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A Continuing Bibliography with Indexes

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 113

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 August 1979 in

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

NASA Scientific and Technical Information Branch 1979
National Aeronautics and Space Administration
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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 436 reports, journal articles, and other documents originally announced in August 1979 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

An annual cumulative index will be published

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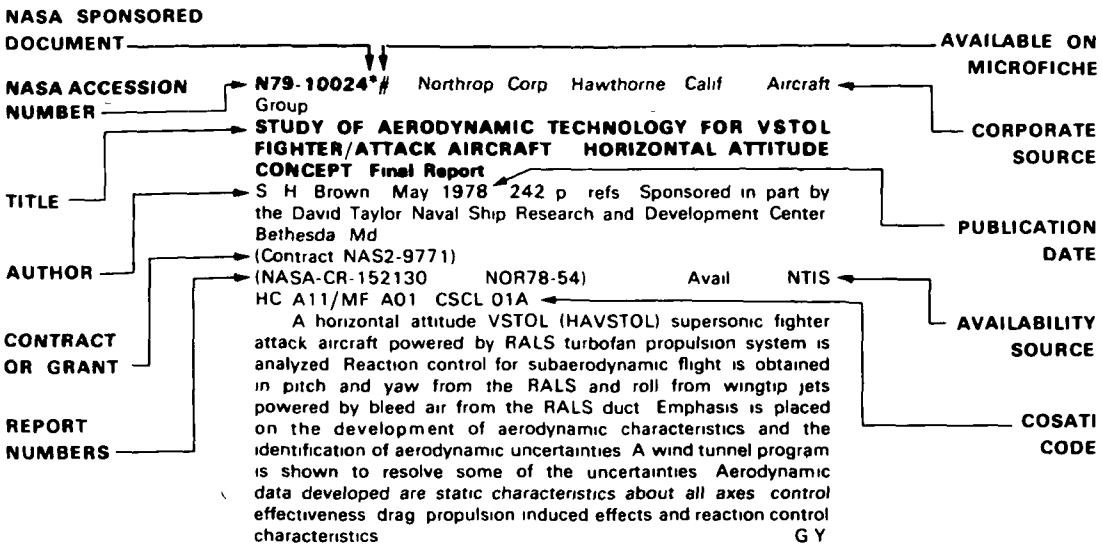

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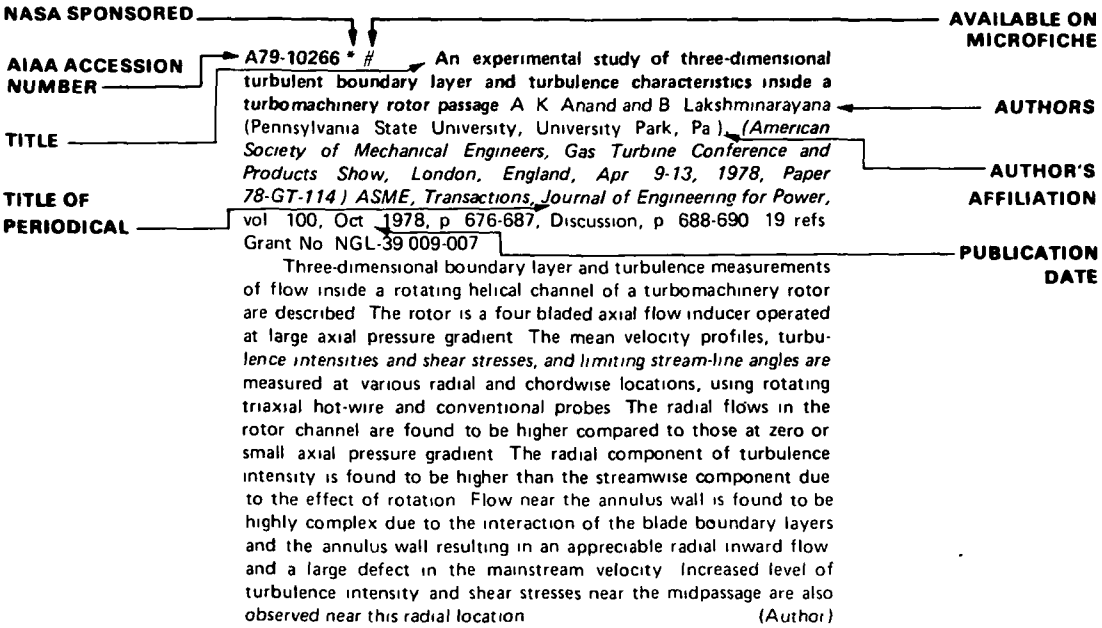

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 113)

SEPTEMBER 1979

IAA ENTRIES

A79-35927 # **Second approximation in theory of a finite-span thin wing in a hypersonic gas flow (Vtoroe priblizhenie v teorii tonkogo kryla konechnogo razmakha, obtekaemogo giperzvukovym potokom gaza)** V I Bogatko, A A Grib, and G A Kolton *Leningradskii Universitet, Vestnik, Matematika, Astronomiia,* Jan 1979, p 88-95 8 refs In Russian

