-DUCT INLET
Royce D Moore George Kovich and George W Lewis Jr Washington May 1977 296 p refs
(NASA-TN-D-8458 E-8268) Avail NTIS HC A13/MF A01 CSCL 01A

A scale model of the JT8D refan stage was tested with a scale model of the S-duct inlet design for the refanned Boeing 727 center engine Detailed survey data of pressures temperatures and flow angles were obtained over a range of flows at speeds from 70 to 97 percent of design speed Two S-duct configurations were tested one with a bellmouth inlet and the other with a flight lip inlet The results indicated that the overall performance was essentially unaffected by the distortion generated by the S-duct inlet The stall weight flow increased by less than 0 5 kg/sec (approximately 1 5% of design flow) with the S-duct inlet compared with that obtained with uniform flow The detailed measurements indicated that the inlet guide vane (IGV) significantly reduced circumferential variations For example the flow angles ahead of the IGV were positive in the right half of the inlet and negative in the left half Behind the IGV the flow angles tended to be more uniform circumferentially Author

N77-28090*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AERODYNAMIC CHARACTERISTICS OF A 1/6-SCALE POWERED MODEL OF THE ROTOR SYSTEMS RESEARCH AIRCRAFT
Raymond E Mineck and Carl E Freeman Washington Jun 1977 240 p refs Prepared in cooperation with Army Air Mobility Res and Develop Lab Moffett Field Calif
(DA Proj 1F1-61101-AH-45)
(NASA-TM-X-3489, L-11287) Avail NTIS HC A11/MF A01 CSCL 01A

A wind-tunnel investigation was conducted to determine the effects of the main-rotor wake on the aerodynamic characteristics of the rotor systems research aircraft (RSRA) For the investigation a 1/6-scale model with a four-blade articulated main rotor was used Tests were conducted with and without the main rotor Both the helicopter and the compound helicopter were tested The latter configuration included the auxiliary thrust engines and the variable-incidence wing Data were obtained over ranges of angle of attack angle of sideslip and main-rotor collective pitch angle at several main-rotor advance ratios Results are presented for the total loads on the airframe as well as the loads on the rotor, the wing and the tail The results indicated that without the effect of the rotor wake, the RSRA had static longitudinal and directional stability and positive effective dihedral With the effect of the main rotor and its wake, the RSRA exhibited longitudinal instability but retained static directional stability and positive effective dihedral Author

N77-28091*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
WIND-TUNNEL INVESTIGATION OF A VARIABLE CAMBER AND TWIST WING
James C Ferris Washington Aug 1977 81 p refs
(NASA-TN-D-8475, L-11357) Avail NTIS HC A05/MF A01 CSCL 01A

The longitudinal aerodynamic characteristics of a 35 deg swept variable camber and twist semispan wing in the presence of a body were studied The variable camber and twist were incorporated to allow a near optimum lift distribution over the wing for both the cruise condition and the high lift conditions for maneuverability The wing incorporated movable leading-edge segments whose swept hinge lines provided maximum camber variations at the outboard leading edge and movable trailing-edge segments whose swept hinge lines provided maximum camber variations near the inboard trailing edge The model was investigated at Mach numbers of 0 60 0 80, and 0 90 through an angle-of-attack range from 0 deg to 10 deg or buffet onset
Author

N77-28092*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FREE-FLIGHT WIND-TUNNEL INVESTIGATION OF A FOUR-ENGINE SWEPTWING UPPER-SURFACE BLOWN TRANSPORT CONFIGURATION
Lysle P Parlett Washington Aug 1977 35 p refs
(NASA-TN-D-8479 L-11332) Avail NTIS HC A03/MF A01 CSCL 01A

The dynamic stability and control characteristics of a four-engine turbofan transport model having an upper-surface blown jet flap were investigated by means of the free-flight technique in the Langley full-scale tunnel The flight characteristics of the model were investigated through a range of lift coefficients from 3 to 8 with all four engines operating and with one outboard engine not operating Static characteristics were investigated by conventional power-on force tests over the flight-test angle-of-attack range and through the stall Author

N77-28093*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
INVESTIGATION OF EFFECT OF PROPULSION SYSTEM INSTALLATION AND OPERATION ON AERODYNAMICS OF AN AIRBREATHING HYPERSONIC AIRPLANE AT MACH 0 3 TO 1 2
James M Cubbage and Charles E Mercer Washington Jul 1977 94 p refs
(NASA-TN-D-8503) Avail NTIS HC A05/MF A01 CSCL 01A

Results from an investigation of the effects of the operation of a combined turbojet/scramjet propulsion system on the longitudinal aerodynamic characteristics of a 1/60-scale hypersonic airbreathing launch vehicle configuration are presented Decomposition products of hydrogen peroxide were used for simulation of the propulsion system exhaust Author

N77-28094*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AERODYNAMIC CHARACTERISTICS OF WING-BODY CONFIGURATION WITH TWO ADVANCED GENERAL AVIATION AIRFOIL SECTIONS AND SIMPLE FLAP SYSTEMS
Harry L Morgan Jr and John W Paulson Jr Washington Aug 1977 71 p refs
(NASA-TN-D-8524 L-11305) Avail NTIS HC A05/MF A01 CSCL 01A

Aerodynamic characteristics of a general aviation wing equipped with NACA 65 sub 2-415 NASA GA(W)-1 and NASA GA(PC)-1 airfoil sections were examined The NASA GA(W)-1 wing was equipped with plain split and slotted partial- and full-span flaps and ailerons The NASA GA(PC)-1 wing was equipped with plain partial- and full-span flaps Experimental chordwise static-pressure distribution and wake drag measurements were obtained for the NASA GA(PC)-1 wing at the 22 5-percent spanwise station Comparisons were made between the three wing configurations to evaluate the wing performance stall and maximum lift capabilities The results of this investigation indicated that the NASA GA(W)-1 wing had a higher maximum lift capability and almost equivalent drag values compared with both the NACA 65 sub 2-415 and NASA GA(PC)-1 wings The NASA GA(W)-1 had a maximum lift coefficient of 1 32 with 0 deg flap deflection and 1 78 with 41 6 deg deflection of the partial-span slotted flap The effectiveness of the NASA GA(W)-1 plain and slotted ailerons with differential deflections were equivalent The NASA GA(PC)-1 wing with full-span flaps deflected 0 deg for the design climb configuration showed improved lift and drag performance over the cruise flap setting of -10 deg
Author

N77-28097# Naval Ship Research and Development Center, Bethesda Md Aviation and Surface Effects Dept
EXPERIMENTAL OBSERVATIONS OF THE TWO-DIMENSIONAL POWER AUGMENTED RAM WING OPERATED STATICALLY OVER WATER Final Report, Jun - Feb. 1977
B H Carson Mar 1977 33 p refs
(AD-A038163, DTNSRDC/ASED-372) Avail NTIS HC A03/MF A01 CSCL 20/4

Experiments were performed in a rectangular tank partially filled with water and spanned by a flat-bottomed airfoil section derived from an NACA 0015 thickness distribution Upstream of the airfoil was placed a two-dimensional air jet also spanning the tank One side of the tank was transparent to permit flow visualization Two-dimensional turbulent jet theory was used to establish the relationship between the jet exit dynamic pressure and the pressure recovery under the wing which was supported by experimental evidence It was found that the recovery of pressure was not highly sensitive to jet geometry however the formation of spray was For minimum spray formation a jet impingement angle of about 25 deg was established Several interesting wind-wave flow instabilities were observed A thrust-reversal phenomenon, predicted by inviscid theory could not be duplicated in the present experiment Author (GRA)

N77-28100*# Little (Arthur D) Inc Cambridge Mass
THE MARKET FOR AIRLINE AIRCRAFT A STUDY OF PROCESS AND PERFORMANCE
Nov 1976 204 p refs Prepared in cooperation with Simat, Helliesen and Eichner Inc Tarrytown, N J
(Contract NASw-2971)
(NASA-CR-154617) Avail NTIS HC A10/MF A01 CSCL 01C

The key variables accounting for the nature timing and magnitude of the equipment and re-equipment cycle are identified and discussed Forecasts of aircraft purchases by U S trunk airlines over the next 10 years are included to examine the anatomy of equipment forecasts in a way that serves to illustrate how certain of these variables or determinants of aircraft demand can be considered in specific terms Author

N77-28102# Naval Weapons Center, China Lake, Calif
AIRCRAFT FIRE SIMULATOR TESTING OF CANDIDATE FIRE BARRIER SYSTEMS Test and Evaluation Report, Feb - Sep 1976
Herman H Hoffman and John S Fontenot Nov 1976 43 p
(AD-A038601 NWC-TP-5915) Avail NTIS HC A03/MF A01 CSCL 01/2

The results of a study to evaluate candidate aircraft fire barrier materials to in-flight fires are presented Four organic materials two inorganic materials, and three metallics combined with insulators were tested in an in-flight fire simulator Eight intumescent coatings were evaluated to determine their ability to close barrier gaps in the event of a fire Author (GRA)

N77-28103 Purdue Univ Lafayette Ind
MANUAL CONTROL DISPLAYS FOR A FOUR DIMENSIONAL LANDING APPROACH Ph D Thesis
James Taylor Silverthorn 1976 136 p
Avail Univ Microfilms Order No 77-1776

Six instrument rated pilots flew a STOL fixed base simulator to study the effectiveness of three displays for a four-dimensional approach The three examined displays were a digital readout of forward position error a digital speed command and an analog display showing forward position error and error prediction A flight director was used in all conditions All test runs were for a typical four-dimensional approach in moderate turbulence that included a change in commanded ground speed a change in flight path angle and two standard rate sixty degree turns Use of the digital forward position error display resulted in large overshoot in the forward position error The best overall performance was obtained using the speed command display It was demonstrated that curved approaches can be flown with relative ease Dissert Abstr

N77-28104# Aeronautical Research Council London (England)
DESIGN AND THEORETICAL ASSESSMENT OF EXPERIMENTAL GLIDE PATH AND FLARE SYSTEMS FOR A BAC 1-11 AIRCRAFT (INCLUDING DIRECT LIFT CONTROL)
F R Gill (RAE Farnborough Engl) and M J Corbin (RAE Farnborough Engl) 1975 66 p refs Supersedes RAE-TR-74013 and ARC-35979
(ARC-CP-1337 RAE-TR-74013 ARC-35979
ISBN-011-470947-5) Avail NTIS HC A04/MF A01 HMSO £2 60 PHI

Two experimental glide path and flare systems are described one using spoilers installed in the aircraft to provide direct lift control The various longitudinal control modes altitude hold glide path and flare have similar feedback control gains whose values were determined by parameter optimisation An assessment of the performance of these two systems is described Using elevator and throttle control only there was little improvement over current flare systems but use of high gain direct lift control gives significant improvement Author

N77-28106# Facility Checking Squadron (1868th) (AFCS) APO New York 09332
TRACALS EVALUATION REPORT NAVAIDS STATION EVALUATION REPORT, AVIANO AB, ITALY (16-23 AUGUST 1976) Final Report
Robert L Jones 25 Feb 1977 65 p
(AD-A038062 Rept-76/68-T-18) Avail NTIS HC A04/MF A01 CSCL 17/7

This Traffic Control and Landing Systems (TRACALS) station evaluation report presents data collected to define the capabilities and limitations of the Tactical Air Navigation (TACAN) System AN/GRN-19A with an AN/GRA-120 antenna system and associated power equipment at Aviano Air Base Italy Included in the report are coverage diagrams and analysis of airborne and ground performance data Data analysis indicates the configuration to be capable of satisfying the required mission The data presented in this report can be used as a valid guide to this facility s anticipated performance until there is a configuration change which alters the capabilities of the equipment or until a change occurs in the horizontal profile Author (GRA)

N77-28108*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
FLUT - A PROGRAM FOR AEROELASTIC STABILITY ANALYSIS
Erwin H Johnson Jun 1977 57 p refs
(NASA-TM-73217 A-6955) Avail NTIS HC A04/MF A01 CSCL 01C

A computer program (FLUT) that can be used to evaluate the aeroelastic stability of aircraft structures in subsonic flow is described The algorithm synthesizes data from a structural vibration analysis with an unsteady aerodynamics analysis and then performs a complex eigenvalue analysis to assess the system stability The theoretical basis of the program is discussed with special emphasis placed on some innovative techniques which improve the efficiency of the analysis User information needed to efficiently and successfully utilize the program is provided In addition to identifying the required input the flow of the program execution and some possible sources of difficulty are included The use of the program is demonstrated with a listing of the input and output for a simple example Author

N77-28109*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW-SPEED WIND-TUNNEL INVESTIGATION OF A LARGE-SCALE ADVANCED ARROW WING SUPERSONIC TRANSPORT CONFIGURATION WITH ENGINES MOUNTED ABOVE THE WING FOR UPPER-SURFACE BLOWING
James P Shivers H Clyde McLemore and Paul L Coe Jr 2 Aug 1977 67 p refs
(NASA-TM-X-72761) Avail NTIS HC A04/MF A01 CSCL 01C

The Langley full scale tunnel was used to investigate the low speed stability and control of an advanced arrow wing supersonic transport with engines mounted above the wing for upper-surface blowing Tests were made over an angle of attack

range of -10 to 32 deg slideslip angles of + or -5 deg and a Reynolds number ranging from 3 53 million to 7 33 million (referenced to mean aerodynamic chord of the wing) Configuration variables included trailing-edge flap deflection, engine jet nozzle angle engine thrust coefficient engine out operation, and asymmetrical trailing-edge BLC for providing roll trim Downwash measurements at the tail were obtained for different thrust coefficients tail heights and at two fuselage stations Author

N77-28110# Aeronautical Research Council, London (England)
AN ASSESSMENT OF THE ACCURACY OF SUBSONIC LINEARIZED THEORY FOR THE DESIGN OF WARPED SLENDER WINGS
Patricia J Davies (RAE Farnborough Engl) 1975 40 p refs Supersedes RAE-TR-73159 and ARC-35314
(ARC-CP-1324 Rae-TR-73159 ARC-35314
ISBN-011-470934-3) Avail NTIS HC A03/MF A01 HMSO £1 80, PHI

A series of warped slender wings were designed using the linearized theory of subsonic flow as a basis for a systematic experimental investigation of the drag reduction obtainable by warp at low speeds The force measurements on these wings are supplemented by measurements of the pressure distribution over one of them and the pressure distribution on it was calculated for inviscid incompressible flow by a surface singularity method The distribution of pressure used in the design is compared with those measured and calculated for the design incidence at which the flow was attached and assesses the validity of the linear theory The chief weaknesses are found to be on the thicker cross sections near the apex, and towards the trailing edge where boundary layer effects become significant Author

N77-28111*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
CONSTANT LIFT ROTOR FOR A HEAVIER THAN AIR CRAFT Patent Application
Robert H Stroub inventor (to NASA) Filed 25 Jul 1977 17 p
(NASA-Case-ARC-11045-1 US-Patent-Appl-SN-818916) Avail NTIS HC A02/MF A01 CSCL 01C

A constant lift rotor is described It consists of a rotor blade radially from a hub with an elongated spar and several axially aligned shells pivotally mounted on the spar each having an aerodynamic center located in trailing relation with the spar and supported for simultaneous axial and angular displacement as centrifugal forces are applied The pitch is controlled by limiting arms transverse to the spar each characterized by a cam surface along one edge supporting a cam follower of a truck pivotally connected to a shell and supported for pivotal motion about an axis coincident with a radius of the spar A push-pull link interconnects the arms for imparting pivotal motion whereby the angular relationship of the arms to the spar is varied for changing the motion of the trucks along the arms for limiting the pitch of the segments about the spar NASA

N77-28112*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOAD AND STABILITY MEASUREMENTS ON A SOFT-INPLANE ROTOR SYSTEM INCORPORATING ELASTOMERIC LEAD-LAG DAMPERS
William H Weller Washington Jul 1977 70 p refs Prepared in cooperation with the US Army Air Mobility R and D Lab Hampton Va
(DA Proj 1L2-62209-AH-76)
(NASA-TN-D-8437 L-11315) Avail NTIS HC A04/MF A01 CSCL 01C

An experimental investigation was conducted of the dynamic response and inplane stability associated with a new soft-inplane helicopter rotor The unique feature of this rotor was the use of an internal elastomeric damper to restrain the blade inplane motion about the lead-lag hinge The properties of the elastomer were selected to provide both a nominal first inplane frequency ratio of 0 65 and sufficient damping to eliminate the need for additional external damping sources to prevent ground resonance on a typical fuselage structure For this investigation a 1/5-scale aeroelastic model was used to represent the rotor The four-blade model had a diameter of 3 05 m (10 ft) and a solidity of 0 103 The first out-of-plane frequency ratio was 1 06 The model was tested in hover and in forward flight up to an advance ratio of 0 45 At each forward speed the rotor lift was varied up to simulated maneuver conditions The measured rotor loads and response were within acceptable limits and no adverse response qualities were observed Moderate out-of-plane hub moments were measured even for zero lift to indicate the beneficial control power available for this design Blade inplane stability testing indicated that the rotor system damping remained at moderate levels throughout the operating envelope Author

N77-28113*# Computer Sciences Corp Mountain View Calif
COMPUTERS FOR REAL TIME FLIGHT SIMULATION A MARKET SURVEY
George A Bekey and Walter J Karplus Washington NASA Jul 1977 84 p
(Contract NAS2-7806)
(NASA-CR-2885) Avail NTIS HC A05/MF A01 CSCL 01C

An extensive computer market survey was made to determine those available systems suitable for current and future flight simulation studies at Ames Research Center The primary requirement is for the computation of relatively high frequency content (5 Hz) math models representing powered lift flight vehicles The Rotor Systems Research Aircraft (RSRA) was used as a benchmark vehicle for computation comparison studies The general nature of helicopter simulations and a description of the benchmark model are presented and some of the sources of simulation difficulties are examined A description of various applicable computer architectures is presented along with detailed discussions of leading candidate systems and comparisons between them Author

N77-28114# Army Materials and Mechanics Research Center Watertown Mass
SECONDARY DAMAGE TO AIRCRAFT BY RICOCHETED SMALL ARMS PROJECTILES AND FRAGMENTS Final Report
Stuart V Arnold and Russel G Hardy Nov 1976 26 p
(AD-A038755 AMMRC-TR-76-35) Avail NTIS HC A03/MF A01 CSCL 19/1

Under certain conditions of oblique impact against aircraft structures small arms projectiles (or fragments thereof) ricochet thereby causing damage to adjoining structures components or personnel This report describes terminal ballistics of caliber 30 AP M2 and 7 62-mm ball M59 projectiles striking 0 375-inch-thick 2024-T351 aluminum and 0 25-inch-thick Ti-6Al-4V alloy plates over ranges of obliquity and velocity Effects of these factors upon potential for secondary damage are assessed Principles for design of aircraft structures to reduce vulnerability to ricochet damage are proposed Author (GRA)

N77-28115# Air Force Flight Test Center Edwards AFB Calif
C-141A PITOT-STATIC SYSTEM CALIBRATION TESTS
Ronald K Pomeroy Herbert Klein Joseph A Guthrie Jr and Thomas P Stafford Dec 1976 25 p refs
(AD-A036241) Avail NTIS HC A02/MF A01 CSCL 14/2

The flight test program consisted of six C 141A/T-38A pacer flights On flight 2 a series of tower fly-by points were also accomplished Prior to each flight a ground calibration of the aircraft s pitot-static systems was performed (Appendix B) Each of the six pacer flights consisted of 30 000 and 20 000 feet (MSL) cruise configuration and 10 000 feet (MSL) takeoff and landing configuration points On flight 5 adverse weather conditions prohibited flight operations at 10 000 feet The T 38A pacer position and alignment detailed in figure A1 enabled the pacer pilot to perceive small airspeed and altitude changes while maintaining a position outside the C-141A pressure wave GRA

N77-28116# Naval Postgraduate School Monterey Calif
A PERSONALIZED SYSTEM OF INSTRUCTION FOR AIRCRAFT PERFORMANCE M S Thesis
Donald Leslie Finch Mar 1977 412 p refs
(AD-A039654) Avail NTIS HC A18/MF A01 CSCL 05/9

A personalized system of instruction utilizing self-contained text material and combining the principle of autotutorial instruction with modified self-pacing was developed for a course in aircraft performance The course material was applied to the aircraft performance portion (six weeks) of a 12 week course in aircraft performance control and stability taught to 11 students The course results tended to confirm the advantages and substantial value of this instructional method GRA

N77-28118* National Aeronautics and Space Administration Langley Research Center Langley Station Va
DUAL CYCLE AIRCRAFT TURBINE ENGINE Patent
Mark R Nichols inventor (to NASA) Issued 5 Jul 1977 8 p Filed 6 Sep 1973 Supersedes N73-31699 (11 - 22 p 2710)
(NASA-Case-LAR-11310-1 US-Patent-4 033,119
US-Patent-Appl-SN-394898 US-Patent-Class-60-226R
US-Patent-Class-60-263 US-Patent-Class-415-145) Avail US Patent Office CSCL 21E

A method and apparatus are presented for improving operating efficiency over broad ranges of flight conditions and for reducing jet engine noise output in takeoff and landing by controlling the airflow entering and exiting the engines A turbojet engine apparatus is described which operates efficiently at both subsonic and supersonic speeds and a method is described which enables a turbofan with an associated satellite turbojet or turbofan to operate more efficiently at both subsonic and supersonic speeds In both cases takeoff and landing noise is reduced substantially The apparatus consists essentially of arranging for two separate portions of an engine to act upon one airstream or alternately to operate on independent airstreams
Official Gazette of the U S Patent Office

N77-28119*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AERO-ACOUSTIC PERFORMANCE COMPARISON OF CORE ENGINE NOISE SUPPRESSORS ON NASA QUIET ENGINE C
Harvey E Bloomer and John W Schaefer Jul 1977 20 p refs Presented at the 13th Propulsion Conf Orlando Fla 11-13 Jul 1977 Cosponsored by the Am Inst of Aeron and the Soc of Automotive Engr
(NASA-TM-X-73662 E-9182) Avail NTIS HC A02/MF A01 CSCL 21H

The relative aero-acoustic effectiveness of two core engine suppressors a contractor-designed suppressor delivered with the Quiet Engine, and a NASA-designed suppressor was evaluated The NASA suppressor was tested with and without a splitter making a total of three configurations being reported in addition to the baseline hardwall case The aerodynamic results are presented in terms of tailpipe pressure loss corrected net thrust and corrected specific fuel consumption as functions of engine power setting The acoustic results are divided into duct and far-field acoustic data The NASA-designed core suppressor did the better job of suppressing aft end noise, but the splitter associated with it caused a significant engine performance penalty The NASA core suppressor without the splitter suppressed most of the core noise without any engine performance penalty
Author

N77-28121# Aeronautical Research Council London (England)
THE EFFECT OF TEMPERATURE ON SUBSONIC JET NOISE
B J Cocking (Natl Gas Turbine Estab Farnborough Engl) 1975 41 p refs Supersedes NGTER-331 and ARC 35575
(ARC-R/M-3771 NGTER-331 ARC-35575
ISBN-0-11-4709165) Avail NTIS HC A03/MF A01 HMSO £3 50, PHI

The noise levels produced by hot and cold subsonic jets were measured using a convergent circular nozzle in an anechoic chamber The effects of jet temperature on the sound power the overall sound pressure levels, and the spectra of the jet noise are presented Results show an unexpected increase in noise with increasing jet temperature at low jet velocities The possibility of observation arising from sources upstream of the nozzle exit is considered and discounted It is concluded that both the spectral shapes and the overall sound pressure level of a hot jet are significantly affected by refraction of the sound jet The overall sound pressure levels were correlated to form the basis of a method for the prediction of the noise from static jets
Author

N77-28122*# General Electric Co Evendale Ohio Aircraft Engine Group
ATTENUATION OF UPSTREAM-GENERATED LOW FREQUENCY NOISE BY GAS TURBINES Final Report
V L Doyle and R K Matta Aug 1977 232 p refs
(Contract NAS3-19435)
(NASA-CR-135219 R77AEG482) Avail NTIS HC A11/MF A01 CSCL 20A

The acoustic transfer functions of low frequency (below 3500 Hz) noise through aircraft turbines were investigated Model test results were compared with theoretical predictions in order to assess the validity of the theory Component tests were conducted on both high pressure and low pressure model turbines The influence of inlet temperature and turbine speed attenuation was evaluated, while the effects of turbine pressure ratio blade-row choking and additional downstream stages were determined Preliminary identification of pertinent aeroacoustic correlating parameters was made
Author

N77-28123*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FULL-SCALE ALTITUDE ENGINE TEST OF A TURBOFAN EXHAUST-GAS-FORCED MIXER TO REDUCE THRUST SPECIFIC FUEL CONSUMPTION
Richard R Cullom and Roy L Johnson Jul 1977 31 p refs
(NASA-TM-X-3568 E-9111) Avail NTIS HC A03/MF A01 CSCL 21E

The specific fuel consumption of a low-bypass-ratio confluent-flow turbofan engine was measured with and without a mixer installed Tests were conducted for flight Mach numbers from 0 3 to 1 4 and altitudes from 10,670 to 14 630 meters (35 000 to 48 000 ft) for core-stream-to-fan-stream temperature ratios of 2 0 and 2 5 and mixing-length-to-diameter ratios of 0 95 and 1 74 For these test conditions, the reduction in specific fuel consumption varied from 2 5 percent to 4 0 percent Pressure loss measurements as well as temperature and pressure surveys at the mixer inlet the mixer exit and the nozzle inlet were made
Author

N77-28126# General Electric Co Cincinnati, Ohio
SUPERSONIC JET EXHAUST NOISE INVESTIGATION VOLUME 2 TECHNICAL REPORT
Paul R Knott, R Mani C L Merkle, H S Ribner and P Scott Jul 1976 393 p refs
(Contract F33615-73-C-2031)
(AD-A038613 R74AEG452-Vol-2 AFAPL-TR-76-68-Vol-2) Avail NTIS HC A17/MF A01 CSCL 20/1

This report discusses detailed accounts of major theoretical and experimental investigations directed toward obtaining better understanding and mathematical specification of supersonic turbulent jets Complete theoretical discussions are given describing the influence of a jet s mean flow shrouding on acoustic radiation of heated and unheated jets approximate closed form acoustic expressions for turbulent mixing noise characterized by self-noise and shear-noise are given and theoretical aero-acoustic formulations for the orderly structure of supersonic jets are reviewed Extensive theory/data comparisons of developed acoustic models are given Experimental investigations aimed at studying high velocity jet refraction and the influence of jet swirl and upstream combustion roughness on jet noise is presented Additionally an extensive series of laser velocimeter measurements for high velocity and high temperature simple circular jets is discussed Results include hot-film/laser velocimeter comparisons for ambient jets mean velocity and turbulent velocity plume surveys of heated supersonic shock-free and shocked flow nozzles and a demonstration experiment illustrating the capability of performing in-jet turbulence to far-field acoustic cross-correlation
Author (GRA)

N77-28127# General Electric Co , Cincinnati, Ohio
SUPERSONIC JET EXHAUST NOISE INVESTIGATION VOLUME 3 COMPUTER USERS MANUAL FOR AERO-ACOUSTIC PREDICTIONS Final Technical Report, 1 Dec 1972 - 23 Sep 1975
David R Ferguson Michael A Smith, and Paul R Knott Jul 1976 701 p refs
(Contract F33615-73-C-2031)
(AD-A038614 R74AEG452-Vol-3, AFAPL-TR-76-68-Vol-3) Avail NTIS HC A99/MF A01 CSCL 20/1

This report gives a detailed description of aerodynamic (Shock-free/Shocked flow) and acoustic turbulent mixing computer prediction programs developed by the General Electric Company for subsonic and supersonic simple exhaust jets In addition to giving detailed descriptions of the aeroacoustic formulations and discussions of computer manual instructions for operating the program extensive theory/data comparisons are given as well as computer program listings and sample test cases
Author (GRA)

N77-28129# General Motors Corp , Indianapolis Ind Detroit Diesel Allison Div
LOW-EMISSIONS COMBUSTOR DEMONSTRATION Final Report, 1 Mar 1974 - 31 Dec 1975
D L Troth Mar 1977 405 p refs
(Contract DAAJ02-74-C-0025)
(AD-A038550 DDA-EDR-8723 USAAMRDL-TR-76-29) Avail NTIS HC A18/MF A01 CSCL 21/5

The objectives of this eighteen-month program were to further develop two low-emission combustors-the prechamber combustor and the modified conventional combustor to install them in a Detroit Diesel Allison Model 250-C20B engine and to evaluate their performance in an engine environment The combustors were to retain the 50% overall reduction in gas turbine mass emissions with no increase in any individual pollutant when tested over a typical Army light observation helicopter (LOH) duty cycle
GRA

N77-28130# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
THE ELECTROSTATIC SENSING OF SIMULATED MA-1A GAS PATH DISTRESSES M S Thesis
Robert Wesley Dunn Dec 1976 77 p refs
(AD-A038527 AFIT/GNE/PH/76-2) Avail NTIS HC A05/MF A01 CSCL 14/2

Jet engine distresses were simulated using a MA-1A start cart Three primary methods were used to distress the gas turbine engine Material was ingested through the compressor intake the compressor section was rubbed with an aluminum rod and foreign material was burned in the combustor can The current wave forms created by these distresses were observed with four separate detectors Since the MA-1A was on rubber tires the current between the chassis and ground could be measured This chassis current was equal to the rate at which charge was expelled in the exhaust A Gaussian ring around the exhaust port provided a second way of detecting charges leaving the start cart The third and fourth devices were an ion probe and a screen that were placed in the exhaust
GRA

N77-28131# Massachusetts Inst of Tech Cambridge Gas Turbine Lab
STUDIES ON TRANSONIC TURBINES WITH FILM-COOLED BLADES Annual Technical Report, 1 Jul 1975 - 30 Jun 1976
H O Demuren N Adams F Hajjar O M Amana and Jean F Louis Jun 1976 110 p refs
(Contract N00014-67-A-0204-0079)
(AD-A036402 TR-76-1 ATR-3) Avail NTIS HC A06/MF A01 CSCL 21/5

In the third year of the contract further advances were made towards the goal of gathering the heat transfer and aerodynamics flow data necessary for a good understanding of the performance of film-cooled highly-loaded transonic turbine blading The MIT cascade blowdown facility now fully operational was used in evaluating the heat transfer performance of the four blade profiles designed in the first year of the program The results show that the level of turbulence is an important parameter in determining heat transfer in transonic cascades It also shows that the heat transfer to the trailing edge of the blades is very high being about 75% of the heat transfer to the leading edge A comparison of the Nusselt number calculated from heat transfer measurements with the Nusselt number obtained by a prediction method using the pressure distribution shows good correspondence The variation of average Stanton number over a range of Mach numbers shows that the reference blade has the most superior heat transfer performance Preliminary data has been obtained on the off-design performance of the blades and full scale tests are underway Comparative studies show that about 21% less heat needs to be taken out by internal cooling if one stage of a transonic turbine is used to replace two moderately loaded subsonic stages which produce the same output have the same inlet stagnation conditions have the same mass flow and the same tip speed This demonstrates one of the potential advantages of transonic turbines
GRA

N77-28132# Detroit Diesel Allison Indianapolis Ind
COMPRESSOR STATOR TIME-VARIANT AERODYNAMIC RESPONSE TO UPSTREAM ROTOR WAKES Interim Report
Sanford Fleeter Robert L Jay and William A Bennett Nov 1976 121 p refs
(Contract F44620-74-C-0065 AF Proj 9781)
(AD-A036343 DDA-EDR-9005 AFOSR-77-0066TR) Avail NTIS HC A02/MF A01 CSCL 21/5

An experimental investigation was conducted to determine the fluctuating pressure distribution on a stationary vane row with the primary source of excitation being the wakes from the upstream rotor blades This was accomplished in a large scale low speed single stage research compressor The forcing function the velocity defect created by the rotor wakes was measured with a crossed hot-wire probe The aerodynamic response on the vanes was measured by means of flush mounted high response dynamic pressure transducers The dynamic data were analyzed to determine the chordwise distribution of the dynamic pressure coefficient and aerodynamic phase lag as referenced to a transverse gust at the vane leading edge Vane suction and pressure surface data as well as the pressure difference across the vane were obtained for reduced frequency values ranging from 3 65 to 16 80 and for incidence angles from -4 5 to -31 0 deg The pressure difference data were correlated with a state-of-the-art aerodynamic cascade transverse gust analysis
Author (GRA)

N77-28133# California Inst of Tech Pasadena Guggenheim Jet Propulsion Center
ANALYTICAL STUDIES OF SOME ACOUSTIC PROBLEMS OF JET ENGINES Ph D Thesis Interim Report
Sebastien M Candel Washington DOT May 1976 240 p refs
(Contract DOT-OST-20197)
(PB-264918/4 DOT-TST-76-104) Avail NTIS HC A11/MF A01 CSCL 21E

The propagation and generation of acoustic waves in a choked nozzle is considered where pressure and entropy fluctuations caused by gas stream non-uniformities like hot spots are incident on the nozzle entrance A noise-generation mechanism is found which produces acoustic waves of strength proportional to the entrance entropy fluctuation and local gradient of the mean flow velocity A transformation is introduced which relates the solutions of problems involving the propagation of acoustic waves in a moving medium to the solutions of associated problems in a stationary medium
GRA

N77-28134 Aeronautical Research Labs , Melbourne (Australia)
THE EFFECT OF SPANWISE GUST VARIATIONS ON THE TRANSFER FUNCTION OF AN AIRCRAFT MODEL WITH ONE DEGREE OF FREEDOM
Douglas John Sherman Aug 1976 31 p refs
(ARL-Struc-Note-431 AR-228) Copyright Avail Issuing Activity

Charts are derived for the determination of the power spectrum parameters (a standard deviation of vertical acceleration at aircraft center of gravity/standard deviation of vertical gust velocity and N sub 0 rate of level crossings of mean value), due to atmospheric turbulence The method takes account of spanwise variations in gust loading and so overcomes the paradox of an infinite N sub 0 which is found with a one-dimensional gust model
Author

N77-28135*# Kansas Univ Center for Research Inc Lawrence
FLIGHT EVALUATION OF A SPOILER ROLL CONTROL SYSTEM ON A LIGHT TWIN-ENGINE AIRPLANE
David L Kohlman Dec 1976 50 p refs
(Grant NsG-1227)
(NASA-CR-154121 KU-FRL-203) Avail NTIS HC A03/MF A01 CSCL 01C

Slot lip spoilers were designed installed and flight tested on a modified Piper PA34-200 aircraft Data obtained during in-flight monitoring are presented and discussed Topics include configuration description instrumentation, spoiler roll characteristics, and wheel deflections and forces
A R H

N77-28136*# Old Dominion Univ Research Foundation Norfolk, Va
EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS TO IMPROVE LOW-SPEED PERFORMANCE AND STABILITY AND CONTROL CHARACTERISTICS OF SUPERSONIC CRUISE FIGHTER VEHICLES Final Report
A B Graham Jun 1977 5 p
(Grant NsG-1309)
(NASA-CR-154122) Avail NTIS HC A02/MF A01 CSCL 01C

Small- and large-scale models of supersonic cruise fighter vehicles were used to determine the effectiveness of airframe/propulsion integration concepts for improved low-speed performance and stability and control characteristics Computer programs were used for engine/airframe sizing studies to yield optimum vehicle performance
Author

N77-28137*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLIGHT INVESTIGATION OF A VERTICAL-VELOCITY COMMAND SYSTEM FOR VTOL AIRCRAFT
James R Kelly Frank R Niessen Kenneth R Yenni and Lee H Person Jr Washington Jul 1977 26 p refs
(NASA-TN-D-8480 L-11454) Avail NTIS HC A03/MF A01 CSCL 01C

A flight investigation was undertaken to assess the potential benefits afforded by a vertical-velocity command system (VVCS) for VTOL (vertical take-off and landing) aircraft This augmentation system was conceived primarily as a means of lowering pilot workload during decelerating approaches to a hover and/or landing under category III instrument meteorological conditions The scope of the investigation included a determination of acceptable system parameters a visual flight evaluation and an instrument flight evaluation which employed a 10 deg decelerating simulated instrument approach task The results indicated that the VVCS which decouples the pitch and vertical degrees of freedom provides more accurate glide-path tracking and a lower pilot workload than does the unaugmented system
Author

N77-28138*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
A THEORETICAL ANALYSIS OF AIRPLANE LONGITUDINAL STABILITY AND CONTROL AS AFFECTED BY WIND SHEAR
Windsor L Sherman Washington Jul 1977 53 p refs
(NASA-TN-D-8496 L-11392) Avail NTIS HC A04/MF A01 CSCL 01C

The longitudinal equations of motion with wind shear terms were used to analyze the stability and motions of a jet transport A positive wind shear gives a decreasing head wind or changes a head wind into a tail wind A negative wind shear gives a decreasing tail wind or changes a tail wind into a head wind It was found that wind shear had very little effect on the short period mode and that negative wind shear although it affected the phugoid did not cause stability problems On the other hand, it was found that positive wind shear can cause the phugoid to become aperiodic and unstable In this case a stability boundary for the phugoid was found that is valid for most aircraft at all flight speeds Calculations of aircraft motions confirmed the results of the stability analysis It was found that a flight path control automatic pilot and an airspeed control system provide good control in all types of wind shear Appendixes give equations of motion that include the effects of downdrafts and updrafts and extend the longitudinal equations of motion for shear to six degrees of freedom
Author

N77-28139*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
AN INVESTIGATION OF A CLOSE-COUPLED CANARD AS A DIRECT SIDE-FORCE GENERATOR ON A FIGHTER MODEL AT MACH NUMBERS FROM 0 40 TO 0 90
Richard J Re and Francis J Capone Washington Jul 1977 37 p refs
(NASA-TN-D-8510 L-11613) Avail NTIS HC A03/MF A01 CSCL 01C

The canard panels had 5 deg of dihedral and were deflected differentially or individually over an incidence range from 10 deg to -10 deg and a model angle-of-attack range from -4 deg to 15 deg Significant side forces were generated in a transonic tunnel by differential and single canard-panel deflections over the Mach number and angle-of-attack ranges The yawing moment resulting from the forward location of the generated side force would necessitate a vertical tail/rudder trim force which would augment the forebody side force and be of comparable magnitude Incremental side forces yawing moments, lift and pitching moments due to single canard-panel deflections were additive that is, their sums were essentially the same as the forces and moments produced by differential canard-panel deflections of the same magnitude Differential and single canard-panel deflections produced negligible rolling moments over the Mach number and angle-of-attack ranges
Author

N77-28140# Boeing Vertol Co , Philadelphia Pa
THE CH-47C VULNERABILITY REDUCTION MODIFICATION PROGRAM FLY-BY-WIRE BACKUP DEMONSTRATION Final Report, Jul 1975 - Mar 1976
Bruce McManus and Joseph Gonsalves Aug 1976 157 p refs
(Contract DAAJ02-75-C-0052, DA Proj 1F2-62209-AH-76)
(AD-A030682, D210-11046-1 USAAMRDL-TR-76-22) Avail NTIS HC A08/MF A01 CSCL 01/3