The uniform hypersonic flow of an inviscid gas on the windward side of a thin wing of finite span is studied Thin boundary layer theory is applied to obtain corrections to the main Newtonian flow The shock is assumed to be attached to the leading edge at at least two points The special case of a symmetric conical wing with rectilinear leading edge is considered P T H

A79-35928 # **Construction of an initial approximation for the solution of the integral equation of a lifting surface (O postroenii nachal'nogo priblizheniia dlia resheniia integral'nogo uravneniia nesushchei poverkhnosti)** O F Mel'nikova and N N Poliakhov *Leningradskii Universitet, Vestnik, Matematika, Astronomiia,* Jan 1979, p 104-110 6 refs In Russian

Weissinger's hypothesis is used to obtain in a simple manner an analytic expression for an initial approximation to the solution of the integral equation for a lifting surface It is proved that the approximate solution obtained in this way satisfies the boundary conditions of the problem and the requirement for practical convergence of the iterations P T H

A79-36003 **X-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 (Rontgenographische Ermittlung der bei der Oberflachenbearbeitung von TiAl6V4 und TiAl6V6Sn2 entstehenden Eigenspannungszustande)** H E Franz *(Verein Deutscher Ingenieure, Internationale Konferenz uber experimentelle Spannungsanalyse, 6th, Munich, West Germany, Sept 18-22, 1978) VDI-Berichte,* no 313, 1978, p 453-462 14 refs In German

A report is given on the states of internal stress occurring near the surface on the surface finishing of two titanium alloys (TiAl6V4 and TiAl6V6Sn2) The finishing methods investigated comprise milling, grinding, milling plus grinding, turning, turning plus grinding, rolling and shot peening The results are compared with those relating to steel It is pointed out that taking internal stresses due to finishing into account in aircraft construction may perhaps lead to reductions in weight and thus to lower costs of operation (Author)

A79-36024 **Application of advanced data reduction methods to gas turbine dynamic analysis** P B Juhl *(Verein Deutscher Ingenieure, Internationale Konferenz uber experimentelle Spannungsanalyse, 6th, Munich, West Germany, Sept 18-22, 1978) VDI Berichte,* no 313, 1978, p 637-642

This paper discusses the application of advanced data reduction methods to the evaluation of dynamic data from gas turbines and turbine components. The use of the Fast Fourier Transform and of real-time spectrum analyzers is discussed The use of power spectral density and probability density functions for analyzing random data is discussed Examples of the application of these modern techniques to gas turbine testing are presented The use of the computer to automate the data reduction procedures is discussed (Author)

A79-36065 **Evaluation of GPS performance for low-cost general aviation** A N Joglekar (Mitre Corp , Metrek Div , McLean, Va) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 7-12

This paper presents preliminary results of a simulation effort to evaluate requirements and feasibility of GPS as a civil navigation system The paper focuses on evaluation of GPS requirements, from operational considerations, such as application to nonprecision approaches The conceptual low-cost GPS receiver simulated here does not correct for the ionospheric or tropospheric delay, is sequential in nature, tracks only four satellites, and is not mechanized to make independent range rate measurements based on the Doppler shift of the GPS carrier frequency The proposed GPS system has significantly different performance characteristics from the presently used VOR/DME system The GPS is a low signal level system and may have a relatively slow data rate due to the low cost sequential receiver design The results indicate that although the conceptual low-cost GPS receiver/navigator is potentially more accurate than a VOR, the accuracy may degrade during aircraft turns and satellite shielding periods (Author)

A79-36069 # **Internationalization of OMEGA** D T Haislip (U S Coast Guard, Washington, D C) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 37-39

The OMEGA system of radionavigation is a Very Low Frequency (VLF) system operating in the internationally allocated radio frequency band of 10 to 13 kHz Navigators using the OMEGA system will be able to obtain positional data on a worldwide and nearly continuous basis when the system is in full operation with eight transmitting stations Experimental stations commenced operating in 1966 in support of system evaluation and testing These experimental stations provided coverage over most of the North Atlantic Ocean, North American Continent, and eastern portions of the North Pacific Ocean This coverage provided the fundamental basis for initial operational evaluation and further development of the system intended to be available to the users of all nations, both ships and aircraft This paper will review the growth, current status and future plans for management of this international radionavigation system (Author)

A79-36070 ***Hyperbolic positioning per se is passe*** R R Hatch (Magnavox Government and Industrial Electronics Co , Ft Wayne, Ind) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 51-58 7 refs

Hyperbolic navigation schemes, originally instituted to limit computational time, no longer have justification in positioning systems that use microprocessors Instead of differencing raw measurements, the computational process for navigation systems should use raw, biased range measurements The integrated Doppler count in the Transit navigation system is intrinsically hyperbolic, but

results can still be obtained that are optimal in a batch sense In this paper, a computationally efficient method capable of accounting for the measurement covariance in hyperbolic positioning systems is presented J M B

A79-36071 Loran C - Its future in the shadow of Navstar GPS J P Van Etten (ITT, ITT Avionics Div , Nutley, N J) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 63-72 10 refs

The Navstar Global Positioning System, which may become available for civil use in 1990, has a projected development cost of 3 0 billion dollars However, U S civil users, concentrated in the continental U S and its coastal zones, may be better served by the Loran-C long-range regional radio navigation system Accuracy available to civil users of Navstar is expected to be somewhat poorer than that obtainable from Loran-C, furthermore, Navstar receivers are projected to be twice as costly as Loran-C receivers J M B

A79-36072 The MX 1105, an integrated Transit/Omega navigator J E Maenpa (Magnavox Government and Industrial Electronics Co , Fort Wayne, Ind) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 73-88 20 refs

An integrated Transit/Omega navigation system based on a single, compact, microprocessor-controlled instrument has been developed The integrated navigator combines the advantage of highly accurate position fixes in any weather (available through Transit) and the capability of nearly continuous position and velocity sensing over most of the globe (available through Omega) The integrated Transit/Omega system retains the bounded error characteristics and continuous navigation capability of Omega to limit error growth between Transit position fixes Transit position fix degradation due to Omega-derived velocity is minimized Testing of the integrated navigator over Atlantic, Pacific and Indian Ocean routes has been carried out J M B

A79-36077 Reliability, performance, and fault isolation considerations in the design of interconnected navigation systems J S H Liu and T J Murphy (Dynamics Research Corp , Wilmington, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 114-121 14 refs

The study demonstrates that decentralized approaches in the design of interconnected navigation systems are sometimes better than 'intuitively obvious' centralized approaches suggested by theory This means that although theory can show that centralized approaches will provide the best navigation accuracy under normal operating conditions, their performance can be adversely affected when conditions are not normal A good decentralized approach represents an acceptable engineering tradeoff between the issues of accuracy, cost, and reliability The focus is on interface design for a master-slave hierarchical interconnection The issues of accuracy, cost, and reliability are developed on the basis of a specific example It is shown that the design of the decentralized interface is better than that of a centralized interface in terms of an engineering tradeoff between accuracy, cost, and reliability S D

A79-36082 The results of synthesizing and evaluating potential solutions for Multi-Function Inertial Reference Assembly /MIRA/ candidate configurations J M Perdzock (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), R C Burns, and G C Jackson (McDonnell Aircraft Co , St Louis, Mo) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 159-164

The development of the Multi-Function Inertial Reference Assembly (MIRA) satisfying the combined kinematic data requirements of flight control, navigation, weapon delivery, and terminal area control is reported to be a potential solution to increasing avionic costs on advanced Air Force fighter and transport aircraft of the 1980's A single line replaceable unit (LRU) of the selected MIRA configuration can replace eight LRUs on the F-15A and is characterized by improvements in velocity and attitude output accuracies while retaining position accuracy, safety and mission reliability, redundancy, maintainability, and survivability MIRA can accommodate either tuned rotor gyros (TRG) or ring laser gyros (RLG) With performance considerations favoring RLGs and weight projections favoring TRGs, it is found that RLGs are more adaptable for redundancy, afford rapid reaction from cold temperature, exhibit an inherent high dynamic capability, and offer potentially higher reliability and operational life V T

A79-36084 Drone formation control system /DFCS/ - A new generation test range system W A Rice (U S Army, White Sands Missile Range, White Sands, N Mex) and K D Rehm (IBM Corp , Federal Systems Div , Owego, N Y) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 182-190

The Drone Formation Control System (DFCS) has been operating at the White Sands Missile range since September 1976 This paper briefly describes the DFCS and some of the missions performed by it A brief description of system hardware emphasizes the data link and display subsystems The DFCS uses distance-measuring equipment to locate a drone, then, the DFCS compares the present drone position to that desired and generates the commands necessary to bring the drone to the desired location The paper highlights the various types of missions the DFCS can support and discusses missions that used BQM-34s and PQM-102s in single and multiple aircraft formations at all altitudes Included are manual and automatic control, high 'g' maneuvers, and the takeoff and landing of GF102 and GF86 drones The effects of multipath on DFCS data link performance over land and water are also presented (Author)

A79-36086 Evaluation of an FM/CW range measurement system for VTOL landing D G Krenz, D R Colvin (Cubic Corp , San Diego, Calif), S K Miyashiro, F E Morris, and W A Carlson (U S Naval Ocean Systems Center, Tactical Sensors and EW Div , San Diego, Calif) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 298-304