The purpose of the work performed was to accomplish a laboratory demonstration of a fly-by-wire (FBW) backup flight control system for application to the CH-47C helicopter Tests, evaluations, and an analysis were conducted to determine the feasibility of using an electrical linkage as a backup to the existing mechanical flight control system Of primary concern was the interfacing technique between the two systems, which was to result in no degradation of control system performance during normal operation and which would permit safe operation of the aircraft in the event of a failure in either the mechanical or the FBW backup system The program was performed in four tasks Task I involved the definition of a FBW backup system based on use of HLH ATC components suitable to demonstrate concept feasibility on the Boeing Iron Bird flight control test rig Task II involved the modification and installation of the system on the test rig with the actual testing and performance evaluation being conducted during Task III Task IV effort involved the reassessment of effects analysis conducted under Contract DAAJ02-74-C-0052
Author (GRA)

N77-28141# Human Engineering Labs Aberdeen Proving Ground Md
HELICOPTER INTEGRATED CONTROL (GAT-2H) Final Report
John D Waugh and John A Stephens Dec 1976 33 p refs (AD-A036204 HEL-TM-39-76) Avail NTIS HC A03/MF A01 CSCL 01/3

Two experimental three-axis helicopter controls combining collective and cyclic functions into an optional one-handed controller were simulator flight tested and their performance measured in energy-expended terms was compared to conventional helicopter controls The nature of the results indicates that further development through flight testing should be undertaken Author (GRA)

N77-28143*# National Bureau of Standards, Boulder Colo Cryogenics Div
CRYOGENIC DESIGN AND SAFETY REVIEW NASA-LANGLEY RESEARCH CENTER 0 3 METER TRANSONIC CRYOGENIC TUNNEL
R O Voth and T R Strobridge Apr 1977 28 p refs Sponsored by NASA
(NASA-TM-74767, NBSIR-77-857) Avail NTIS HC A03/MF A01 CSCL 14B

A cryogenic design and safety review of a 0 3 m transonic cryogenic tunnel is presented The tunnel working fluid and coolant is nitrogen The nitrogen, supplied as liquid is exhausted as a low temperature gas The tunnel and ancillary systems are generally well designed but several recommendations to improve the cryogenic systems are made The cost of recovering the cold vent gas is compared to the cost of producing the required liquid nitrogen using a captive air separation plant Although the economic analysis is preliminary it shows that because of the periodic operation of the tunnel a captive air separation plant has a lower annual operating cost than the vent gas recovery systems considered Author

N77-28144# Aeronautical Research Council, London (England)
UREA FORMADEHYDE FOAMED PLASTIC EMERGENCY ARRESTERS FOR CIVIL AIRCRAFT
G M Gwynne (RAE Bedford England) 1975 62 p refs Supersedes RAE-TR-74002 and ARC-35771
(ARC-CP-1329, RAE-TR-74002, ARC-35771 ISBN-011-470939-4) Avail NTIS HC A04/MF A01 HMSO £2 20,PHI

Arresting trials with a Comet 3B aircraft at its maximum landing mass of 54,400 kg at speeds up to 56 kn in test beds of urea formaldehyde foam of varying depth length and density are described The main conclusions from the trials are that retardation of the aircraft in the arrester is independent of entry speed and significant drag is contributed by both the leading and trailing wheels of a bogie arrangement and the drag is predictable The performance of the arrester is unaffected by the application of antiskid controlled wheel brakes The foam causes no significant damage to turbine engines or aircraft structure, and the addition of a foam lead in gradient to the full depth foam bed reduces the ratio of peak to mean retardation A number of minor conclusions are also presented Design examples for foam arresters demonstrating that it should be possible to devise configurations suitable for airfields where overrun hazards exist for arresting aircraft safety without overstressing undercarriage units due to the foam drag loads are also included Author

N77-28145*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FORCE TESTING MANUAL FOR THE LANGLEY 20-INCH MACH 6 TUNNEL
J Wayne Keyes Jul 1977 100 p
(NASA-TM-74026) Avail NTIS HC A05/MF A01 CSCL 14B

Data reduction and procedures for conducting force tests in a 20 inch Mach 6 tunnel are described A discussion of pretest and testing phases are included Items that are to be checked during model design and construction are outlined as well as safety requirements, starting loads tests instructions for data acquisition and model installation Measurement of balance and model misalignment and instructions for calibrating the angle of attack screen are covered Procedures for making reference pressure attitude tare and data runs are included The 20 inch tunnel force program is examined and a description of data recording system input and load contrast sheets is given An appendix presents a description operating characteristics and Mach number calibration of the tunnel as well as tunnel characteristics Author

N77-28146# Illinois Univ Urbana-Champaign Savoy Aviation Research Lab
SIMULATORS FOR TRAINING AND PROFIT
Charles O Hopkins Jul 1976 10 p refs
(Contract F44620-76-C-0009)
(AD-A038190, ARL-76-10/AFOSR-76-5 AFOSR-77-0373TR) Avail NTIS HC A02/MF A01 CSCL 05/9

The use of simulators for training and profit is discussed in terms of the concept of cost effectiveness Increased degree and fidelity of simulation require greater equipment complexity and cost Data are presented that show a high negative correlation between cost and field reliability of avionics equipment There is a paucity of research data on the relationships between simulator fidelity and transfer effectiveness The results of the first and only recently completed experiment to investigate transfer of initial flight training as a function of simulator cockpit motion are summarized A rational basis for simulator selection and use developed by Jacobs and Roscoe is presented The need for research to establish relationships between transfer of training and physical characteristics such as degree and fidelity of simulation is seen as critical to the widespread future use of simulators for training and profit Author (GRA)

N77-28147# Illinois Univ Urbana-Champaign Savoy Aviation Research Lab
SIMULATOR COCKPIT MOTION AND THE TRANSFER OF INITIAL FLIGHT TRAINING
Robert S Jacobs Jun 1976 90 p refs
(Contract F44620-76-C-0009)
(AD-A038194 ARL-76-8/AFOSR-76-4 AFOSR-77-0380TR) Avail NTIS HC A05/MF A01 CSCL 05/9

Transfer of flight training from a Singer-Link GAT-2 training simulator modified to approximate a counterpart Piper Cherokee Arrow airplane was measured for independent groups of nine flight-naive subjects each trained in one of three simulator cockpit motion conditions normal washout motion in bank with sustained pitch angles washout banking motion in which the direction of motion relative to that of the simulated airplane was randomly reversed 50% of the time as the cab passed through a wings-level attitude and a fixed-base condition Subjects received predetermined fixed amounts of practice in the simulator on each of 11 flight maneuvers drawn from the Private Pilot flight curriculum Transfer performance measures including flight time and trials to FAA performance criteria and total errors made in the process showed reliable transfer for all groups with differential transfer effects and cost effectiveness implications depending upon the type of simulator motion An aptitude estimator measure and the analysis of covariance technique provided increased discrimination among groups in the presence of considerable individual variation in performance within treatment conditions Author (GRA)

N77-28149# Naval Civil Engineering Lab Port Hueneme Calif
EXPEDIENT STRUCTURAL SANDWICH SOIL SURFACING OF FIBERGLASS REINFORCED POLYESTER AND POLY-URETHANE FOAM Technical Note, Jun 1973 - Jun 1976
M C Hironaka R B Brownie and S Tuccillo Feb 1977 66 p refs
(AD-A038417 CEL-TN-1472) Avail NTIS HC A04/MF A01 CSCL 13/13

A structural soil surfacing (FOMAT) consisting of a rigid polyurethane foam core sandwiched between two fiberglass reinforced plastic (FRP) layers is being developed to fulfill a need for a designable heavy-duty expedient surfacing for Marine

Corps amphibious landing applications In analytical and laboratory investigations FOMAT showed very good potential for meeting expedient surfacing requirements The FOMAT constructed of 15- and 20-pcf-density foams will adequately carry F4 aircraft wheel loadings as determined from finite element computer analyses and plate loading tests in a mechanical simulated subgrade Tests performed on FOMAT with 20-pcf foam core showed that it meets or exceeds F4 aircraft arresting gear hook/impact and jet engine heat/blast performance specifications for a heavy-duty matting Construction of FOMAT under field conditions indicated a problem with bonding of the polyurethane foam core and the bottom FRP layer causing premature termination of simulated F4 aircraft wheel traffic tests on eight FOMAT panels located on heavy clay lean clay, and sand soils FOMAT panels consisting of 15- and 20-pcf density and 1- and 2-inch-thick foam cores were subjected to the traffic loadings At a maximum of 40 passes on two panels of 2-inch-thick 15-pcf and 2-inch-thick 20-pcf foam core a wheel deflection of 1 inch on the FOMAT surface was experienced Development of field construction techniques to insure a positive bond between the foam core and bottom FRP layer is recommended

Author (GRA)

N77-28150# Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering

TECHNIQUES FOR THE INITIAL EVALUATION OF FLIGHT SIMULATOR EFFECTIVENESS M S Thesis

Ralph L Miller Dec 1976 105 p refs

(AD-A036460 GSM/SM/76D-34) Avail NTIS HC A06/MF A01 CSCL 14/2

This report presents an analysis of the development and initial evaluation of Air Force flight simulators The objectives of the study were to determine the criterion variables most applicable to an initial flight simulator evaluation and to develop a general technique for the evaluation of these criterion variables The research began with a review of current Navy Army and Air Force flight simulator development and evaluation techniques This review combined with information gathered from related sources provided the basis for examination and selection of criterion variables The variables examined by this effort were aircraft flight time saved, training efficiency transfer of training fidelity of psychological simulation fidelity of engineering simulation and simulator effectiveness The examination of these variables concentrated on their measurability during an initial flight simulator evaluation and their ability to predict how well a flight simulator would perform its intended mission Following the examination of criterion variables the research concentrated on the development of a technique for the evaluation of applicable criterion variables The resulting technique is a combination of the traditional quantitative techniques plus some subjective techniques The purpose of the subjective techniques is to identify simulator characteristics that are perceived to be different from the real work aircraft characteristics and to assess the impact that these differences will have on the operational use of the flight simulator Author (GRA)

N77-28225* National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex

SURFACE FINISHING Patent

Jack A Kinzler James T Hefferman Leroy G Fehrenkamp and William S Lee inventors (to NASA) Issued 28 Jun 1977 8 p Filed 16 Apr 1975 Supersedes N75-23476 (13 - 15, p 1752)

(NASA-Case-MSC-12631-1 US-Patent-4 032 089 US-Patent-Appl-SN-568541 US-Patent-Class-244-123 US-Patent-Class-428-141, US-Patent-Class-428-161 US-Patent-Class-428-425 US-Patent-Class-428-457 US-Patent-Class-428-458, US-Patent-Class-156-229) Avail US Patent Office CSCL 11D

A surface of an article adapted for relative motion with a fluid environment is finished by coating the surface with a fluid adhesive The adhesive is covered with a sheet of flexible film material under tension and the adhesive is set while maintaining tension on the film material

Official Gazette of the U S Patent Office

N77-28232# Hercules Inc Magna Utah Bacchus Works

GRAPHITE COMPOSITE AIRCRAFT LANDING GEAR WHEEL Final Report, 18 Mar 1974 - 30 Oct 1975

May 1976 91 p

(Contract F33615-74-C-3040)

(AD-A036207 AFFDL-TR-76-38) Avail NTIS HC A05/MF A01 CSCL 01/3

The effort during Phase I of the contract included detailed design of a composite wheel assembly to function structurally and mechanically in a manner identical to the existing metal braked main landing gear wheel for the T-39 aircraft The design and analysis of the graphite composite landing gear wheel was based on demonstrated material properties A thermal analysis of the composite structure showed the maximum wheel temperature to be 406 F adjacent to the steel brake keys (inner wheel half) and 223 F on the outer wheel half Hercules 4397/AS resin system was selected for the inner wheel half and 3501/AS for the outer half During Phase II one inner and two outer wheel halves were fabricated Author (GRA)

N77-28267 Aeronautical Research Labs Melbourne (Australia)

THE DISTRIBUTION OF FRACTURE TOUGHNESS DATA FOR D6ac STEEL

Jacqueline Coyle J M Grandage and D G Ford Aug 1976 13 p refs

(ARL/Struc Note-429) Copyright Avail Issuing Activity

Data on the fracture toughness of D6ac steel is analyzed for conformity with three probability distributions The three parameter extreme value distribution is selected and parameters are estimated for specified conditions Author

N77-28282# Wright State Univ Dayton, Ohio Dept of Engineering

LIFE PREDICTION TECHNIQUES FOR ANALYZING CREEP-FATIGUE INTERACTION IN ADVANCED NICKEL-BASE ALLOYS Final Technical Report, 8 Jul 1975 - 7 Jul 1976

M N Menon Wright-Patterson AFB, Ohio AFML Nov 1976 65 p refs

(Contract F33615-76-C-5030 AF Proj 2279)

(AD-A038069 AFML-TR-76-172) Avail NTIS HC A04/MF A01 CSCL 11/6

On the basis of the limited data that are presented in this study it may be concluded that the effect of creep damage on the low cycle fatigue behavior of Rene 95 at 1200 F is not very severe This is probably because of the good stress rupture properties of the material at this temperature Strain Range Partitioning approach does not seem to hold much promise for analyzing, and therefore, for predicting strain controlled low cycle fatigue behavior of Rene 95 under creep-fatigue conditions at 1200 F When compared to the SRP approach the Frequency Modified approach appears less cumbersome and, hence, more advantageous The present study indicates however that the FM approach using the frequencies calculated on the basis of the actual cycles holds only a slight edge over that involving unmodified inelastic strain range versus cyclic life representation At present, the damage approach proposed by Ostergren seems to offer more potential as it takes into account the aspect of loop shift that accompanies fatigue cycling of Rene 95 GRA

N77-28316# Drexel Univ Philadelphia Pa Dept of Mechanical Engineering and Mechanics

IMPACT BEHAVIOR OF POLYMERIC MATRIX COMPOSITE MATERIALS Final Technical Report, Mar 1975 - Jul 1976

Pei Chi Chou and Richard W Mortimer Wright-Patterson AFB Ohio AFML Dec 1976 93 p refs

(Contract F33615-73-C-5102)

(AD-A038188, AFML-TR-76-242) Avail NTIS HC A05/MF A01 CSCL 21/5

The problem of foreign-object impacts of jet-engine fan-blades is studied by two approaches First the overall response of a blade-like structure is predicted by a one-degree-of-freedom impact model in which the blade is treated as a cantilever beam or plate Design curves are presented for finding the peak stress levels in many impact situations including both hard and soft

(fluid) impactors Second, the local response to an edge impact is studied using a finite-difference method based on anisotropic constitutive relations In addition experiments have been conducted to compare with each method Author (GRA)

N77-28322*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
ALTERNATE AIRCRAFT FUELS PROSPECTS AND OPERATIONAL IMPLICATIONS
Robert D Witcofski May 1977 44 p refs
(NASA-TM-X-74030) Avail NTIS HC A03/MF A01 CSCL 21D

The potential use of coal-derived aviation fuels was assessed The studies addressed the prices and thermal efficiencies associated with the production of coal-derived aviation kerosene liquid methane and liquid hydrogen and the air terminal requirements and subsonic transport performance when utilizing liquid hydrogen The fuel production studies indicated that liquid methane can be produced at a lower price and with a higher thermal efficiency than aviation kerosene or liquid hydrogen Ground facilities of liquefaction storage, distribution and refueling of liquid hydrogen fueled aircraft at airports appear technically feasible The aircraft studies indicate modest onboard energy savings for hydrogen compared to conventional fuels Liquid hydrogen was found to be superior to both aviation kerosene and liquid methane from the standpoint of aircraft engine emissions Author

N77-28325# Exxon Research and Engineering Co Linden, N J Government Research Lab
EVALUATION OF METHODS TO PRODUCE AVIATION TURBINE FUELS FROM SYNTHETIC CRUDE OILS, PHASE 2, VOLUME 2 Final Report, 24 Jan 1975 - 24 Apr 1976
Charles D Kalfadelis Wright-Patterson AFB Ohio AFAPL May 1976 365 p
(Contract F33615-74-C-2036)
(AD-A036190 EXXON/GRU 2PEA 76-Vol-2
AFAPL-TR-75-10-Vol-2) Avail NTIS HC A16/MF A01 CSCL 07/1

An experimental pilot-plant program is described which has demonstrated that specification JP-4 wide-cut type and Jet A narrow-cut type aviation turbine fuels may be produced from domestic shale oils Three shale oils and two coal-derived liquids were evaluated in the program which is the second phase in a three phase overall program The original whole crude samples were assayed and fractionated to yield kerosene-boiling-range feedstocks for catalytic hydrotreatment experiments Three levels of hydrotreatment severity were investigated using nickel-molybdenum and cobalt-molybdenum catalysts Hydrotreated products were fractionated and reblended to yield finished fuels The experimentally obtained process and analytical information will be used in the third phase of the program to provide a basis for an engineering and and economic evaluation of the effect of the use of synthetic crude oil in a refinery processing both petroleum and synthetic crude Author (GRA)

N77-28440# Cambridge Univ (England) Dept of Engineering
A NOTE ON COMPRESSOR EXIT STATIC PRESSURE MALDISTRIBUTIONS IN ASYMMETRIC FLOW
E M Greitzer 1976 18 p refs
(CUED/A-Turbo/TR-79) Avail NTIS HC A02/MF A01

Conditions were examined in which a static pressure maldistribution existed at the exit of an axial flow compressor It was shown that contrary to what was often assumed the exit static pressure could be substantially nonuniform whenever there was a velocity maldistribution which was unsteady relative to the last blade row of the compressor This occurred for example in the case of a rotor moving through a steady circumferential maldistribution A physical explanation is given for the existence of this nonuniformity in static pressure as well as the phase relationship between velocity and pressure maldistributions Author

N77-28485# Royal Aircraft Establishment Farnborough (England)
FATIGUE STRENGTH OF JOINTS WITH SPECIAL FASTENING SYSTEMS
D Schuetz and J J Gerharz 1977 17 p refs Transl into ENGLISH of Schwingfestigkeit von Fuegungen mit Sonderbefestigungselementen Rept TM-69/73 Laboratorium fuer Betriebsfestigkeit Darmstadt 1973
(RAE-Lib-Trans-1914 BR58073 TM-69-73) Copyright Avail PHI

The performance of various special (fatigue resistant) fasteners has been evaluated by testing under variable amplitude loading to an LBF standard spectrum for a transport aircraft wing The fasteners were tested in three types of joints which had varying degrees of load transfer and additional bending The report presents the results of the first phase of the test programme Author

N77-28518# Linkoeping Univ (Sweden) Dept of Mechanical Engineering
COMPUTER SIMULATION OF FATIGUE CRACK PROPAGATION IN AIRCRAFT COMPONENTS
Jan Baecklund Soeren Sjoestroem and Hans Wennerstroem Feb 1977 49 p refs Sponsored by SAAB-SCANIA AB
(ISBN-91-7372-147-6 ICAF-Doc-934) Avail NTIS HC A03/MF A01

Cracks emanating from fastener holes propagated faster than expected in a part of the wing beam close to the fuselage Laboratory tests were performed on specimens with simplified geometry designed so as to imitate the conditions in the critical part of the wing beam Attempts to simulate the fatigue crack propagation in these specimens in a computer are presented Author