A Precision Ku-Band FM/CW Range Measurement System was designed and built by Cubic for the Naval Ocean Systems Center to test and evaluate its effectiveness as a landing/guidance system for VTOL aircraft Primary equipment consisted of an interrogator, transponder, control and display console, and government-furnished antennas and computer The system operated on the principle that a continuous-wave signal modulated onto a radio-frequency carrier and propagated through free space undergoes a phase shift that can be measured to provide slant range Test results conclusively indicate that the system provides more-than-adequate accuracy for the ranging requirements of a VTOL landing guidance system (Author)

A79-36087 A navigation filter for an integrated GPS/ JTIDS/INS system for a tactical aircraft B A Kriegsman and W M Stonestreet (Charles Stark Draper Laboratory, Inc , Cambridge, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 316-320 14 refs Contract No F33657-77-C-0672

An integrated dual-grid navigation system including the Global Positioning System (GPS), the Joint Tactical Information Distribution System (JTIDS), and an Inertial Navigation System (INS) is studied for use in a community of tactical fighter aircraft A 19-state

minimum-variance filter on board each aircraft is designed to process most efficiently data from the different navaids The integration of GPS with a JTIDS/INS system leads to better user overall navigation-system performance by providing more accurate geodetic position and velocity information, better estimates of absolute INS tilts and user clock errors, and more accurate estimation of baro-altimeter bias errors S D

A79-36090 **Stability analysis of relative navigation systems** M S Greenberg (Dynamics Research Corp , Wilmington, Mass) and H J Rome (Lowell University, Lowell, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 335-344

Stability properties of relative navigation systems are investigated with regard to the level of inter-unit range measurement integration within a multi-member airborne community Each member is capable of processing relative range measurements and inertial dead-reckoning data The analysis isolates and highlights the effects of various measurement weighting criteria and various measurement selection protocols and demonstrates a crossover from unstable to stable behavior for certain combinations and types of information hierarchies and rel nav filter mechanization choices A rel nav covariance analysis simulation is used for the evaluation of a four aircraft community, each unit equipped with an inertial dead reckoning system, a TDMA transceiver, and rel nav filter software for the selection, weighting, and processing of inter-unit measurements (Author)

A79-36096 **Recent results in navigation systems utilizing signal aiding from Navstar satellites** J N Damoulakis, V Gylys, and T N Upadhyay (Texas Instruments, Inc , Dallas, Tex) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif , November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 388-395 11 refs Contract No F04701-75-C-0180

This paper describes some recent results and experience in designing navigation systems that use signals from GPS/Navstar satellites Three distinct navigation/system configurations are considered for applications to aircraft, missile, and man-vehicular user systems The commonality in these three user equipment systems is the continuous use of range/range rate information transmitted from a set of navigation satellites The basic engineering feature of these systems is their capability to process the range/range-rate measurements This is done by a real time combination of double-stage piecewise recursive filtering technique of Kalman's type for estimating the user's position and time This technique consists of fast and slow filter loops The received measurements are processed at a high rate in the fast loop while using the gains computed by the other loop The slow loop also processes the system-error covariance matrix and other system statistics Methods for resolving incompatibilities in the system statistics, resulting from the fast/slow loop processing combination are described (Author)

A79-36100 **Industry seeks lighter aircraft weight** D M North. *Aviation Week and Space Technology,* vol 110, May 21, 1979, p 77, 79, 80, 85

Future design of small general aviation aircraft will be based on fuel efficiency, safety performance, and reduced maintenance and will be influenced by advances in turbomachinery, composite materials, aerodynamics and avionics, with business and personal aircraft markets expected to grow Pressurization, anti-icing systems, weather radar and altimeters will be essential features in the 1990's with the use of composite materials for airframe structure, landing gear and propeller blades providing 25% reduction in empty weight Diesel, rotary and turbine engines will be used noting that turbo charged diesel engines in a four-place aircraft would run at 3500 rpm and would be attached to a composite material propeller by a helicopter type drive shaft It will cruise at an altitude of 25,000 ft, with a 1600 mile range, and 26 mile/gal fuel consumption Wings will have higher aspect ratios, full span flaps with slot-lip roll and flight path spoilers, and pusher propeller technology will be utilized It is expected that general aviation aircraft will provide about 25% more speed and 50-100% better fuel efficiency than aircraft available now A T

A79-36122 **Profile of a nozzle shaping the free-molecule flow intended to investigate air-intakes and cascades** Iu E Kuznetsov and Ia Sh Flaksman *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Sept-Oct 1978, p 171-174) *Fluid Dynamics,* vol 13, no 5, Mar 1979, p 776-778 Translation

A79-36248 **Directionally solidified blades - Greater strength** C A Lombard (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *ManTech Journal,* vol 3, no 3, 1978, p 22-27

Superalloy turbine blades cast by the directional solidification process have higher stress rupture strength, resistance to thermal fatigue, and greater tensile strength than conventional castings, obtaining longer life and lower maintenance costs Although blade cost is 1 5 to 2 times that of conventional blades, 300,000 airfoils made by this process are used in JT9D, F100, TF30 and PT6 Pratt and Whitney engines which accumulated more than 1 5 million hours of field use The three basic directional solidification processes - withdrawal, Rapid Automated Multistation-Directional Solidification, and exothermic are described, noting that the exothermic process was used for the F103, TF-41, T-55 engines, and the TFE731-3 engine which is under NASA contract Single crystal blades made by an extended directional solidification process are being developed to upgrade engine performance by allowing 125 F higher inlet temperatures, expected to reduce mission cost by 21%, save up to $7 million in engine development, and increase overhaul life six to seven times A T

A79-36347 # **Lectures on hydroaeromechanics (Lektsii po gidroaeromekhanike)** S V Vallander Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1978 296 p 5 refs In Russian

The book is a reproduction of Vallander's course on a branch of mechanics dealing with the laws of fluid motion and equilibrium and the laws of interaction between fluids and bodies situated in them The concept of a fluid comprises both liquids and gases The lectures deal with such issues as the derivation of the total system of hydrodynamics equations, the formulation of this system of equations for some representative fluid models, and with the fundamentals of hydrodynamics of ideal and viscous fluids V P

A79-36373 **Making fluid flows visible** W Merzkirch (Bochum, Ruhr-Universitat, Bochum, West Germany) *American Scientist,* vol 67, May-June 1979, p 330-336 7 refs.

Two principles of making a fluid flow visible are discussed in this paper. First, the internal edges or boundaries of the primary fluid can be made visible by introducing into it a secondary substance of a different phase What actually can be seen is the movement of this foreign substance, which is assumed to have the same motion as the primary fluid, this requires that the particles of the foreign substance be as small as possible while still visible The second principle applies to fluids having optical properties that change while the fluid is flowing If the relationship between the state of the flow and the change in an optical parameter is known, optical methods could be applied to measure certain properties in the flow field without disturbing the fluid by introducing a measuring probe or a foreign material into it Since the optical index of refraction of a gas is a function of a gas density, variations in the refractive index can be measured by means of optical interferometry V T

A79-36374 **Boeing 757/767 - On-the-spot report** M Hirst *Flight International,* vol 115, May 19, 1979, p 1673-1678

The article reports on Boeing's new airliners, the medium haul 767, seating 221 and the short haul 757 seating 177 The 767's unique seven abreast seating results in a narrower profile, which in conjunction with the large wing area is responsible for the low seat/mile costs claimed by Boeing The wing design and the decision to use a low tail versus a high tail is also discussed The 757 is a variation of the 707,727,737 theme, and its commonality with the 767 is noted Many systems, including the auxiliary power supply, the virtually all digital electronics of the avionics system, and the tail section surfaces will be shared A separate section notes a possible use of a 767-based nose on the 757 The use of a CRT display instead of a mechanical attitude indicator, and the use of a second CRT for horizontal-situation data is detailed The use of lasers in the inertial reference system (IRS) is also covered, and full specifications, payload and fuel performance data are presented M E P

A79-36376 **Producing light aircraft - Three viability case studies** J M Robertson *Aeronautical Journal,* vol 83, Apr 1979, p 135-148 38 refs

The Piper PA-28-140 Cherokee, the Beagle B121 Pup-100, and the Robin HR 200/100 light aircraft production studies are presented comparing their design details, rates of production envisaged and achieved, the attitudes towards light aviation in the U S , Great Britain and France, the sizes and previous history of the three manufacturers, and the success achieved The three aircraft dimensions and equipment are described, together with their performance, price and production quantities The production background of each aircraft is discussed, considering their respective companies' history, the relationship of manufacture to companies' facilities, and the product support that was being offered Designs of the wings, tail units and fuselage are analyzed, and markets and marketing practices in the countries of origin are considered Finally, an economic production management plan is outlined A T

A79-36379 **Model verification of force determination for measuring vibratory loads** F D Bartlett, Jr (U S Army, Structures Laboratory, Hampton, Va) and W G Flannelly (Kaman Aerospace Corp , Bloomfield, Conn) *American Helicopter Society, Journal,* vol 24, Apr 1979, p 10-18 11 refs Army-supported research

The method of force determination for measuring vibratory forces and moments experienced by helicopters is verified by means of laboratory tests of a dynamic helicopter model The method was used to determine vibratory hub loads on a helicopter with the rotor removed from dynamic calibration data and fuselage accelerometer measurements The mobility matrix is obtained by direct shaking at the hub and modal acceleration testing in order to calibrate the model Errors of force determination predictions are found to lie within the accuracy limits of the instrumentation Results of an application of the force determination method to the flight testing of a UH-1H helicopter fitted with a dynamic antiresonant vibration isolator indicate the potential of force determination for in-flight predictions A L W

A79-36380 **Manufacturers developing fuel-efficient engines** J Mayfield *Aviation Week and Space Technology,* vol 110, May 28, 1979, p 46, 47, 49 (3 ff)