N77-28525*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AEROELASTIC ANALYSIS FOR ROTORCRAFT IN FLIGHT OR IN A WIND TUNNEL
Wayne Johnson Washington Jul 1977 253 p refs Prepared in cooperation with Army Air Mobility Res and Develop Lab Moffett Field Calif
(NASA-TN-D-8515 A-6740) Avail NTIS HC A12/MF A01 CSCL 01C

An analytical model is developed for the aeroelastic behavior of a rotorcraft in flight or in a wind tunnel A unified development is presented for a wide class of rotors helicopters and operating conditions The equations of motion for the rotor are derived using an integral Newtonian method which gives considerable physical insight into the blade inertial and aerodynamic forces The rotor model includes coupled flap-lag bending and blade torsion degrees of freedom and is applicable to articulated hingeless gimballed and teetering rotors with an arbitrary number of blades The aerodynamic model is valid for both high and low inflow and for axial and nonaxial flight The rotor rotational speed dynamics including engine inertia and damping and the perturbation inflow dynamics are included For a rotor on a wind-tunnel support a normal mode representation of the test module strut and balance system is used The aeroelastic analysis for the rotorcraft in flight is applicable to a general two-rotor aircraft including single main-rotor and tandem helicopter configurations and side-by-side or tilting proprotor aircraft configurations Author

N77-28630# Air Force Civil Engineering Center Tyndall AFB Fla
THE EFFECT OF NAVY AND AIR FORCE AIRCRAFT ENGINE TEST FACILITIES ON AMBIENT AIR QUALITY Final Report, 1 Jun 1975 - 31 Jul 1976
Bradford C Grems III and Dennis F Naugle 8 Oct 1976 26 p Supersedes AFCEC-TM-76-7
(AD-A036393 AFCEC-TR-76-36 AFCEC-TM-76-7) Avail NTIS HC A03/MF A01 CSCL 21/5

An investigation of the air quality impact of DoD turbine engine test facilities was performed Emissions and pollutant dispersion from test cells and aircraft at six DoD installations were predicted using a sophisticated computer model Predicted

pollutant concentrations are compared to ambient air quality standards and measured ambient values for hydrocarbons oxides of nitrogen, and particulates Jet engine test cells have no significant impact on air quality for any pollutant at any location studied Test cell pollutant concentrations are considerable less than the levels generated by aircraft operations and well below measured ambient air quality levels in the areas studied Ambient carbon monoxide and sulfur dioxide levels resulting from test cell emissions are insignificant Control of any pollutants generated by test cells would not measurably improve ambient air quality
Author (GRA)

N77-28911*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
INTERIOR NOISE REDUCTION IN A LARGE CIVIL HELICOPTER
James T Howlett Sherman A Clevenson John A Rypf (Joint Inst for Advan of Flight Sci Hampton Va) and William J Snyder Jul 1977 43 p refs
(NASA-TN-D-8477 L-11349) Avail NTIS HC A03/MF A01 CSCL 20A

The results of an evaluation of the effectiveness of current noise reduction technology in attaining acceptable levels of interior noise in a large (about 20 000 kg) passenger-carrying helicopter are presented The helicopter studied is a modified CH-53A with a specially designed acoustically treated passenger cabin The acoustic treatment reduced the average A-weighted interior noise levels from 115 db to 87 db The study suggests selected improvements in the acoustic treatment which could result in additional reduction in cabin noise levels The resulting levels would be only slightly greater than the interior noise levels of current narrow-body jet transports Author

N77-28914# California Inst of Tech Pasadena Guggenheim Jet Propulsion Center
EXPERIMENTAL STUDIES OF THE NOISE PRODUCED IN A SUPERSONIC NOZZLE BY UPSTREAM ACOUSTIC AND THERMAL DISTURBANCES Final Report
Jerome M Auerbach Washington DOT Jun 1976 259 p refs
(Contract DOT-OST-20197)
(PB-264933/3 DOT-TST-76-105) Avail NTIS HC A12/MF A01 CSCL 21E

A steady accelerating flow was produced in a rectangular supersonic nozzle with an entrance Mach number of 0 2 - and an exit Mach number of 1 38 A rotary valve bleed flow system and an electrical wire resistance heater upstream of the nozzle introduced mass flow and temperature fluctuations into the nozzle flow at frequencies up to 500 Hz Sound measurements were made at six positions along the nozzle and outside the nozzle assembly, which was enclosed in an anechoic chamber All data acquisition and processing was done with a computer-controlled data acquisition system By synchronization of the bleed flow and heater a pure temperature disturbance without an associated pressure disturbance caused by heating was produced GRA

N77-28918# Bolt Beranek and Newman, Inc Canoga Park, Calif
CALCULATION OF DAY-NIGHT LEVELS (LDN) RESULTING FROM CIVIL AIRCRAFT OPERATIONS Final Report
D E Bishop A P Hays N H Reddingius and H Seidman Mar 1976 374 p refs
(Contract EPA-68-01-3218)
(PB-266165/0 BBN-3157 EPA-550/9-77-450) Avail NTIS HC A16/MF A01 CSCL 20A

A method is described for calculating the day/night noise level at a point due to aircraft operations from an airport Factors considered include type of takeoff and landing procedure range and non-standard glide slopes The procedure used is to locate the position of the point in question relative to the runway and aircraft flight track A series of charts give Ldn values for different types of aircraft in terms of the distance parameters Adjustments are made to the single event noise levels to account for frequency of operations and the adjusted levels are added logarithmically to represent all of the classes of aircraft using the airport GRA

N77-28980# Defense Systems Management School Fort Belvoir Va
RETURNING RDT AND E ASSETS (AIRCRAFT) TO OPERATIONAL USAGE Student Project Report
David M Sjuggerud Nov 1976 36 p refs
(AD-A036484) Avail NTIS HC A03/MF A01 CSCL 05/1

The purpose of this study report is to review past aircraft programs to gain insight as to what aircraft utilization and program management techniques can be considered in the recovery and continued service utilization of RDT and E aircraft after reconfiguration GRA

N77-29059*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
COLLECTED WORKS OF CHARLES J DONLAN
[1976] 772 p refs
(NASA-TM-74826) Avail NTIS HC A99/MF A01 CSCL 02A

Spin tests and wind tunnel tests for various types of experimental aircraft are discussed The fighter aircraft and monoplanes of the World War II era are emphasized

N77-29060*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN APPROXIMATE SPIN DESIGN CRITERION FOR MONOPLANES, 1 MAY 1939
Oscar Seidman and Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 11 p refs

(NACA-TN-711) Avail NTIS HC A99/MF A01 CSCL 01C

An approximate empirical criterion based on the projected side area and the mass distribution of the airplane was formulated The British results were analyzed and applied to American designs A simpler design criterion based solely on the type and the dimensions of the tail was developed, it is useful in a rapid estimation of whether a new design is likely to comply with the minimum requirements for safety in spinning Author

N77-29061*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SPIN TESTS OF A 1/20-SCALE MODEL OF THE XP-39 AIRPLANE, 15 MARCH 1939
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 23 p refs Sponsored in part by Army

Avail NTIS HC A99/MF A01 CSCL 01C

The tests were performed to determine the spinning characteristics of a 1/20-scale model of the Bell XP-39 airplane Effects of loading changes and of various control dispositions were studied Subsequent tests were performed to determine the effect of a change in wing dihedral Author

N77-29062*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SPIN TESTS OF A 1/20-SCALE MODEL OF THE XF4U-1 AIRPLANE, 12 JULY 1939
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 47 p refs Sponsored in part by Navy

Avail NTIS HC A99/MF A01 CSCL 01C

These tests were performed to determine the spinning characteristics of the 1/20-scale model of the XF4U-1 airplane Effects of loading changes and various control dispositions using both the original and modified vertical tail surfaces were studied Subsequent tests were made to determine the effects of additional tail modifications Author

N77-29063*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SPIN TESTS OF 1/16-SCALE MODELS OF THE N3N-3 LANDPLANE AND SEAPLANE, 12 JANUARY 1940
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 37 p refs Sponsored in part by Navy

Avail NTIS HC A99/MF A01 CSCL 01C
The test program included the study of both the seaplane and landplane types On both versions of the model the effects of loading changes and control dispositions were examined and on the seaplane the effect of the cowled and uncowled engine was investigated Author

N77-29064*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SPIN TESTS OF A LOW-WING MONOPLANE TO INVESTIGATE SCALE EFFECT IN THE MODEL TEST RANGE, MAY 1941
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 23 p refs

(NACA-TN-807) Avail NTIS HC A99/MF A01 CSCL 01C
Concurrent tests were performed on a 1/16 and a 1/20 scale model (wing spans of 2 64 and 2 11 ft respectively) of a modern low wing monoplane in the NACA 15 foot free-spinning wind tunnel Results are presented in the form of charts that afford a direct comparison between the spins of the two models for a number of different conditions Qualitatively the same characteristic effects of control disposition mass distribution and dimensional modifications were indicated by both models Quantitatively the number of turns for recover and the steady spin parameters with the exception of the inclination of the wing to the horizontal, were usually in good agreement Author

N77-29065*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
METHODS OF ANALYZING WIND-TUNNEL DATA FOR DYNAMIC FLIGHT CONDITIONS
Charles J Donlan and I G Recant *In its* Collected Works of Charles J Donlan [1976] 43 p refs

(NACA-TN-828) Avail NTIS HC A99/MF A01 CSCL 01A
The effects of power on the stability and the control characteristics of an airplane are discussed and methods of analysis are given for evaluating certain dynamic characteristics of the airplane that are not directly discernible from wind tunnel tests alone Data are presented to show how the characteristics of a model tested in a wind tunnel are affected by power The response of an airplane to a rolling and a yawing disturbance is discussed particularly in regard to changes in wing dihedral and fin area Solutions of the lateral equations of motion are given in a form suitable for direct computations An approximate formula is developed that permits the rapid estimation of the accelerations produced during pull-up maneuvers involving abrupt elevator deflections Author

N77-29066*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THE EFFECT OF COWLING SHAPE ON THE STABILITY CHARACTERISTICS OF AN AIRPLANE, SEPTEMBER 1942

Charles J Donlan and W Letko *In its* Collected Works of Charles J Donlan [1976] 21 p refs

(L-343) Avail NTIS HC A99/MF A01 CSCL 01C
Three widely different nose shapes were tested on a fuselage alone and on a complete model in the NACA stability tunnel to investigate the effect of cowling shape on stability characteristics The results are presented in the form of charts which show the variation in the aerodynamic characteristics with the three nose shapes for the propeller-removed condition over a wide range of angles of attack and yaw The results indicated that large changes in the cowling shape produced relatively small changes in the aerodynamic characteristics The effects may be appreciable however in the case of an airplane that has marginal stability Author

N77-29067*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
SOME THEORETICAL CONSIDERATIONS OF LONGITUDINAL STABILITY IN POWER-ON FLIGHT WITH SPECIAL REFERENCE TO WIND-TUNNEL TESTING, NOVEMBER 1942
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 25 p refs

(L-309) Avail NTIS HC A99/MF A01 CSCL 01C
Some problems relating to longitudinal stability in power-on flight are considered A derivation is included which shows that under certain conditions the rate of change of the pitching moment coefficient with lift coefficient as obtained in wind tunnel tests simulating constant power operation is directly proportional to one of the indices of stability commonly associated with flight analysis (the slope of the curve relating the elevator angle for trim and lift coefficient) The necessity of analyzing power-on wind tunnel data for trim conditions is emphasized and a method is provided for converting data obtained from constant thrust tests to simulated constant throttle flight conditions Author

N77-29068*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LATERAL STABILITY AND CONTROL TESTS OF THE XP-77 AIRPLANE IN THE NACA FULL-SCALE TUNNEL, 16 JUNE 1944
K R Czarnecki and Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 84 p refs Sponsored in part by Army
Avail NTIS HC A99/MF A01 CSCL 01C
Tests were made in the NACA full-scale tunnel to determine the lateral stability and control characteristics of the XP-77 airplane Measurements were made of the forces and moments on the airplane at various angles of attack and angles of yaw The measurements were made with the propeller removed and with the propeller installed and operating at various thrust coefficients and with the landing flaps retracted and deflected The effects of aileron elevator and rudder deflection on control surface effectiveness and hinge moments were determined The tests were planned to obtain the data required to evaluate as completely as possible the Army Air Force requirements on lateral stability and control for pursuit-type airplanes Author

N77-29069*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THE LATERAL FLYING QUALITIES OF THE BELL XP-77 AIRPLANE AS ESTIMATED FROM FULL-SCALE TUNNEL TESTS, 16 JUNE 1944
Charles J Donlan and K R Czarnecki *In its* Collected Works of Charles J Donlan [1976] 23 p refs Sponsored in part by Army
Avail NTIS HC A99/MF A01 CSCL 01A
Results are presented for tests made of the full scale model of the airplane in the NACA full scale tunnel These tests were planned so as to cover as completely as possible the lateral flying quality requirements for pursuit-type airplanes contracted for by the United States Army Air Forces Author

N77-29070*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THE STABILITY AND CONTROL OF TAILLESS AIRPLANES, 19 AUGUST 1944 Interim Report
Charles J Donlan comp *In its* Collected Works of Charles J Donlan [1976] 16 p refs

(Rept-796) Avail NTIS HC A99/MF A01 CSCL 01C
In the present state of the design of tailless airplanes it appears that (1) Sweepback affords a method of supplying tail length for directional and longitudinal stability and control and allows the utilization of a high lift flap but introduces undersirable

tip stalling tendencies that must be overcome before the advantages of sweepback can be realized (2) The damping in pitching appears to have little effect on the longitudinal behavior of the airplane provided the static margin is never permitted to become negative (3) The directional stability must be as great as for conventional airplanes if the same requirements regarding satisfactory stability and control characteristics are to be adhered to (4) The influence of the lateral resistance and the damping in yawing on the flying qualities is somewhat obscure Author

N77-29071*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
WIND-TUNNEL TESTS OF A 1/4 SCALE MODEL OF THE BELL XS-1 TRANSONIC AIRPLANE 1 LONGITUDINAL STABILITY AND CONTROL CHARACTERISTICS
Charles J Donlan W B Kemp and E C Polhamus *In its* Collected Works of Charles J Donlan [1976] 78 p refs

(DA Proj 653)
(L6D12) Avail NTIS HC A99/MF A01 CSCL 01A
A 1/4 scale model of the Bell XS-1 transonic aircraft was tested in the Langley 300 mile-per-hour 7 by 10 foot tunnel to determine its low speed longitudinal stability and control characteristics Pertinent longitudinal flying qualities expected of the XS-1 research airplane were estimated from the results of these tests including the effects of compressibility likely to be encountered at speeds below the force break It appears that the static longitudinal stability and elevator control power will be adequate, but that the elevator control force gradient in steady flight will be undesirably low for all configurations It is suggested that a centering spring be incorporated in the elevator control system of the airplane in order to increase the control force gradient in steady flight and in maneuvers Author

N77-29072*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
CURRENT STATUS OF LONGITUDINAL STABILITY, 24 MAY 1948
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 17 p refs

(L8A28) Avail NTIS HC A99/MF A01 CSCL 01C
The problems of static and dynamic longitudinal stability both at high speeds and at low speeds are discussed and data are presented which indicate progress made in the solution of these problems It is shown that the incorporation of large amounts of sweepback on both the wing and the horizontal tail can significantly increase the Mach number at which critical trim changes and stability changes occur and can greatly reduce the trim changes and stability changes encountered at supercritical speeds Data are also presented which demonstrate the possibility of obtaining satisfactory longitudinal stability in the landing configuration for wings with sweepback of the order of 45 deg utilizing various stall control devices Optimum arrangements for such devices however should be determined experimentally Author

N77-29073*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FACTORS AFFECTING STATIC LONGITUDINAL STABILITY AND CONTROL
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 16 p refs

Avail NTIS HC A99/MF A01 CSCL 01C
The various factors that constitute static longitudinal stability and control are reviewed and the influence on these factors of power effects and Mach number effects are indicated Author

N77-29074*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW-SPEED WIND-TUNNEL INVESTIGATION OF THE LONGITUDINAL STABILITY CHARACTERISTICS OF A MODEL EQUIPPED WITH A VARIABLE-SPEED WING, 23 MAY 1949
Charles J Donlan and William C Sleeman Jr *In its* Collected Works of Charles J Donlan [1976] 43 p refs

(L9B18) Avail NTIS HC A99/MF A01 CSCL 01A
The longitudinal stability characteristics of a complete model equipped with a variable sweep wings at angles of sweepback of 45 deg 30 deg 15 deg and 0 deg investigated Various wing modifications and an extern 1 flap arrangement designed to minimize the shift in neutral point accompanying the change in sweep angle were studied The results indicate that stability at the stall was obtained at a sweep angle of 15 deg without recourse to stall control devices The basic neutral point movement accompanying the change in sweep angle from 45 deg to 15 deg amounted to 56 percent of the mean aerodynamic chord (at zero sweep angle) and the most effective modification investigated only reduced this change to 47 percent of the chord It appears, therefore that for designs in which the fuselage is the major load carrying element some relative movement between the wing and center of gravity will be required to assure satisfactory stability at all sweep angles Author

N77-29075*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
ESTIMATED TRANSONIC FLYING QUALITIES OF A TAILLESS AIRPLANE BASED ON A MODEL INVESTIGATION, 8 JUNE 1949
Charles J Donlan and Richard E Kuhn *In its* Collected Works of Charles J Donlan [1976] 62 p refs

(L9D08) Avail NTIS HC A99/MF A01 CSCL 01A
Flying qualities of a tailless airplane with the wing quarter chord line swept back 35 deg were analyzed in the Mach number range from 0 40 to 0 91 based on tests of a model of this airplane in the Langley high speed 7 by 10 foot tunnel The results indicate that longitudinal control position instability exists at transonic speeds but the accompanying trim changes are not large Control position maneuvering stability however, is present for all speeds Longitudinal and lateral control appear adequate, but the damping of the short period longitudinal and lateral oscillations at high altitudes is poor and would probably require artificial damping Author

N77-29076*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
SOME EFFECTS OF SWEEPBACK AND AIRFOIL THICKNESS ON LONGITUDINAL STABILITY AND CONTROL CHARACTERISTICS AT TRANSONIC SPEEDS
Charles J Donlan and Arva A Luoma *In its* Collected Works of Charles J Donlan [1976] 12 p refs

Avail NTIS HC A99/MF A01 CSCL 01C
Information on the longitudinal stability and control characteristics of complete transonic airplane configurations is compiled in a form that might indicate whether or not a consistent pattern of behavior exists in regard to the effects of airfoil thickness and sweepback on overall stability and control characteristics at transonic speeds Author

N77-29077*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
A COMPARISON OF THE AERODYNAMIC CHARACTERISTICS AT TRANSONIC SPEEDS OF FOUR WING-FUSELAGE CONFIGURATIONS AS DETERMINED FROM DIFFERENT TEST TECHNIQUES, 4 OCTOBER 1960
Charles J Donlan Boyd C Myers II and Axel T Mattson *In its* Collected Works of Charles J Donlan [1976] 65 p refs

(L5OH02) Avail NTIS HC A99/MF A01 CSCL 01A
The high speed aerodynamic characteristics of a family of four wing-fuselage configurations of 0 35 45 and 60 deg sweepback were determined from transonic bump model tests that were conducted in the Langley high speed 7 by 10 foot tunnel sting supported model tests were conducted in the Langley 8 foot high speed tunnel and in the Langley high speed 7 by 10 foot tunnel and rocket model tests were conducted by the Langley Pilotless Aircraft Research Division A complementary

study of the effect of Mach number gradients and streamline curvature on bump results is also included The qualitative data obtained from the various test facilities for the wing-fuselage configurations were in essential agreement as regards the relative effects of sweepback and Mach number except for drag at zero lift Quantitatively important differences were present Author