The paper presents an analysis for both the General Electric and Pratt & Whitney fuel-efficient turbofans developed under NASA's Energy Efficient Engine (E3) project General Electric engine will produce 36,000 lb of thrust and have a bypass ratio of 6 8 during maximum climb power operation Specific fuel consumption (SFC) of 0 572 is predicted Pratt & Whitney turbofan will produce 41,000 lb of thrust on takeoff with a bypass ratio of 6 55 Its thrust SFC is predicted as 0 576 The engines use such advanced technologies as active clearance control, single-crystal turbine blades and vanes, new power metallurgy alloys, a 23 1 compressor, new combustor designs and digital electronic engine control systems, and may evolve into prototypes for the commercial transport powerplants of the 1990s V T

A79-36423 **Velocity slip and temperature difference of gas mixtures in quasi-one-dimensional nozzle flows** K Nanbu (Tohoku University, Sendai, Japan) *Physics of Fluids,* vol 22, May 1979, p 998, 999

The velocity slip and temperature difference are examined using two-temperature thirteen moment equations It is shown that the velocity slip becomes maximum just beyond the throat and the temperature difference is appreciable in the supersonic flow regions (Author)

A79-36484 **An optical-fiber multiterminal data system for aircraft** J G Farrington and M Chown (Standard Telecommunication Laboratories, Ltd , Harlow, Essex, England) *Fiber and Integrated Optics,* vol 2, no 2, 1979, p 173-193 8 refs Research supported by the Ministry of Defence (Procurement Executive)

As a result of a study on the potential of optical-fiber multiterminal data systems for avionics, a design approach has been chosen that is expected to be a suitable basis for a wide range of applications This is a time division multiplexing system, which has features of being highly immune to problems of optical loss and multipath effects in optical highways having redundant paths, and of avoiding the need for any master terminal This system approach is tailored to characteristics of optical fibers, and should lead to good integrity and ruggedness A breadboarded model of a terminal has been demonstrated, and the construction of functional models is currently under way (Author)

A79-36582 # **Calculation of a laminar wall jet in a wake (Raschet laminarnoi pristennoi strui v sputnom potoke)** V N Zhuravlev *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 31-36 5 refs In Russian

An integral method is proposed for calculating the fundamental portion of a laminar wall jet propagating in a wake with a longitudinal pressure gradient It is assumed that the velocity of the jet is greater than that of the wake V P

A79-36583 # **Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas (Ob optimal'nom vybore geometricheskikh kharakteristik povorotnogo kanala malorazmernoi turbiny s povtornym podvodom gaza)** I P Goldaev, V V Il'inskii, and E A Skvorchevskii *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 37-43 In Russian

The paper deals with gasdynamics methods of profiling channels of auxiliary high-pressure-ratio small-scale aircraft turbines The influence on the flow of the channel curvature in the radial plane of a small-scale axial-flow turbine is studied Optimal channel designs for supersonic inlet flows are proposed V P

A79-36584 # **Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines (Effektivnost' povtornogo podvoda gaza v vysokoperepadnykh malorazmernykh turbinakh)** I P Goldaev, V V Il'inskii, and E A Skvorchevskii *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 44-48 6 refs In Russian

A comparative analysis is carried out of the energetic characteristics of a single-blade-ring turbine and a turbine with readmission of the gas The gasdynamic parameters of the flow in high-pressure-ratio small-scale (auxiliary) aircraft gas turbines are evaluated V P

A79-36585 # **Influence of the flow angle on the characteristics of an elbow-shaped air intake (Vliianie ugla natekaniia potoka na kharakteristiki kolenoobraznogo vozdukhozabornika)** A D Griga and N M Zubov *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 48-50 In Russian

It is shown experimentally that an increase in inlet blade angle from 75 to 105 degrees leads to an increase in circumferential nonuniformity and a decrease in radial nonuniformity, whereas the total pressure losses are hardly affected A satisfactory flow structure at the air-intake exit can be obtained by proper selection of the geometrical relations V P

A79-36586 # **Allowing for the wall boundary layer in an axial compressor stage (K voprosu ucheta pristenochnogo pogranichnogo sloia v stupeni osevogo kompressora)** N S Berestneva, V A Koval', F G Kontsevich, and Iu G Otsechkin *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 51-54 In Russian

If an axial compressor blade is designed without allowance for the boundary layer in the flow area, the flow past the end sections is characterized by large positive angles of attack This leads to an increase in boundary layer thickness at the blade back and possible boundary layer separation In the present paper, a method of designing compressor blades with allowance for the boundary layer is proposed, and test data obtained with blades designed by this method are examined V P

A79-36587 # **Formation of water-fuel emulsions in tanks of grounded aircraft (K voprosu obrazovaniia vodno-toplivnykh emul'sii v samoletnykh bakakh v nazemnykh usloviiakh)** V T Vasilenko and A S Rasborshchuk *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 54-56 In Russian

The factors and conditions leading to the formation of water fuel emulsions in aircraft tanks after refueling are examined The conditions for the formation of emulsion water depend on the temperatures and concentrations of moisture both in the remaining and added fuel and on the stability of water-fuel emulsions A nomogram for determining the mean temperature and mean water content in the fuel mixture after refueling is proposed V P

A79-36588 # **Informativeness and effectiveness of digital command-generating devices (Informativnost' i effektivnost' diskretnykh komandnykh priborov)** N I Brekhin *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 57-61 In Russian

The speed of operation of modern onboard computers exceeds considerably that of analog command-generating devices It is shown that the resulting impairments of device capacity and information transfer can be eliminated by using properly designed digital command-generating devices V P

A79-36589 # **Some possible applications of identification theory techniques in telemetry (O nekotorykh napravleniiakh primeneniia metodov teorii identifikatsii v telemetrii)** Iu N Sokolov, N M Podareva, and V I Uspalenko *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 61-70 24 refs In Russian

The basic principles of model representation of telemetry processes and the application of identification theory techniques to information problems are reviewed Some aspects of the application of information theory techniques to the solution of problems of recording and analyzing telemetry data on the state of flight vehicles are discussed V P

A79-36592 # **Differential method of designing rational aircraft frames made of composite materials (Differentsial'nyi metod proektirovaniia ratsional'nykh korpusnykh aviakonstruktsii iz kompozitsionnykh materialov)** V E Gaidachuk and Ia. S Karpov *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 81-92 6 refs In Russian

In the present paper, some rational structure diagrams for composite subsonic aircraft frames and fuselages are analyzed, and the advantages which accrue from the use of composite materials are pointed out A structure diagram with distinctly separated functions of the principal load carrying members is proposed and its effectiveness is evaluated V P

A79-36593 # **Formulation of empirical formulas for calculating the hydraulic resistance of networks (Opredelenie vida empiricheskikh formul dlia rascheta gidraulicheskikh soprotivlenii v seti)** N V Okolota, N A Skliarenko, N A Shelomov, and B D Ialovkin *Samoletostroenie - Tekhnika Vozdushnogo Flota,* no 43, 1978, p 94-98 In Russian

Okolota et al (1976) have analyzed straight and curved networks of deicing systems and have formulated empirical formulas for calculating hydraulic resistances required for designing aircraft deicing and air-conditioning systems In the present paper, a method is proposed for deriving empirical formulas for calculating the hydraulic resistance of any desired portion of a deicing network V P

A79-36644 ***The British Aerospace Harrier Case study in* aircraft design** J W Fozard (British Aerospace, Aircraft Group, Kingston-upon-Thames, Surrey, England) New York, American Institute of Aeronautics and Astronautics, Inc , 1978 190 p 100 refs

This work covers the history of the development of the jet V/STOL Harrier aircraft Fairly detailed information on the main engineering concepts of the aircraft are given, including the inlet, the Pegasus vectored thrust engine, nozzle bearing assemblies, engine installation, engine controls and cockpit throttle box, fuel system and its installation, air intake aerodynamic design, nozzle actuation system, wing aerodynamic design, stability and control qualities, flight control system, structural design, undercarriage design, and cockpit and escape system Attention is also given to the operational aspects of the aircraft on land and on ships P T H

A79-36645 # **The Rockwell International Sabreliner-65 Case study in aircraft design** G E Mathwig (Rockwell International Corp , St Louis, Mo) New York, American Institute of Aeronautics and Astronautics, Inc , 1978 80 p

The report summarizes the design and development process for the Sabreliner-65 executive jet aircraft, including the marketing and financial studies The process was an experience in codevelopment involving several companies The development schedule, test objectives and results, and design problems and solutions are summarized Tables and graphs are given which summarize model study parameters, engines considered, study performance data, aircraft configuration, and basic aerodynamic characteristics P T H

A79-36646 # **The Lockheed C-5 Case study in aircraft design** W C J Garrard (Lockheed-Georgia Co , Marietta, Ga) New York, American Institute of Aeronautics and Astronautics, Inc , 1978 68 p

The paper reports on the activities during each of the four main phases in the design of the C-5 transport (1) preconcept formulation phase, (2) concept formulation phase, (3) project definition phase and proposal, and (4) acquisition phase with detailed design, manufacture, and qualification The initial requirements, configuration studies, airframe design studies, trade-off studies, engine and landing gear selection, cargo configurations, reliability and maintenance requirements, flying qualities and augmentation considerations, structural tests, and flight tests are summarized P T H

A79-36702 **Bonding and durability** A C Fehrle and R L McDougal (Lockheed-Georgia Co , Marietta, Ga) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790561* 14 p

Bonding materials and processes and the increasing use of the adhesive bonded structures in all Lockheed cargo aircraft starting with the C-130 are evaluated By analyzing the application of bonding to structural durability, it is shown that more durable airframe structures can be built at little or no weight penalty while meeting the durability and damage tolerance criteria imposed by the

new Military Standards and Specifications An experiment conducted under NASA contract has shown that it may be economically feasible to use laminated sheet structures or bonded reinforcements throughout the aircraft, however, it may not only be feasible but mandatory in fatigue and fracture critical areas of future aircraft Further improvements can be achieved by combined advantages of laminated structures and cold working or interference-fit fasteners as well as by the use of the new generation adhesives and surface preparations V T