N77-29078*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
CHARACTERISTICS OF SWEPT WINGS AT HIGH SPEEDS, 30 JANUARY 1952
Charles J Donlan and Joseph Weil *In its* Collected Works of Charles J Donlan [1976] 20 p refs

(L52A15) Avail NTIS HC A99/MF A01 CSCL 01C
Some results of recent swept wing investigations are presented that were undertaken to determine the effects of thickness and thickness distribution camber and twist nose-flap deflection and devices or fixes for improving the wing pitching moment characteristics at high lift coefficients Author

N77-29079*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN ASSESSMENT OF THE AIRPLANE DRAG PROBLEM AT TRANSONIC AND SUPERSONIC SPEEDS, 15 JULY 1974
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 16 p refs Presented at Meeting of NACA Comm on Aerodyn Langley Station Va 28 Apr 1954

(L54F16) Avail NTIS HC A99/MF A01 CSCL 01A
The factors influencing the drag of bodies of revolution are reviewed and the effectiveness in reducing wave drag of various methods of improving the cross sectional area distribution of aircraft configurations is illustrated It is demonstrated that irrespective of the method adopted for improving area distribution a high effective fineness ratio and smooth area progressions along the equivalent body are essential to the achievement of low drag Author

N77-29082*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
PROPORTIONING THE AIRPLANE FOR LATERAL STABILITY
Charles J Donlan *In its* Collected Works of Charles J Donlan [1976] 6 p refs
Avail NTIS HC A99/MF A01 CSCL 01C
Proportioning for lateral aircraft control included (1) directional stability (slope of curve of yawing moment coefficient against sideslip) and (2) effective dihedral factor (slope of curve of rolling moment coefficient against sideslip) Basic forces influencing the directional stability of aircraft are indicated Propeller side force, basic fuselage yaw and vertical tail side force contributed to yaw moment about center of gravity J A M

N77-29085*# Aerophysics Research Corp Bellevue, Wash
NSEG, A SEGMENTED MISSION ANALYSIS PROGRAM FOR LOW AND HIGH SPEED AIRCRAFT VOLUME 1 THEORETICAL DEVELOPMENT Final Report
D S Hague and H L Rozendaal Washington NASA Aug 1977 82 p refs 3 Vol
(Contract NAS1-13599)
(NASA-CR-2807) Avail NTIS HC A05/MF A01 CSCL 02A
A rapid mission analysis code based on the use of approximate flight path equations of motion is presented Equation form varies with the segment type for example accelerations climbs cruises descents and decelerations Realistic and detailed characteristics were specified in tabular form The code also contains extensive flight envelope performance mapping capabilities Approximate take off and landing analyses were performed At high speeds centrifugal lift effects were accounted for Extensive turbojet and ramjet engine scaling procedures were incorporated in the code Author

N77-29086 California Univ Los Angeles
A STUDY OF THE EFFECT OF UNSTEADY AERODYNAMICS ON THE AEROELASTIC STABILITY OF ROTOR BLADES IN HOVER Ph D Thesis
Cheng-Hsien Yuan 1976 166 p
Avail Univ Microfilms Order No 77-8539
Various existing unsteady aerodynamic strip theories which have been developed in the past for both fixed and rotary wing aerodynamic analyses are modified so as to make them applicable to the coupled flap-lag-torsional aeroelastic problem of a rotor blade in hover The modified strip theories are incorporated in a coupled flap-lag-torsional aeroelastic analysis The results indicate that the various unsteady aerodynamic strip theories available must be modified and reinterpreted when applying them to the coupled flap-lag-torsional aeroelastic problem of a rotor blade in hover These modifications are primarily due to constant angle of attack constant inflow and variable free stream velocity due to lead-lag motion Dissert Abstr

N77-29087 Minnesota Univ Minneapolis
DYNAMICS AND STABILITY OF LIFTING PARACHUTES Ph D Thesis
David Paul Saari 1976 209 p
Avail Univ Microfilms Order No 77-6999
A dynamic model is formulated which is capable of describing the three-dimensional motion of a general parachute-load system with general initial conditions and a method is presented for determining five components of aerodynamic force and moment as functions of general angles of attack in three-dimensional motion Wind tunnel measurements of the aerodynamic coefficients for a lifting parachute made at a Reynolds number of 5 500 00 is presented Dissert Abstr

N77-29089 California Univ Los Angeles
THE COUPLED FLAP-LAG-TORSIONAL AEROELASTIC STABILITY OF HELICOPTER ROTOR BLADES IN FORWARD FLIGHT Ph D Thesis
Manuel Reyna-Allende 1976 295 p
Avail Univ Microfilms Order No 77 8530
A set of coupled flap lag torsional equations of motion capable of simulating general hingeless rotor blade configurations are derived for the case of a rotor blade having moderate deflections The final equations of motion are represented by a system of coupled nonlinear partial differential equations The equations are capable of simulating rotor blades having (1) precone (2) droop (3) built in twist (4) distributed torsion (5) root torsion (or pitch link flexibility) (6) blade root offsets (7) and offsets between the elastic axis aerodynamic center and the blade cross sectional center of mass Quasisteady aerodynamic loads are used and the effects of stall and compressibility are neglected Reversed flow is included in the representation of the airloads Dissert Abstr

N77-29090 Georgia Inst of Tech Atlanta
A METHOD OF COMPUTING THE POTENTIAL FLOW ON THICK WING TIPS Ph D Thesis
Pradeep Rao 1976 174 p
Avail Univ Microfilms Order No 77-7352
An iterative procedure to compute detailed velocity and pressure distributions on the surface of thick wing tips is developed using potential flow theory The method uses a two dimensional surface vorticity distribution as an initial approximation Therefore the two dimensional problem is first formulated in the form of an integral equation using vorticity as the surface singularity which is solved by the elementary vortex distribution technique A comparison of the flow computed on a circular cylinder with the exact analytical results provides a measure of accuracy The two dimensional noncirculatory and circulatory flow is computed for NACA basic thickness form airfoils Dissert Abstr

N77-29091 Cornell Univ Ithaca N Y
TWO PROBLEMS THAT ARISE IN THE GENERATION AND PROPAGATION OF SONIC BOOMS 1 FLOW FIELD IN

THE PLANE OF SYMMETRY BELOW A DELTA WING 2 FOCUSING OF AN ACOUSTIC PULSE AT AN ARETE Ph D Thesis

Mark Stephen Cramer 1976 42 p

Avail Univ Microfilms Order No 77-8353

The flow field in the plane of symmetry of a thin lifting delta wing with supersonic leading edges is examined A simplified treatment of the interaction between the plane expansion wave enamating from the trailing edge and the three-dimensional bow shock is presented In the region unaffected by the wing tips the shock decays inversely with distance from the wing The focusing of a nearly straight acoustic wavefront is examined The equation that describes this focusing is derived and the resulting similitude discussed The initial conditions come from a formal matching of this nonlinear description with the linear solution The maximum value of the pressure coefficient is shown to be proportional to the two thirds power of both the initial strength of the wavefront and a small parameter characterizing its straightness Dissert Abstr

N77-29095*# Rockwell International Corp Los Angeles Calif Aircraft Div

LOW SPEED AERODYNAMIC CHARACTERISTICS OF A VECTORED THRUST V/STOL TRANSPORT WITH TWO LIFT/CRUISE FANS

Dirk J Renselaer Jul 1977 201 p refs

(Contract NAS2-9003)

(NASA-CR-152029) Avail NTIS HC A10/MF A01 CSCL 01A

A wind tunnel test was conducted to obtain power on low speed characteristics of a twin fan vectored thrust V/STOL transport aircraft Longitudinal as well as some lateral directional data were analyzed Hover STOL and conventional flight modes were investigated Determination of STOL characteristics hover characteristics roll control effectiveness and aircraft attitude were evaluated The study also included various means to improve the lifting capability of the aircraft such as by application of fuselage strakes exhaust vanes capable of shifting the thrust vector aft and external flap blowing for STOL performance Author

N77-29096*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

LOW-SPEED WIND TUNNEL INVESTIGATION OF AN ADVANCED SUPERSONIC CRUISE ARROW-WING CONFIGURATION

Paul L Coe Jr Paul M Smith (Vought Corp Hampton Va) and Lysle P Parlett Jul 1977 85 p refs

(NASA-TM-74043) Avail NTIS HC A05/MF A01 CSCL 01A

A preliminary assessment of possible means for improving the low speed aerodynamic characteristics of advanced supersonic cruise arrow wing configurations and to extend the existing data base of such configurations has been made Principle configuration variables included wing-leading and trailing-edge flap deflection fuselage nose strakes and engine exhaust nozzle deflection Results showed that deflecting the wing leading edge apex flaps downward provided improved longitudinal stability but resulted in reduced directional stability The model exhibited relatively low values of directional stability over the operational angle of attack range and experienced large asymmetric yawing moments at high angles of attack The use of nose strakes was found to be effective in increasing the irectional stability and eliminating the asymmetric yawing moment Author

N77-29097*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va

LOAD DISTRIBUTION ON A CLOSED-COUPLED WING CANARD AT TRANSONIC SPEEDS

Blair B Gloss and Karen E Washburn Aug 1977 11 p refs

(NASA-TM-74053) Avail NTIS HC A02/MF A01 CSCL 01A

A wind tunnel test where load distributions were obtained at transonic speeds on both the canard and wing surfaces of a closely coupled wing canard configuration is reported Detailed component and configuration arrangement studies to provide insight into the various aerodynamic interference effects for the leading edge vortex flow conditions encountered are included Data indicate that increasing the Mach number from 0 70 to 0 95 caused the wing leading edge vortex to burst over the wing when the wing was in the presence of the high canard Author

N77-29098*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif

F-8 SUPERCRITICAL WING FLIGHT PRESSURE, BOUNDARY LAYER, AND WAKE MEASUREMENTS AND COMPARISONS WITH WIND TUNNEL DATA

Lawrence C Montoya and Richard D Banner Washington Jun 1977 194 p refs

(NASA-TM-X-3544, H-850) Avail NTIS HC A09/MF A01 CSCL 01A

Data for speeds from Mach 0 50 to Mach 0 99 are presented for configurations with and without fuselage area-rule additions with and without leading-edge vortex generators and with and without boundary-layer trips on the wing The wing pressure coefficients are tabulated Comparisons between the airplane and model data show that higher second velocity peaks occurred on the airplane wing than on the model wing The differences were attributed to wind tunnel wall interference effects that caused too much rear camber to be designed into the wing Optimum flow conditions on the outboard wing section occurred at Mach 0 98 at an angle of attack near 4 deg The measured differences in section drag with and without boundary-layer trips on the wing suggested that a region of laminar flow existed on the outboard wing without trips Author

N77-29100*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

MEASUREMENTS OF SURFACE-PRESSURE AND WAKE-FLOW FLUCTUATIONS IN THE FLOW FIELD OF A WHITCOMB SUPERCRITICAL AIRFOIL

Frederick W Roos (McDonnell Douglas Corp St Louis Mo) and Dennis W Riddle Washington Aug 1977 53 p refs

(NASA-TN-D-8443 A-6877) Avail NTIS HC A04/MF A01 CSCL 01A

Measurements of surface pressure and wake flow fluctuations were made as part of a transonic wind tunnel investigation into the nature of a supercritical airfoil flow field Emphasis was on a range of high subsonic Mach numbers and moderate lift coefficients corresponding to the development of drag divergence and buffeting Fluctuation data were analyzed statistically for intensity frequency content and spatial coherence Variations in these parameters were correlated with changes in the mean airfoil flow field Author

N77-29101*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

EFFECT OF WINGLETS ON A FIRST-GENERATION JET TRANSPORT WING 2 PRESSURE AND SPANWISE LOAD DISTRIBUTIONS FOR A SEMI SPAN MODEL AT HIGH SUBSONIC SPEEDS

Lawrence C Montoya (NASA Dryden Flight Research Center) Stuart G Flechner and Peter F Jacobs Washington Jul 1977 211 p refs

(NASA-TN-D-8474 L-11026) Avail NTIS HC A10/MF A01 CSCL 01A

Pressure and spanwise load distribution on a first generation jet transport semispan model at high subsonic speeds are presented The data were given for the basic wing and for configurations with an upper winglet only upper and lower winglets, and a simple wing tip extension Selected data were discussed to show the general trends and effects of the various configurations Author

N77-29102*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

SUBSONIC AND SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SUPERSONIC CRUISE FIGHTER MODEL WITH A TWISTED AND CAMBERED WING WITH 74 DEG SWEEP

Odell A Morris Washington Aug 1977 63 p refs
(NASA-TM-X-3530 L-11457) Avail NTIS HC A04/MF A01 CSCL 01A

A wind tunnel investigation has been conducted to determine the longitudinal and lateral aerodynamic characteristics of a model of a supersonic cruise fighter configuration with a design Mach number of 2 60 The configuration is characterized by a highly swept arrow wing twisted and cambered to minimize supersonic drag due to lift twin wing mounted vertical tails, and an aft mounted integral underslung duel-engine pod The investigation also included tests of the configuration with larger outboard vertical tails and with small nose strakes Author

N77-29105# National Aerospace Lab Amsterdam (Netherlands) Fluid Dynamics Div

PREDICTION OF AERODYNAMIC INTERFERENCE EFFECTS ON A FIGHTER TYPE WING-TIP TANK CONFIGURATION WITH AND WITHOUT PYLON AND STORE

H A Sytsma 5 Mar 1975 36 p refs
(Contract RNLAF-RB-KL-1975/S3)
(NLR-TR-75070-U) Avail NTIS HC A03/MF A01

Using the NLR panel method pressure distribution was calculated for a fighter type wing-tiptank configuration with and without pylon and store to establish the applicability of this panel mwthod to the aerodynamic interference problems associated with this type of configurations Calculated pressure distributions on wing and store are compared with experimental results Agreement between theoretical and experimental results is satisfactory Author (ESA)

N77-29108# European Space Agency Paris (France)

BEHAVIOR OF A SUBSONIC FLOW PAST A THIN WING IN THE VICINITY OF THE LEADING EDGE

Jean-Sylvestre Darrozes Jul 1977 48 p refs Transl into ENGLISH of 'Comportement d'un Ecoulement Subsonique au Voisinage du Bord d Attaque d une Aile Mince ONERA Paris Report ONERA-NT-1976-16 Feb 1977 Original report in FRENCH previously announced as N77-25107
(ESA-TT-401 ONERA-NT-1976-16) Avail NTIS HC A03/MF A01

The technique of matched asymptotic expansions leads to a uniformly valid description of a subsonic flow past a thin wing with round edges The outer solution is the classical one given by the linearized theory The inner problem requires a local formulation which corresponds to a local subsonic flow past a parabola in a plane normal to the leading edge The inner solution is given explicitly in the case of weakly subsonic flows Author (ESA)

N77-29111*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

REAL-TIME MANNED SIMULATION OF ADVANCED TERMINAL AREA GUIDANCE CONCEPTS FOR SHORT-HAUL OPERATIONS

Leonard Tobias and Paul J OBrien Washington Aug 1977 33 p refs Prepared in cooperation with the Natl Aviation Facilities Exptl Center, Atlantic City N J
(NASA-TN-D-8499 A-6841) Avail NTIS HC A03/MF A01 CSCL 17G

A real-time simulation was conducted of three-dimensional area navigation and four-dimensional area navigation equipped (STOL) aircraft operating in a high-density terminal area traffic environment The objectives were to examine the effects of 3D RNAV and 4D RNAV equipped aircraft on the terminal area traffic efficiency, and to examine the performance of an air traffic control system concept and associated controller display proposed for use with advanced RNAV systems Three types of STOL aircraft were simulated each with different performance capabilities System performance was measured in both the 4D mode and in a 3D mode, the 3D mode used as a baseline was simply the 4D mode less any time specification The results show that communications workload in the 4D mode was reduced by about 35 percent compared to the 3D while 35 percent more traffic was handled with the 4D Aircraft holding time in the 4D mode was only 30 percent of that required in the 3D mode In addition the orderliness of traffic was improved significantly in the 4D mode Author

N77-29112# Civil Aeromedical Inst Oklahoma City Okla

AN EPIDEMIOLOGIC INVESTIGATION OF OCCUPATION, AGE AND EXPOSURE IN GENERAL AVIATION ACCIDENTS

Charles F Booze Apr 1977 22 p refs
(AD-A040978 FAA-AM-77-10) Avail NTIS HC A02/MF A01 CSCL 01/2

A census of general aviation accident-involved airmen records was studied Population comparison data for occupation age exposure and other epidemiologic profile information were obtained from a sample of currently certified airmen medical records Author

N77-29113# National Aviation Facilities Experimental Center Atlantic City N J

ANALYSIS OF SELECTED GENERAL AVIATION STALL/SPIN ACCIDENTS Final Report, Feb - Jun 1975

Jack Shrager Apr 1977 90 p refs
(FAA Proj 184-520-100)
(AD-A040824 FAA-NA-77-2 FAA-RD-77-41) Avail NTIS HC A05/MF A01 CSCL 01/2

An automated data search of existing general aviation data bases was employed in an effort to relate aircraft stall/spin accident history to general design characteristics The technique utilized a chi square analysis to evaluate a stall/spin history of selected aircraft The statistical analysis indicated that accident rates are influenced by aircraft usage and by pilot experience Low horsepower low stallspeed aircraft have a higher propensity to stall/spin accidents the highest incidence being in the takeoff phase of flight Author

N77-29114*# Summerfield Associates Santa Monica Calif

A STUDY OF COMMUTER AIRLINE ECONOMICS Final Report

John R Summerfield Dec 1976 24 p refs
(NASA Order A-29917-B)
(NASA-CR-152035) Avail NTIS HC A02/MF A01 CSCL 05C

Variables are defined and cost relationships developed that describe the direct and indirect operating costs of commuter airlines The study focused on costs for new aircraft and new aircraft technology when applied to the commuter airline industry With proper judgement and selection of input variables the operating costs model was shown to be capable of providing economic insight into other commuter airline system evaluations J H

N77-29115# Naval Air Development Center Warminster Pa Crew Systems Dept

DEVELOPMENT OF AN INFLATABLE HEAD/NECK RESTRAINT SYSTEM FOR EJECTION SEATS Interim Report

Thomas J Zenobi 28 Feb 1977 32 p
(AD-A038762 NADC-76357-40) Avail NTIS HC A03/MF A01 CSCL 06/7

A ring-shaped inflatable head/neck restraint system for ejection seats is being developed at the Crew Systems Department NADC The purpose of this system is to reduce neck injuries due to violent forward head rotation at the time of ejection thrust and parachute opening shock Inflation of the neck ring will be conducted by a solid propellant gas generator Design considerations include form-and-fit cost effectiveness packaging and integration into life support equipment Author (GRA)

N77-29117# National Aviation Facilities Experimental Center Atlantic City N J

LONGITUDIAL SEPARATION ANALYSIS OF THE CENTRAL EAST PACIFIC TRACK SYSTEM Final Report, Dec 1973 - Jun 1974

Wayne E Smoot Jun 1977 109 p refs
(AD-A040759 FAA-NA-76-39 FAA-EM-77-3) Avail NTIS HC A06/MF A01 CSCL 01/2

An evaluation of aircraft Mach number spacing and inertial navigation systems is represented as regards their impact on longitudinal separation and collision risk in the Central East Pacific A nomograph was produced for predicting maximum expected changes in longitudinal separation of aircraft flying on long distance transoceanic flights Results indicate that a statistically significant difference in maintaining longitudinal separation exists between those aircraft employing Mach number spacing techniques and those not using the techniques and likewise between aircraft with more sophisticated air data systems than those without Collision risk from loss of longitudinal separation was found to be at an acceptable level Author

N77-29119# Systems Control Inc Palo Alto Calif
AREA NAVIGATION ROUTE WIDTH REQUIREMENTS Final Report
A R Stephenson and W H Clark Dec 1976 119 p refs
(Contract DOT-FA72WA-3098)
(AD-A040153 FAA-RD-77-21) Avail NTIS HC A06/MF A01 CSCL 01/2

Route width requirements for both high altitude enroute and terminal areas are quantified based on the impact of route width on route efficiency airspace capacity and route length Results of this study which based on analysis of specific high traffic demand geographical areas indicate that there is a requirement to eliminate the current splayed route widths and provide constant width routes but that there is no requirement for reduction of route widths below a constant + or - 4 nm in the high altitude enroute structure or below the + or - 2 nm or + or - 4 nm in the high altitude enroute structure, or below the + or - 2 nm or + or - 4 nm, dependent upon distance from the VORTAC, which are currently required in the terminal area Author

N77-29120# Stanford Research Inst Menlo Park, Calif
ADVANCED PRODUCTIVITY ANALYSIS METHODS FOR AIR TRAFFIC CONTROL OPERATIONS Final Report, Jan 1974 - Dec 1976
Paul L Tuan H Steven Procter and George J Couluris Dec 1976 199 p refs
(Contract DOT-TSC-1128)
(AD-A035095 DOT-TSC-FAA-76-27 FAA-RD-76-164) Avail NTIS HC A09/MF A01 CSCL 17/7

A description of the air traffic control productivity analysis methods is reported The relative capacity estimating process models the traffic handling capabilities of individual sectors in terms of routine surveillance, and conflict processing workloads The air traffic flow model simulates a multisector network by tracing aircraft flows from sector to sector and measuring traffic loadings workload requirements and delays under given sets of traffic input parameters and congestion relief strategy Author

N77-29123# West Virginia Univ Morgantown Dept of Electrical Engineering
AIRCRAFT ANTENNA ANALYSIS AND MICROWAVE LANDING SYSTEM (MLS) APPLICATIONS Final Summary Report, 1 Jan 1974 - 31 Dec 1975
Constantine A Balanis and Yuk-Bun Cheng 31 Jan 1976 223 p refs
(Contract DOT-OS-40013)
(AD-A041484 FAA-RD-76-37) Avail NTIS HC A10/MF A01 CSCL 01/2

Analytical methods for predicting the radiation characteristics of antennas on aircraft were developed Diffraction techniques in conjunction with other classical electromagnetic methods were used to take into account contributions from various structural features of an airframe Computed values were compared with measured data of antennas on scaled model aircraft A very good agreement between theory and experiment was indicated Computations were made for antennas on full scale aircraft with the frequency of operation remaining within the proposed band for the MLS A circumferential aperture mounted below the nose or above the cockpit of a Boeing 747 provides the most attractive coverage for MLS application Author

N77-29124# Federal Aviation Administration Washington D C
BOSTON AIR ROUTE TRAFFIC CONTROL CENTER (ARTCC) LIGHTING STUDY Final Report, Apr - Nov 1976
Alan J Kopala Charles M Hall (Raytheon Co Sudbury, Mass) and Richard M Carr (Raytheon Co Sudbury Mass) May 1977 163 p refs
(Contract DOT-FA76WA-3738)
(AD-A041324 FAA-RD-76-203) Avail NTIS HC A08/MF A01 CSCL 17/7

Work at an air route traffic control center was accomplished in reducing reflections on the faceplates of the plan view displays while increasing the level of ambient lighting This was intended to improve the observation of flight data by air traffic controllers and to facilitate reading and walking in the immediate aisle area Lighting experts identified glare and reflection sources and lighting deficiencies measured their various intensities with photometric test equipment and provided practical suggestions to rectify the lighting problems The results of this project were the significant reduction of reflections and glare and an increase in the ambient illumination Author

N77-29125# Transportation Systems Center Cambridge Mass
ILS GLIDE SLOPE PERFORMANCE PREDICTION MULTIPATH SCATTERING Final Report, Jul 1975 - Mar 1976
S Morin D Newsom and M Scotto Dec 1976 81 p ref
(AD-A035298, DOT-TSC-FAA-76-16 FAA-RD-76-216) Avail NTIS HC A05/MF A01 CSCL 07/7

A mathematical model has been developed which predicts the performance of instrument landing glide slope systems subject to multipath scattering and the effects of irregular terrain contours The model is discussed in detail and then applied to a test case for purposes of illustration A complete listing of all computer programs has been appended to the report Author

N77-29126# National Aviation Facilities Experimental Center, Atlantic City N J
EVALUATION OF RADIO REMOTE CONTROL SYSTEM FOR AIRPORT VISUAL AIDS Final Report, Nov 1975 - Aug 1976
Bret B Castle Jun 1977 18 p
(AD-A041603 FAA-NA-76-51 FAA-RD-77-67) Avail NTIS HC A02/MF A01 CSCL 17/7

An evaluation was made to determine if a particular radio remote control system could provide reliable control of distant airport visual aids in place of laying lengthy control cables to the system s power regulators Simple operation and flexibility of usage were required of the system as well as continual monitoring of the status of the remote stations emergency operation during electrical power failures and reliability of operation approaching hard-wire systems Results show that during the 5 000 hours of testing the system worked well, except for high and low operating temperature problems caused by the use of unreliable commercial components in the transceiver It was recommended that following transceiver improvements, operational evaluation in-service type tests be performed on the system in an operating airport environment Author

N77-29127# Lincoln Lab Mass Inst of Tech , Lexington
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Jan - 31 Mar 1977
1 Apr 1977 30 p
(Contracts DOT-FA72WAI-261 FAA Proj 034-241-012)
(AD-A041089 FAA-RD-77-64) Avail NTIS HC A03/MF A01 CSCL 17/7

Results to date of analytical studies, laboratory and flight experiments and software developments supporting the concept feasibility and performance definition phase of the discrete address beacon system are presented Author

N77-29128# Transportation Systems Center Cambridge Mass
USER'S MANUAL FOR GENERALIZED ILSGLD-ILS GLIDE SLOPE PERFORMANCE PREDICTION MULTIPATH SCATTERING Final Report, Jul 1975 - Mar 1976

S Morin D Newsom, and M Scotto Nov 1976 81 p refs (AD-A034492 DOT-TSC-FAA-76-19 FAA-RD-76-186) Avail NTIS HC A05/MF A01 CSCL 17/7

The computer program package for the generalized ILSGLD scattering model is presented The text includes a complete description of the program as well as a brief outline of the instrument landing system and antenna patterns The program listings are included as appendixes and contain both input generation programs and output plotting programs Author

N77-29129# Ohio Univ Athens Dept of Electrical Engineering

THE PERFORMANCE OF THE NULL-REFERENCE GLIDE-SLOPE SYSTEM IN THE PRESENCE OF DEEP SNOW, 1975 - 1976 Final Report, Dec 1975 - May 1976

Lawrence H Mitchell and Richard H McFarland Jan 1977 50 p

(Contract DOT-FA76WA-3764)

(AD-A041139 FAA-RD-77-24 EER29-1) Avail NTIS HC A03/MF A01 CSCL 17/7

An experimental glide slope established at 330 8 MHz on a runway at the airport in Houghton County Michigan was used for measuring response to ground plane snow cover up to 34 inches Results indicate that the path angle increases approximately 0 10 degree for each foot of snow cover and no significant deterioration occurs in path width or clearance Special far-field monitoring using a two-frequency capture type monitor was only marginally successful Author

N77-29130# Transportation Systems Center Cambridge Mass

USER'S MANUAL FOR ILSS (REVISED ILSLOC) SIMULATION FOR DEROGATION EFFECTS ON THE INSTRUMENT LANDING SYSTEM Final Report, Aug 1973 - Mar 1976

O Chin L Jordan D Kahn S Morin, D Newsom and M Scotto Dec 1976 121 p ref

(AD-A035690 DOT-TSC-FAA-76-7 FAA-RD-76-217) Avail NTIS HC A06/MF A01 CSCL 17/7

The complete ILSS computer program package is presented A thorough description of the program and a listing with comments are included as well as a brief description of the instrument landing system and antenna patterns A test case has been created and the figures of the case are incorporated in the report Author

N77-29133# Champlain Technology Inc West Palm Beach Fla

AN OPERATIONAL FLIGHT TEST EVALUATION OF A LORAN-C NAVIGATOR Final Report

M Hughes and R J Adams Mar 1977 127 p refs

(Contract DOT-CG-63154-A)

(AD-A039498, USCG-D-9-77) Avail NTIS HC A07/MF A01 CSCL 17/7

This report presents the results of an operational test and evaluation of a Loran-C navigation system The tests were performed in a Coast Guard HH-52A helicopter from 21 September to 19 October 1976 The flight test profiles, procedures and test objectives were developed to determine the applicability of the prototype Loran-C navigator to Coast Guard operations as well as to assess the functional and accuracy performance of the Loran-C navigator operating as an area navigation system in the National Airspace System The operational testing reported in this document includes search and rescue missions as well as surveillance and enforcement missions The former consisted of evaluating the Loran-C navigator during creeping line sector and expanding square search patterns The latter involved performing low altitude hovers over fixed and movable objects and documenting Loran-C accuracy and repeatability This latter data is also directly applicable to the operations of the off-shore oil industry GRA

N77-29134# Federal Aviation Administration Washington D C Office of Management Systems

FAA AIR TRAFFIC ACTIVITY, CALENDAR, YEAR 1976 Semiannual Report

Patricia Wilson 31 Dec 1976 236 p

(AD-A040474) Avail NTIS HC A11/MF A01 CSCL 01/2

This report furnishes terminal and enroute air traffic activity information of the National Airspace System The data have been reported by the FAA-operated Airport Traffic Control Towers (ATCTs) Air Route Traffic Control Centers (ARTCCs) Flight Service Stations (FSSs) Combined Station Towers (CS/Ts) International Flight Service Stations (IFFSSs) and Approach Control Facilities Author (GRA)

N77-29139*# Operations Research Inc Silver Spring Md

AVIATION AND PROGRAMMATIC ANALYSES, VOLUME 1, TASK 1 AVIATION DATA BASE DEVELOPMENT AND APPLICATION

28 Mar 1977 114 p refs 3 Vol

(Contract NAS5-23477)

(NASA-CR-152581) Avail NTIS HC A06/MF A01 CSCL 01C

A method was developed for using the NASA aviation data base and computer programs in conjunction with the GE management analysis and projection service to perform simple and complex economic analysis for planning forecasting and evaluating OAST programs Capabilities of the system are discussed along with procedures for making basic data tabulations updates and entries The system is applied in an agricultural aviation study in order to assess its value for actual utility in the OAST working environment A R H

N77-29140*# Operations Research Inc Silver Spring Md

AVIATION AND PROGRAMMATIC ANALYSES VOLUME 2, TASK 2 IDENTIFICATION OF PLANNING FACTORS AND ACTIVITIES Final Report

28 Mar 1977 250 p refs 3 Vol

(Contract NAS5-23477)

(NASA-CR-152582) Avail NTIS HC A11/MF A01 CSCL 01C

For abstract see N77-29139

N77-29141*# Operations Research Inc Silver Spring Md

AVIATION AND PROGRAMMATIC ANALYSES VOLUME 3, TASK 3 DEVELOPMENT OF SPECIAL ISSUE PAPERS Final Report

28 Mar 1977 204 p refs 3 Vol

(Contract NAS5-23477)

(NASA-CR-152583) Avail NTIS HC A10/MF A01 CSCL 01C

For abstract see N77-29139

N77-29142*# Kansas Univ Center for Research Inc Lawrence

A STUDY OF COMMUTER AIRPLANE DESIGN OPTIMIZATION

J Roskam R David Wyatt Douglas A Griswold and James L Hammer 31 Aug 1977 276 p refs

(Grant NsG-2145)

(NASA-CR-154270 KU-FRL-313-4 SR-3) Avail NTIS HC A13/MF A01 CSCL 01C

Problems of commuter airplane configuration design were studied to affect a minimization of direct operating costs Factors considered were the minimization of fuselage drag methods of wing design and the estimated drag of an airplane submerged in a propellor slipstream all design criteria were studied under a set of fixed performance mission and stability constraints Configuration design data were assembled for application by a computerized design methodology program similar to the NASA-Ames General Aviation Synthesis Program J H

N77-29143*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

COMPATIBILITY CHECK OF MEASURED AIRCRAFT RESPONSES USING KINEMATIC EQUATIONS AND EXTENDED KALMAN FILTER

Vladislav Klein (George Washington Univ Washington D C) and James R Schiess Washington Aug 1977 49 p refs

(NASA-TN-D-8514 L-11420) Avail NTIS HC A03/MF A01 CSCL 01C

An extended Kalman filter smoother and a fixed point smoother were used for estimation of the state variables in the

six degree of freedom kinematic equations relating measured aircraft responses and for estimation of unknown constant bias and scale factor errors in measured data The computing algorithm includes an analysis of residuals which can improve the filter performance and provide estimates of measurement noise characteristics for some aircraft output variables The technique developed was demonstrated using simulated and real flight test data Improved accuracy of measured data was obtained when the data were corrected for estimated bias errors Author

N77-29144# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

COMPARISON BETWEEN THE STATISTICAL DISCRETE GUST METHOD AND THE POWER-SPECTRAL DENSITY METHOD

R Noback 25 Nov 1975 77 p refs Sponsored by Dept of Civil Aviation

(NLR-TR-75158-U) Avail NTIS HC A05/MF A01

These two methods of calculating aircraft design loads due to atmospheric turbulence were compared qualitatively and quantitatively on the basis of the load exceedance curves for certain aircraft models It is shown that for the first and second order models without unsteady aerodynamic forces and within certain ranges of model-parameters the two methods give the same results for the design loads when the design criteria are also based on these types of models It is shown that the methods are related to each other giving the same results for simple first and second order airplane models It is concluded that the statistical discrete gust method has no advantages and a number of disadvantages compared to the power spectral density method and is not suitable as an airworthiness requirement for the calculation of design loads Author (ESA)

N77-29145# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

EQUATIONS FOR THE RESPONSE OF AN AIRPLANE TO NON-STATIONARY ATMOSPHERIC TURBULENCE PATCHES

R Noback 8 Mar 1976 62 p refs

(Contract NIVR-1775)

(NLR-TR-76056-U) Avail NTIS HC A04/MF A01

A method to calculate the load exceedance curve for a linear system having a finite modulated Gaussian process as input is described The derivation is based on the use of ensemble averages defined as the expected values at a certain point of time The equations can be used for any airplane-transfer function to which the power spectral density method is applicable Author (ESA)

N77-29146# Army Materials and Mechanics Research Center Watertown Mass

EVALUATION OF SCRATCH-AND SPALL-RESISTANT WINDSHIELDS Final Report

John R Plumer and Wilson C McDonald Dec 1976 30 p (AD-A038849 AMMRC-TR-76-39 AVSCOM-76 22) Avail NTIS HC A03/MF A01 CSCL 06/17

A program was conducted to develop and assess materials configurations offering a potential improvement to the scratching and spalling problems present in existing Army helicopter windshields Two prototype designs were fabricated for the UH-1 helicopter flight tested at Ft Rucker Alabama and subjected to ballistic and bird impact tests while under flight simulated conditions The designs tested included an acrylic windshield (used as the standard) a monolithic polycarbonate windshield with an abrasion-resistant coating on both surfaces and a glass-plastic composite using Chemcor and polycarbonate materials GRA

N77-29148 Georgia Inst of Tech Atlanta

A VORTEX WAKE ANALYSIS OF OPTIMUM HIGH BY-PASS RATIO DUCTED FANS Ph D Thesis

Damaraju Subramanya Janakiram 1976 177 p

Avail Univ Microfilms Order No 77-7622

A consistent mathematical potential wake model is presented for the fan wake and the boundary sheets and the compatibility relationships to be satisfied by each of the cylindrical boundary vortex sheets are obtained It is shown that for the wake model to be consistent, the jet wake needs to satisfy certain conditions as far as the induced velocities in it are concerned The compressibility and viscous effects are neglected in the analysis of the wake Using the Biot-Savart law the vortex strength distribution of the ultimate wake is found numerically and then is related to the blade bound vortex strength distribution The expressions for the thrust induced power and induced efficiency are developed using integral theorems and evaluated numerically The ultimate wake vortex model for a ducted fan with infinite number of blades is also developed Dissert Abstr

N77-29149 Engineering Sciences Data Unit London (England)

EFFECT OF INTAKE TOTAL PRESSURE LOSS ON NET THRUST AT TAKE-OFF TURBOJET AND TURBO-FAN ENGINES

Mar 1977 6 p

(ESDU-77001 ISBN-0-85678-172-5) For information on availability of series sub-series and other individual data items write NTIS attn ESDU Springfield Va 22161 HC $98 50

A method is given for estimating the effect of intake total pressure loss on the net thrust of turbojet and turbofan engines at takeoff conditions The total pressure loss characteristics of typical intakes are included along with data for use in estimating the consequent reduction in net thrust ESDU

N77-29151# Lockheed-California Co Burbank

EXPERIMENTAL INVESTIGATIONS OF AERODYNAMIC NOISE DURING FISCAL YEARS 1974, 1975 AND 1976

J D Revell and G J Healy 15 Aug 1977 134 p refs

(LR-27438) Avail NTIS HC A07/MF A01 CSCL 20A

Arguments exist for expecting an airframe noise contribution related to the induced drag associated with dissipation of trailing vortices Turbulence in the swirling shear layers surrounding the trailing vortices causes extra pressure fluctuations to be generated at the wing trailing edge these fluctuations are described The experimental effort on aerodynamic noise was devoted to free jet anechoic wind tunnel tests with airfoils and sting mounted models The noise levels measured for scale model were higher than the theory at Mach numbers between 0 2 and 0 4 by a maximum of 5 db gradually decreasing with Mach number The increase in noise at low Mach numbers above the theory was associated with low Reynolds number laminar instability tones Author

N77-29152# IIT Research Inst Chicago, Ill

TURBINE ENGINE PARTICULATE EMISSION CHARACTERIZATION Final Report

Donald L Fenton Sep 1976 140 p refs

(Contract DOT-FA75WA-3722)

(AD-A041499, C-6352-10 FAA-RD-76-141) Avail NTIS HC A07/MF A01 CSCL 21/5

A particulate material sampler was designed to be used in conjunction with commercial aircraft turbine engines The engines of interest include a low bypass ratio turbofan a mixed flow turbofan and a high bypass ratio turbofan The samples and information provided by the sampler included particle size distribution particle size/shape characteristics and particulate mass concentration The influence of engine operating variables such as power setting and compressor inlet conditions on particle characteristics can be determined Author

N77-29154# Dornier-System G m b H Friedrichshafen (West Germany)

DETERMINATION OF COMPRESSIBLE UNSTEADY AERODYNAMIC FORCES ON A FINITE NUMBER OF WEAKLY CURVED CASCADE OF ARBITRARY DEPTH IN PLANE FLOW [BESTIMMUNG KOMPRESSIBLER, INSTATIONAERER LUFTKRAEFTE AN EINER ENDLICHEN ZAHL SCHWACH GEKRUEMMTER KASKADENSCHAUFELN BELIEBIGER TIEFE IN EBENER STROEMUNG]

W Schuler Bonn DOKZENTBw 1976 45 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin der Verteidigung

(BMVg-FBWT-76-24) Avail NTIS HC A03/MF A01 DOKZENTBw Bonn DM 30

The method described is based on the panel-technique which allows the calculation of approximate unsteady aerodynamic forces on a finite harmonically vibrating cascade consisting of slightly curved lifting surfaces (vanes) and boundary surfaces in a two-dimensional, compressible subsonic airstream Some results obtained from applying the method to a special cascade are presented, and comparison is made with a proven method for the case of a single vane Author (ESA)

N77-29155# Politecnico di Torino (Italy) Ist di Macchine e Motori per Aeromobili

ANALYSIS OF UNSTEADY FLOW IN TURBOJET ENGINE AFTERBURNERS [ANALISI DEL MOTO NON STAZIONARIO IN POSTBRUCIATORI DI TURBOREATTORI]

Matteo Andriano and Luca Zannetti Oct 1976 19 p refs In ITALIAN ENGLISH summary

(Publ-185) Avail NTIS HC A02/MF A01

Transients due to the fuel throttling and a variable geometry exhaust nozzle in turbojet engine afterburners were numerically investigated using a one-dimensional theory An unsteady combustion model is proposed Hyperbolic partial differential equations representative of unsteady flow and combustion are integrated by means of a finite difference method Computational examples are described Author (ESA)

N77-29156# Loughborough Univ of Technology (England) Dept of Transport Technology

NOISE LEVELS OF JET TRANSPORT AIRCRAFT DURING INITIAL CLIMB

M Lanzer D Brown and J B Ollerhead Mar 1977 39 p refs

(Contract SN/1170/012)

(TT-7702) Avail NTIS HC A03/MF A01

Noise peak level data measured for 271 jet transport departure flights at minimum slant range distances of between 1000 ft (305 m) and 6000 ft (1830m) are given The nose *data in D-weighted sound levels dB(D) were obtained by analyses* of noise history tape recordings each of which was accompanied by a photographic record of the flight track Propagation laws relating peak sound level and minimum slant range are derived for ten different aircraft types and for two categorized groupings (2- and 4-engined turbofan aircraft) These empirical laws show that for the maximum power climb condition of flight the radiated peak levels diminish at a rate of about 10 to 12 dB(D) per distance doubling Directivity properties of the D-weighted sound level of selected aircraft are also derived from the sound history and photographic records These are shown to be reasonably approximated by a spherically uniform radiation model Author (ESA)

N77-29159# McDonnell Aircraft Co St Louis Mo

AIRCRAFT HYDRAULIC SYSTEM DYNAMIC ANALYSIS VOLUME 3 FREQUENCY RESPONSE (HSFR) COMPUTER PROGRAM USER MANUAL Interim Technical Report

Gerry Amies and Bob Greene Wright-Patterson AFB Ohio AFAPL Feb 1977 77 p

(Contract F33615-74-C-2016 AF Proj 3145)

(AD-A038691 AFAPL-TR-76-43-Vol-3) Avail NTIS HC A05/MF A01 CSCL 01/3

The hydraulic system frequency response (HSFR) computer program was developed to simulate the dynamic response of a hydraulic system to the acoustic noise generated by the pump Detailed instructions for modeling the system pump lines and components and for using the program are presented For a selected system pressure temperature flow and pump speed range the program calculates the pulsation pressure and energy levels generated by the pump It predicts the amplitude and location of the resulting acoustical standing waves and how these waves are transmitted and attenuated throughout the hydraulic system The program may be used for acoustical analysis in the pressure side or both the pressure and return sides of the hydraulic system GRA

N77-29162# McDonnell Aircraft Co St Louis Mo

AIRCRAFT HYDRAULIC SYSTEM DYNAMIC ANALYSIS VOLUME 6 STEADY STATE FLOW ANALYSIS (SSFAN) COMPUTER PROGRAM TECHNICAL DESCRIPTION Interim Technical Report

Ray Levek and Bob Young Wright-Patterson AFB Ohio AFAPL Feb 1977 501 p refs

(Contract F33615 74-C-2016 AF Proj 3145)

(AD-A038692 AFAPL-TR-76-43 Vol-6) Avail NTIS HC A22/MF A01 CSCL 01/3

The SSFAN computer program analyzes steady state hydraulic flow and pressure primarily in aircraft It uses a building block approach so that new elements or components can be added with minimum change to the rest of the program The solution method is a matrix type using an iterative technique to obtain a final flow balance The program corrects viscosities for pressure determines whether flow is laminar transitive or turbulent applies appropriate resistance factors and corrects reservoir pressure for altitude It handles complex flow networks containing flow and pressure discontinuities such as unbalanced area actuators Author (GRA)

N77-29164# Air Force Inst of Tech Wright Patterson AFB Ohio School of Engineering

A METHOD FOR ANALYSIS OF ELECTROSTATIC PROBE SIGNALS RELATING TO JET-ENGINE MICRODISTRESSES M S Thesis

William Edward Gifford III Dec 1976 62 p refs

(AD-A038528 AFIT/GNE/PH/76-3) Avail NTIS HC A04/MF A01 CSCL 14/2

Various methods of data reduction to correlate electrostatic probe signals with engine gas-path distress were developed and tested These methods consisted of counting pulse signals monitoring turbine and compressor vibrations examining individual pulses to determine significant characteristics and using the integrated areas of all pulses in a given test cycle to determine the level of engine distress The systems developed were tested using tape recorded data from a TF-41 undergoing a simulated flight endurance test at Detroit Diesel Allison Division in *Indianapolis Indiana During the test the LP2 turbine experienced* a non-catastrophic failure due to a seal rub Tapes recorded during the test indicate that the failure occurred over an 80 hour period in which large (350 msec long 8 volts high) pulses were observed on accelerations The vibration signature of the engine also changed during this period A system which integrated the areas under the pulses showed a factor of 20 increase during the period of highest recorded distress Author (GRA)

N77-29165# Texas A&M Univ College Station Dept of Industrial Engineering

ESTIMATION OF ENGINE REMOVAL TIMES AND PREDICTION OF REPLACEMENT REQUIREMENTS Final Report 1 Dec 1975 - 30 Sep 1976

Laurence L George Dec 1976 145 p ref

(Contract F33615-76-C-3042 AF Proj 7071)

(AD-A038076 AFFDL-TR-76-130) Avail NTIS HC A07/MF A01 CSCL 21/5

The report contains a review of the actuarial method for estimation of engine lives a suggestion to reduce the variance of the estimate by using variable age intervals a description of alternative estimators that use all data on engine removal ages a comparison of estimators a sequential two sample test for obtaining a representative data set of engine lives a review of the actuarial method and a simulation program for predicting replacement requirements a next event simulation program for predicting engine requirements and suggestions for more comprehensive models of engine performance and replacement The first appendix contains the derivation of the maximum likelihood estimator for engine lives from a multiple risk model with a progressively censored sample The second appendix describes variance reduction by antithetic variates for a next event replacement simulation The third appendix describes the next event type simulation of operation of a fleet of aircraft with a single type of engine GRA

N77-29166*# Systems Control Inc Palo Alto Calif
IDENTIFICATION OF STABILITY DERIVATIVES FROM WIND TUNNEL TESTS OF CABLE-MOUNTED AEROELASTIC MODELS
Richard L Mohr and W Earl Hall Jr [1977] 124 p refs (Contract NAS1-13938)
(NASA-CR-145123) Avail NTIS HC A06/MF A01 CSCL 01C

The test models were mounted within the wind tunnel on a cable support system which allowed five degrees of freedom in the model s motion A parameter identification algorithm was computer coded to calculate the maximum likelihood estimates of the stability and control derivatives based on an assumed structure of the equations of motion Models of the F-14 aircraft and the space shuttle orbiter were tested in the transonic dynamics tunnel to demonstrate the feasibility of identifying aerodynamic coefficients from wind tunnel test data of cable-mounted models Author

N77-29167# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
LONGITUDINAL MOMENT DEVIATIONS OF WINGS FOR LARGE ANGLES OF ATTACK IN SUBSONIC FLOW [LAENGSMOMENTENDERIVATIVE VON FLUEGELN BEI HOHEN ANSTELLWINKELN IN UNTERSCHALLSTROEMUNG]
C P Schneider and D Nikolitsch Bonn DOKZENTBw 1976 71 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin der Verteidigung
(BMVg-FBWT-76-26) Avail NTIS HC A04/MF A01 DOKZENTBw Bonn DM 30

The steady and quasisteady derivatives of the longitudinal stability of wings of arbitrary shape in subsonic flow were determined by means of the nonlinear Gersten theory The theory was extended to include the compressibility influence of flow Whenever possible, the results of the calculation were compared with the experiment As an additional procedure to predict the unsteady pitching moment derivative the momentum method of the incompressible slender body theory applicable to slender pointed wings was combined with the nonlinear steady lift coefficient The result of both methods show that within the range of applicability of theories the damping derivatives increase with growing angle of attack in other words the increase in angle of attack has a stabilizing effect Author (ESA)

N77-29168# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Flugmechanik der Flaechenflugzeuge
CALCULATION OF THE DYNAMIC RESPONSE OF CCV-TYPE AIRCRAFT Ph D Thesis
Bernd Krag 14 Dec 1976 86 p refs In GERMAN, ENGLISH summary
(DLR-FB-76-78) Avail NTIS HC A05/MF A01 DFVLR Cologne DM 38 60

The lateral motion of a flexible aircraft with a T-tail was investigated The aeroelastic oscillations of the T-tail were damped by a control system without adversely affecting the rigid body motion Modal control theory and an extended root-locus method were used to design the control system The developed methods were used to make an example calculation with HFB-320 aircraft Author (ESA)

N77-29170# Loughborough Univ of Technology (England) Dept of Transport Technology
POLE-PLACEMENT METHODS A SURVEY OF APPLICABLE METHODS FOR FLIGHT CONTROL SYSTEMS
D McLean Oct 1976 64 p refs
(TT-7607) Avail NTIS HC A04/MF A01

Effective methods of pole-placement a technique of linear systems theory which is useful in the design of flight control systems are discussed The methods were collected from a range of publications and are illustrated by examples A digital computer program which evaluates the parameters of the compensation networks is also given Author (ESA)

N77-29171# Committee on Government Operations (U S House)
FAA PROCEDURES IN MAKING NO HAZARD DETERMINATIONS WITH RESPECT TO STRUCTURES NEAR AIRPORTS
Washington GPO 1976 60 p Hearing before a subcomm of Comm on Govt Operations 94th Congr 2d Sess 10 Sep 1976
(GPO-79-322) Avail Comm on Govt Operations

The process of appoving construction of potentially hazardous structures near an airport is examined the local environmental effects and community involvement are considered This hearing focuses on the construction of a radio antenna tower in the vicinity of the Rochester-Monroe County Airport in New York J H

N77-29173*# Computer Sciences Corp Mountain View Calif
SIMULATION OF A SYNERGISTIC SIX-POST MOTION SYSTEM ON THE FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT AT NASA-AMES
Samiresh C Bose and Benton L Parris Jul 1977 44 p refs (Contract NAS2-7806)
(NASA-CR-152010) Avail NTIS HC A03/MF A01 CSCL 14B

Motion system drive philosophy and corresponding real-time software have been developed for the purpose of simulating the characteristics of a typical synergistic Six-Post Motion System (SPMS) on the Flight Simulator for Advanced Aircraft (FSAA) at NASA-Ames which is a non-synergistic motion system This paper gives a brief description of these two types of motion systems and the general methods of producing motion cues of the FSAA An actuator extension transformation which allows the simulation of a typical SPMS by appropriate drive washout and variable position limiting is described Author

N77-29174# Army Engineer Waterways Experiment Station Vicksburg Miss Soils and Pavements Lab
STRUCTURAL DESIGN OF PAVEMENTS FOR LIGHT AIRCRAFT Final Report, Jan 1975 - May 1976
Donald M Ladd Frazier Parker Jr , and A Traboza Pereira Dec 1976 79 p refs
(Contract DOT-FA75WAI-526)
(AD-A041300 FAA-RD-76-179) Avail NTIS HC A05/MF A01 CSCL 01/5

Structural design criteria for airfield pavements to be used by light aircraft were studied Criteria for conventional flexible and rigid pavements for rigid and flexible pavements containing stabilized layers and membrane encapsulated soil layers and for unsurfaced areas are presented A cost benefit analysis and a construction guide for thin concrete pavements are outlined Author

N77-29175# Army Engineer Waterways Experiment Station, Vicksburg Miss
PLASTIC PIPE IN AIRPORT DRAINAGE SYSTEM, PHASE 2 Interim Report, May - Sep 1976
Gary G Harvey Jan 1977 83 p refs
(Contract DOT-FA75WAI-536)
(AD-A041200 FAA-RD-77-38) Avail NTIS HC A05/MF A01 CSCL 01/5

The types of plastic pipe chosen for recommended use are (a) polyethylene (PE) (b) polyvinyl chloride (PVC) and (c) acrylonitrile-butadienestyrene (ABS) The products dealt with are perforated corrugated PE tubing and perforated smooth-wall PVC pipe for underdrains and unperforated smooth-wall PVC and ABS composite pipe for storm drains collector drains and small culverts Available plastic pipe products were evaluated for their potential performance in airport drainage applications The evaluation considered such factors as pipe strength soil-structure interaction chemical and ultraviolet radiation resistance abrasion resistance and resistance to biological attack Author

N77-29176# Aerospace Systems Inc Burlington Mass
REPORT ON AIRPORT CAPACITY LARGE HUB AIRPORTS IN THE UNITED STATES Final Report

Daniel E Gentry Jack D Howell and Nawal K Taneja May 1977 873 p refs
(AD-A041435 FAA-AVP-77-26) Avail NTIS HC A99/MF A01 CSCL 01/5

An airport capacity analysis recently completed for the large hub airports of the United States is decribed Information was collected on existing and planned airport capacities and facilities for the airport terminal and landside components, as well as on ticket counters curb frontages baggage claim devices, security checkpoints parking, gates and runways The study motivation data sought survey methodology, and data sources are also considered Author

N77-29179# Forschungsinstitut fuer Anthropotechnik Meckenheim (West Germany)

METHODS OF NOISE SIMULATION AND THEIR APPLICATION TO FLIGHT SIMULATORS [METHODEN DER GERAEUSCHSIMULATION UND IHRE ANWENDUNG IN FLUGSIMULATOREN]

K-P Gaertner and K Hillmann Apr 1975 110 p refs In GERMAN ENGLISH summary
(FB-22) Avail NTIS HC A06/MF A01 Forschungsinst fuer Anthropotech Meckenheim West Ger DM 10

A survey of methods for electronically synthesizing sounds is presented A given amount of hardware and computer capacity places an upper limit on the degree and fidelity of realism of sound simulation which is attainable Good sound realism for aircraft simulators can be especially expensive because of the complexity of flight sounds and their changing patterns through time The flight simulator described shows that it is possible to design an inexpensive sound simulator with the required acoustic properties using analog computer elements The characteristics of the sub-sound elements produced by this sound simulator for take-off, cruise, and approach are discussed Author (ESA)

N77-29180# Naval Postgraduate School Monterey Calif

AVIATION COMMON GROUND SUPPORT EQUIPMENT REPLACEMENT POLICY INVESTIGATION M S Thesis

Ronald Gilbert Patterson and Fred H Bardley Jr Mar 1977 65 p refs
(AD-A039160) Avail NTIS HC A04/MF A01 CSCL 05/1

A detailed examination of the existing Naval Air Systems Command Common Ground Support Equipment replacement model is presented Basic existing equipment replacement models are discussed and the Annual Cost Model is selected as being most applicable to Navy needs Model inputs consisting of both empirical data and assumptions are critically examined to determine the reasons for the observed limited program utility Several areas for future research are also suggested to improve the program viability Author (GRA)

N77-29181# Systems Research Labs Inc Dayton Ohio

AIRCRAFT SIMULATOR DATA REQUIREMENTS STUDY VOLUME 1 EXECUTIVE SUMMARY Final Report, 1 May 1976 - 30 Jan 1977

George A Whiteside Jan 1977 18 p
(Contract F33615-76-C-0106)
(AD-A040955 SRL-3298-Vol-1 ASD-TR-77-25-Vol-1) Avail NTIS HC A02/MF A01 CSCL 01/3

In view of the increasing importance of modern digital computer-driven flight simulators in providing the required training both for initial qualification and for the maintenance of readiness it was determined that an up-to-date standard to identify the data required by simulator manufactures was needed This standard would then be included in the development and acquisition contracts for future weapon systems to provide for the timely supply of the requisite data GRA

N77-29182# Systems Research Labs Inc Dayton Ohio

AIRCRAFT SIMULATOR DATA REQUIREMENTS STUDY, VOLUME 3 Final Report

George A Whiteside and Harold L Iffland Jan 1977 38 p
(Contract F33615-76-C-0106)
(AD-A040928 SRL-3298-Vol-3 ASD-TR-77-25-Vol-3) Avail NTIS HC A03/MF A01 CSCL 01/3

This specification establishes the requirements for the preparation of aircraft design data for use in the design of aircraft training devices The configuration data supplied herein will be used to fabricate and assemble crew stations which are physically equivalent to those used in the aircraft The performance data will be used to develop transfer functions which will be programmed on a computer to accept inputs from pilot and crew stations and generate outputs to activate instruments displays indicators etc in a realistic manner GRA

N77-29278# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

AMBIENT TEMPERATURE CRACK GROWTH IN TITANIUM ALLOYS AND ITS SIGNIFICANCE FOR AIRCRAFT STRUCTURES

R J H Wanhill Mar 1976 62 p refs Submitted for publication
(NLR-MP-76008-U) Avail NTIS HC A04/MF A01

The influence of microstructure processing heat treatment and fracture modes on ambient temperature cracking in titanium alloys is reviewed in order to predict ambient temperature cracking which may occur in titanium alloy aircraft structures Selection of materials for aircraft structural applications basing the selection on both conventional mechanical properties and damage tolerance criteria, is discussed Author (ESA)

N77-29280# Royal Aircraft Establishment Farnborough (England) Structures Dept

A COMPARISON OF FATIGUE CRACK PROPAGATION RATES IN CM002 (UNCLAD RR58) ALUMINIUM ALLOY IMMERSED IN JET FUEL AND A FUEL SIMULANT

F E Keates and R F Mousley London Aeron Res Council 1977 20 p refs Supersedes RAE-TR-76047 ARC-36892
(ARC-CP-1365 RAE-TR-76047 ARC-36892) Avail NTIS HC A02/MF A01 HMSO £1 50 PHI $5 80

Fatigue crack propagation tests were conducted on CM002 (unclad RR58) aluminum alloy sheet under a flight-by-flight loading sequence The specimens were immersed in jet fuel at 70 C and in fuel simulant at 90 C to simulate conditions in Concorde service and in the Concorde major fatigue test respectively No large difference in crack propagation was observed Comparison with results of similar tests in air at room temperature and at 90 C suggested that the presence of fuel or fuel simulant did not in itself materially affect crack growth Author (ESA)

N77-29287# Rockwell International Corp Los Angeles Calif B-1 Div

FRACTURE MECHANICS EVALUATION OF B-1 MATERIALS VOLUME 1 TEXT Documentary Report, Dec 1970 Apr 1975

R Ferguson and R C Berryman Wright-Patterson AFB Ohio AFML Oct 1976 743 p refs 2 Vol
(Contract F33657-70-C-0800)
(AD-A039883 NA-74-862-Vol-1 AFML-TR 76 137-Vol 1) Avail NTIS HC A99/MF A01 CSCL 01/3

A total of 1 764 fracture mechanics tests were conducted on fourteen alloys to develop property data for use in the B 1 design Tests were performed on aluminum alloys 2024 2124 2219 7049 7050 7075 and 7175 titanium alloy Ti-6Al 4V steel alloys 9Ni-4Co-20C 9Ni-4Co-30c and 300M corrosion resistant steel PH13-8Mo nickel alloy Inconel 718 and nickel-cobalt alloy MP 35 N The effects of product form heat-to-heat variability grain orientation and heat treat condition on fracture behavior were investigated In addition the fracture properties of welds in Ti-6Al-4V PH13-8Mo and 9 4-20 alloys and of diffusion bonds in Ti-6Al 4V were determined Testing variables were temperature specimen thickness environment cyclic frequency and R factor for the da/dN tests The results of the tests are presented in tables and graphs in detailed and summarized forms The effects of the various material and testing variables on fracture behavior are discussed GRA

N77-29288# Rockwell International Corp Los Angeles, Calif B-1 Div
FRACTURE MECHANICS EVALUATION OF B-1 MATERIALS VOLUME 2 FATIGUE CRACK GROWTH DATA Documentary Report, Dec 1970 - Apr 1975
R Ferguson and R C Berryman Wright-Patterson AFB, Ohio AFML Oct 1976 597 p 2 Vol
(Contract F33657-70-C-0800)
(AD-A039785, NA-74-862-Vol-2 AFML-TR-76-137-Vol-2) Avail NTIS HC A25/MF A01 CSCL 01/3

A total of 1 764 fracture mechanics tests were conducted on fourteen alloys to develop property data for use in the B-1 design Tests were performed on aluminum alloys 2024 2124 2219 7049, 7050, 7075 and 7175 titanium alloy Ti-6Al-4V steel alloys 9Ni-4Co- 20C 9Ni-4Co- 30c and 300M corrosion resistant steel PH13-8Mo, nickel alloy Inconel 718 and nickel-cobalt alloy MP 35N The effects of product form heat-to-heat variability grain orientation, and heat treat condition on fracture behavior were investigated The results of the tests are presented in tables and graphs in detailed and summarized forms The effects of the various material and testing variables on fracture behavior are discussed GRA

N77-29322# Exxon Research and Engineering Co , Linden N J Government Research Lab
DEVELOPMENT OF HIGH STABILITY FUEL, PHASE 3 Final Report, 1 Jan - 30 Nov 1976
William F Taylor and John W Frankenfeld Dec 1976 91 p refs
(Contract N00140-74-C-0618)
(AD-A038977 EXXON/GRU 17 GAHF 76) Avail NTIS HC A05/MF A01 CSCL 21/4

An extended program has been completed which meets the original objective of developing a High Stability JP-5 fuel This fuel exhibits the markedly improved thermal stability characteristics required for high speed aircraft and yet retains the general physical characteristics of present day JP-5 This development makes possible the design of an improved performance Mach 4-5 speed range aircraft without resorting to cryogenic or specialty fuels and simplifies logistic problems because of its ability to be used in lower speed aircraft Phase III of this contract was devoted to a study of the effects of selected jet fuel additives and of certain dissolved metals on the thermal stability of deoxygenated JP-5 In addition a room temperature interaction between a pyrrole and a carboxylic acid previously found to be deleterious to storage stability was studied in more detail The results of fuel stability research over the length of the contract are sumarized in this report and the implications of these results for establishing new fuel specifications are discussed The potential effects of various refinery processes on fuel stability are reviewed Recommendations concerning storage and handling techniques are also summarized Author (GRA)

N77-29329# Hamburg Univ (West Germany) Inst fuer Schiffbau
PROFILE FLOWS TAKING CAVITATION BUBBLE DYNAMICS INTO ACCOUNT [PROFILSTROEMUNGEN UNTER BERUECKSICHTIGUNG DER DYNAMIK VON KAVITATIONSBLASEN]
W H Isay, L Lederer, and R Voss Bonn DOKZENTBw 1976 48 p refs In GERMAN, ENGLISH summary Sponsored by Bundesmin der Verteidigung
(BMVg-FBWT-76-22) Avail NTIS HC A03/MF A01, DOKZENTBw, Bonn DM 30

The plane steady flow of gas-containing water around hydrofoil profiles was examined taking into account dynamic distortion and stability of bubbles and nuclei The local gas volume ratio the expansion of the bubble nuclei, and the pressure distribution were calculated for several profiles at given bubble size distribution The applicability of the results to cavitation prediction of propellers was tested The sound radiation of bubble systems in the pressure field of a profile was determined ESA

N77-29331# Naval Ship Research and Development Center Bethesda, Md Ship Performance Dept
MOTIONS AND DRAG OF AN AIR CUSHION VEHICLE WITH A DEEP SKIRT IN CALM WATER AND RANDOM WAVES
Alvin Gersten Jan 1977 79 p refs
(50407056)
(AD-A039086 SPD-748-01) Avail NTIS MF A01 CSCL 13/10

A model of an air cushion vehicle (ACV) with a deep pericell-type skirt and high cushion loading has undergone experiments in calm water and head random waves The main goal of the investigation was to obtain drag and motion data which can be used to guide the design of a prototype The results will also be used to validate computer predictions Plots of mean drag are presented in this report as are tables containing standard deviation values of motions and accelerations The effect of model weight and volume air flow on drag and motions is discussed It is also shown that this heavily loaded ACV has higher hump and post-hump drag than a similarly configured ACV with smaller payload and shorter skirt In addition the heavier deep-skirted vehicle pitches less and heaves about the same as the other craft Author (GRA)

N77-29346# Office of Telecommunications, Boulder Colo Inst for Telecommunication Sciences
ANTENNA TILTING EXPERIMENTS OVER RADAR MICROWAVE LINKS Final Report
W J Hartman Feb 1977 29 p refs
(Contract DOT-FA74WAI-419)
(AD-A036727 FAA-RD-77-5) Avail NTIS HC A03/MF A01 CSCL 01/2

Signal level recordings were made simultaneously for two systems One utilized an antenna tilted upward to obtain a 2 db loss over optimum alignment and the other used an untilted antenna The path was a 42 3 km radar microwave link over relatively flat terrain covered with tall trees The results showed essentially identical fading on both systems Author

N77-29347# Electromagnetic Compatibility Analysis Center, Annapolis, Md
A MODEL TO PREDICT MUTUAL INTERFERENCE EFFECTS ON AN AIRFRAME Final Report
Priscilla A Dwyer (IIT Research Inst , Annapolis, Md) Oct 1976 157 p refs
(Contract DOT-FA70WAI-175)
(AD-A039224/1, ECAC-PR-76-067, FAA-RD-76-50) Avail NTIS HC A08/MF A01 CSCL 09/3

An analysis model has been developed to determine the mutual interference effects of introducing new avionics equipment to an existing airframe, containing operational equipment The model has been updated improved and expanded in a series of scheduled efforts Those improvements are summarized and the current version of the model is completely documented Author

N77-29348# Lincoln Lab , Mass Inst of Tech Lexington
COMPARISON OF THE PERFORMANCE OF THE MOVING TARGET DETECTOR AND THE RADAR VIDEO DIGITIZER
R M Odonnell and L Cartledge Hanscom AFB Mass 26 Apr 1977 90 p refs
(Contract F19628-76-C-0002)
(AD-A040472, ATC-70 FAA-RD-76-191) Avail NTIS HC A05/MF A01 CSCL 17/9

Side by side simultaneous tests were made to compare the performance of the moving target detector (MTD) digital signal processor and that of an adaptive sliding window detector the radar video digitizer (RVD-4) The MTD used with a highly modified FPS-18 employs coherent linear doppler filtering adaptive thresholding and a fine grained clutter map which together reject all forms of clutter simultaneously The RVD-4, which was used with an ASR-7 is a nonlinear noncoherent digital processor The detection and false alarm performance of both processors in thermal noise was identical Measured detection and sub-clutter visibility performance of the MTD on controlled aircraft flying in heavy rain in heavy ground clutter, and at near zero radial velocity is shown to be superior to that of the RVD-4 MTD report data is also shown to be more accurate than the RVD-4 data resulting in improved ARTS-3 tracker performance when using MTD processed data Author

N77-29532# Boeing Commercial Airplane Co., Renton, Wash
TIRE RUNWAY INTERFACE FRICTION PREDICTION SUBSYSTEM Final Report, May - Dec 1975
M Wahi and H H Straub Mar 1977 202 p refs
(Contract F33657-74-C-0129)
(AD-A039968, ASD-TR-77-7) Avail NTIS HC A10/MF A01 CSCL 01/2

An analytical tire model was developed that correlates with existing tire test data to within + or - 5% The model consists of a prediction equation expressing the relationships between seven dimensionless groups (pi terms) needed to define the aircraft tire-runway interface friction A tire test program was recommended to validate the said model A specification criteria has been established for the interface Friction Prediction Subsystem and various ground vehicles in use to date were evaluated None of the vehicles meet the specification criteria GRA

N77-29552 California Univ Los Angeles
A MULTILEVEL APPROACH IN OPTIMUM DESIGN OF STRUCTURES INCLUDING BUCKLING CONSTRAINTS Ph D Thesis
Rappal Krishnan Ramanathan 1976 243 p
Avail Univ Microfilms Order No 77-8529

Optimum design of truss and wing structures including size strength displacement local and system buckling constraints is presented A feasible design vector describing the overall proportions of the structure and the detailed dimensions of the component is obtained from each stage of the multilevel design procedure The importance of including local and system buckling constraints in optimum design procedures is underscored by the numerical results of this study Finally some potential extensions of the multilevel method are pointed out particularly the relative ease with which other types of components could be used with only minor modifications at the system level Dissert Abstr

N77-29564# Dornier-System G m b H., Friedrichshafen (West Germany)
DYNAMIC BEHAVIOR OF STOCHASTICALLY EXCITED AIRCRAFT STRUCTURES FOR DETERMINATION OF STRESS AND LIFE [UNTERSUCHUNG DES DYNAMISCHEN VERHALTENS STOCHASTISCH ERREGTER FLUGZEUG-STRUKTUREN ZUR ERMITTLUNG DER SPANNUNGEN UND DER LEBENSDAUER]
M Rother Bonn DOKZENTBW 1976 56 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin der Verteidigung (BMVG-FBWT-76-25) Avail NTIS HC A04/MF A01 DOKZENTBw Bonn DM 30

Based on the general random response theory and considering the peculiarities valid for technical random processes an engineering procedure was derived to calculate structural response The assumptions refer to small damping and phase coincidence of the exciting forces The procedure was applied to aircraft skin panels subjected to jet noise loading This was achieved by means of the finite element method and modal analysis The maximum rms stresses were calculated for plane and simply curved skin panels The varieties of important structural parameters considered includes the aspect ratio skin thickness and curvature as well as the elasticity of the stiffening frames and stringers The results correspond well with the AGARD design data The analysis of individual rigidly fixed skin panels in place of the actual structure proved this sufficient A simple test structure was investigated analytically and experimentally with and without consideration of the phase information to test the influence of phase differences of the exciting forces It became apparent that the simplified calculation procedure supplies conservative results for the maximum values of the structural response Measures to estimate fatigue life are discussed It is possible to determine the number of cycles to failure for the investigated structures in good approximation by means of the lowest natural frequency
Author (ESA)

N77-29565# National Aerospace Lab., Amsterdam (Netherlands) Structures and Materials Div
RATE EFFECTS ON RESIDUAL STRENGTH OF FLAWED STRUCTURES AND MATERIALS
H P vanLeeuwen and L Schra 22 Dec 1975 81 p refs
(Contract LI/LW/4969)
(NLR-TR-76004-U) Avail NTIS HC A05/MF A01

The literature is reviewed with respect to tests conducted to investigate crack re-initiation under dynamic loads and arrest of a running crack metallurgical sources of rate effects available data for aerospace engineering materials and mechanical sources of rate effects dynamic crack tip stresses and kinetic energy effects Conclusions are drawn and recommendations made
Author (ESA)

N77-29569# National Aerospace Lab., Amsterdam (Netherlands) Structures and Materials Div
RESIDUAL STRENGTH DATA OF RIVETED PANELS WITH DIFFERENT STIFFENER CONFIGURATIONS
H Vlieger 10 Mar 1976 28 p refs
(Contract NIVR-1705)
(NLR-TR-76033-U) Avail NTIS HC A03/MF A01

Residual strength tests were carried out on center-cracked panels with a 2024-T3 or 7075-T6 skin and provided with eccentric stiffeners of practical design The stiffeners were riveted to the skin The material of the stiffeners was 7075-T6 In some cases the stiffeners were combined with Ti-alloy crack stoppers On the basis of the test results the effects of different panel parameters and material properties on the residual strength characteristics of the various panel configurations were evaluated The interrelated effects of crack propagation and residual strength in a certain fail-safe design are discussed and the effects of material properties and structural configuration on the inspection interval are appraised Author (ESA)

N77-29577# Colorado State Univ Fort Collins Dept of Mechanical Engineering
THEORETICAL AND EXPERIMENTAL ANALYSIS OF SURFACE CRACKS EMANATING FROM FASTENER HOLES Final Report, 1 May 1974 - 23 Oct 1976
F W Smith and T E Kullgren Feb 1977 198 p refs
(Contract F33615-74-C-3069)
(AD-A039817, AFFDL-TR-76-104) Avail NTIS HC A09/MF A01 CSCL 01/3

The finite element-alternating method is used to determine stress intensity factors along the periphery of a part-elliptical crack emanating from a fastener hole in a finite-thickness plate The method performs a sequence of iterations between an analytic solution for an elliptical crack embedded in an infinite solid and a finite element solution for a finite-thickness uncracked plate with a fastener hole to obtain the stress field near the crack the stress intensity factor and the crack opening displacements Mode-one stress intensity factors around the crack front are presented for three classes of crack locations relative to the hole and numerous crack shapes and sizes Calculations are performed for cracks emanating from both loaded and unloaded fastener holes Crack opening displacements for all cases are presented The results of this study are compared to static fracture tests in polymethylmethacrylate and with experiments and estimates of other authors Author (GRA)

N77-29918*# Bolt Beranek and Newman Inc Canoga Park Calif
EFFECTS OF INTERIOR AIRCRAFT NOISE ON SPEECH INTELLIGIBILITY AND ANNOYANCE Final Report
Karl S Pearsons and Ricarda L Bennett Aug 1977 67 p refs
(Contract NAS1-14463)
(NASA-CR-145203) Avail NTIS HC A04/MF A01 CSCL 20A

Recordings of the aircraft ambiance from ten different types of aircraft were used in conjunction with four distinct speech interference tests as stimuli to determine the effects of interior aircraft background levels and speech intelligibility on perceived annoyance in 36 subjects Both speech intelligibility and background level significantly affected judged annoyance However the interaction between the two variables showed that

above an 85 db background level the speech intelligibility results had a minimal effect on annoyance ratings Below this level people rated the background as less annoying if there was adequate speech intelligibility Author

N77-29919# Federal Aviation Administration, Washington D C
HELICOPTER NOISE MEASUREMENTS DATA REPORT VOLUME 1 HELICOPTER MODELS HUGHES 300-C, HUGHES 500-C, BELL 47-G, BELL 206-L
Harold C True and Richard M Letty Apr 1977 386 p 2 Vol
(AD-A040561 FAA-RD-77-57-Vol-1) Avail NTIS HC A17/MF A01 CSCL 01/3

The purpose of this test program was to provide a data base for a possible helicopter noise certification rule Only the measured data is presented The eight helicopters tested during this Helicopter Noise Test Program constituted a wide range of gross weights and included participation from several helicopter manufacturers The helicopter models used in this test program were the Hughes 300C Hughes 500C, Bell 47-G, Bell 206-L, Bell 212 (UH-1N) Sikorsky S-61 (SH-3A) Sikorsky S-64 Skycrane (CH-54B) and Boeing Vertol Chinook CH-47C The test procedure for each helicopter consisted of obtaining noise data during hover level flyover and approach conditions The data consist of time histories 1/3-octave band spectra, EPNL PNL dBA dBD and OASPL noise levels Author

N77-29920# Federal Aviation Administration, Washington, D C
HELICOPTER NOISE MEASUREMENTS DATA REPORT VOLUME 2 HELICOPTER MODELS BELL 212 (UH-1N), SIKORSKY S-61 (SH-3A), SIKORSKY S-64 SKYCRANE (CH-54B), BOEING VERTOL CHINOOK (CH-47C)
Harold C True and Richard M Letty Apr 1977 418 p 2 Vol
(AD-A040562, FAA-RD-77-57-Vol-2) Avail NTIS HC A18/MF A01 CSCL 01/3
For abstract see N77 29919

N77-29921*# Tufts Univ Medford, Mass
INVESTIGATION OF THE EFFECTS OF A MOVING ACOUSTIC MEDIUM ON JET NOISE MEASUREMENTS
John E Cole, III and Douglas W Palmer Dec 1976 91 p refs
(Contract NCA2-OR785-601)
(NASA-CR-152038) Avail NTIS HC A05/MF A01 CSCL 20A

Noise from an unheated sonic jet in the presence of an external flow is measured in a free-jet wind tunnel using microphones located both inside and outside the flow Comparison of the data is made with results of similar studies The results are also compared with theoretical predictions of the source strength for jet noise in the presence of flow and of the effects of sound propagation through a shear layer Author

N77-29923# Institut Franco-Allemand de Recherches, St Louis (France)
EXPERIMENTAL STUDY OF LATERAL WIND EFFECT ON FREE JET NOISE [ETUDE EXPERIMENTALE DE L'EFFET D'UN VENT LATERAL SUR LE BRUIT EMIS PAR UN JET LIBRE]
M Schaffar P G Sava and J J Brunner 23 Jun 1976 37 p refs In FRENCH
(ISL-R-121/76) Avail NTIS HC A03/MF A01

The lateral wind simulates the transversal component of the relative wind due to the flight speed whereby the engine s angle of attack is taken into account For a realistic velocity ratio, it was found that a strong increase takes place in the noise generated, especially at low frequencies (Strouhal number below 0 5) ESA

N77-29952# Naval Electronics Lab Center San Diego Calif
A-7 AIRBORNE LIGHT OPTICAL FIBER TECHNOLOGY (ALOFT) DEMONSTRATION PROJECT Final Report, Mar 1974 - Jan 1977
R D Harder R A Greenwell and G H Holma 3 Feb 1977 48 p refs
(AD-A038455 NELC/TR-2024) Avail NTIS HC A03/MF A01 CSCL 20/6

A the A-7 ALOFT project successfully demonstrated a fiber-optic signal transmission system can accurately transmit data in the demanding environment of a military aircraft Included is a summary of the most significant test results the conclusions reached from the economic analysis and the compilation of reliability and maintainability data Author (GRA)

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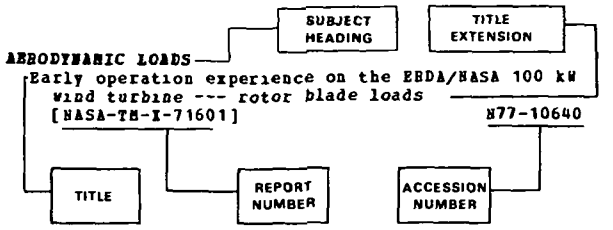

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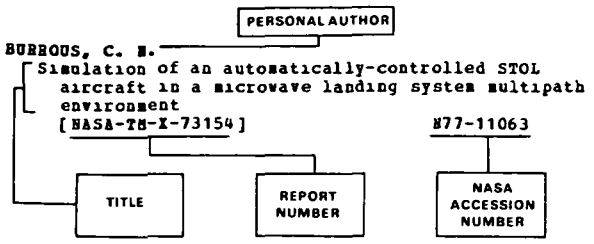

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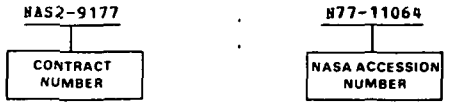

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