A79-36704 Adhesive bonded structure of new pressurized piston twin aircraft A Nagao, T Nakao, and K Usuki (Fuji Heavy Industries, Ltd , Tokyo, Japan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790563* 7 p

Adhesively bonded structures, that is, metal to metal bonding of cabin and wing skin and honeycomb sandwich panel of pressure bulkhead, are used in newly developed general aviation pressurized piston twin aircraft, Rockwell/Fuji Model 700 This paper presents the design consideration of each bonded structure showing the advantages of bonding, and its quality control procedure used in subject aircraft (Author)

A79-36705 Effects of a spin chute installation on spin characteristics J D Patrick (Piper Aircraft Corp , Lock Haven, Pa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790564* 3 p

Data extracted from certification spin testing on a light general aviation training airplane was examined for differences in recovery characteristics that could be assigned to the spin chute installation Several center of gravity and rudder surface positions were tested Both normal spins and spins with aileron misuse were evaluated (Author)

A79-36706 * Spin flight research summary J M Patton, Jr , H P Stough, III, and D J Dicarlo (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790565* 11 p 8 refs

An extensive general aviation stall/spin research program is underway at the NASA Langley Research Center Flight tests have examined the effects of tail design, wing leading edge design, mass distribution, and minor airframe modifications on spin and recovery characteristics Results and observations on test techniques are presented for the first airplane in the program Configuration changes produced spins varying from easily recoverable slow, steep spins to unrecoverable, fast flat spins (Author)

A79-36707 Conversion of wing surface pressures into normalized lift coefficient A W Hoadley (Western Michigan University, Kalamazoo, Mich) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790567* 10 p

A normalized lift coefficient indicator has been developed for single-engine aircraft The system developed incorporates a low-cost capacitance type pressure transducer and an electronic circuit to calculate the wing pressure coefficient The system eliminates the need for probes protruding from the aircraft's wing by using two flush pressure taps on the wing surface and the aircraft's static pressures The pressure taps have been located so as to produce a normalized lift coefficient display that is nearly linear, independent of flap setting, and independent of thrust The system gives the aircraft's proximity to a stall condition regardless of its load factor, weight, or configuration The preceding should reduce the fatal stall/spin accidents that are one of the foremost killers in general aviation (Author)

A79-36708 The effects of low-level wind shear on the approach and go-around performance of a landing jet aircraft R A Greene (Safe Flight Instrument Corp , White Plains, N Y) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790568* 9 p 14 refs

The development and operation of the Wind Shear Monitor System which computes the thrust required to overcome horizontal wind shears and vertical downdrafts during jet landing is outlined The operation of the Wind Shear Computer which resolves the two orthogonal vectors of a wind shear encounter and provides meter output and threshold alert indications of the encounter are described Severe wind shear occurs when the additional thrust required to maintain desired glide path and airspeed exceed 15% of the aircraft's gross weight A 3-axis wind model has been developed for a Boeing 747 training simulator to repeat weather conditions at the time of an accident Beyond signaling for the crew a severe reduction in performance, indication of positive shear conditions acts to guide the crew to anticipate a negative shear, thus preventing a reduction of thrust The early rapid detection of a severe encounter will significantly improve the go-around profile and recovery opportunities A T

A79-36709 * A Demonstration Advanced Avionics System for general aviation D G Denery, G P Callas, C T Jackson, B K Berkstresser, and G H Hardy (NASA, Ames Research Center, Moffett Field, Calif) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790569* 11 p

A program initiated within NASA has emphasized the use of a data bus, microprocessors, electronic displays and data entry devices for general aviation A Demonstration Advanced Avionics System (DAAS) capable of evaluating critical and promising elements of an integrating system that will perform the functions of (1) automated guidance and navigation, (2) flight planning, (3) weight and balance performance computations, (4) monitoring and warning, and (5) storage of normal and emergency check lists and operational limitations is described Consideration is given to two major parts of the DAAS instrument panel the integrated data control center and an electronic horizontal situation indicator, and to the system architecture The system is to be installed in the Ames Research Center's Cessna 402B in the latter part of 1980, engineering flight testing will begin in the first part of 1981 V T

A79-36710 Electronic system safety - Testing reality G L Neal (Collins Radio Group, Collins Avionics Div , Cedar Rapids, Iowa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790570* 7 p

Fundamentals of redundant avionics systems architecture are discussed, exposing some of the difficult and least understood redundancy defeating mechanisms Such basic definitions as single, dual and triple concepts and the mean time between failures are given showing that simplistic thinking tends to give unreliable results because of the usually ignored problems of rare faults, common faults, tolerance propagation, hidden faults, unmonitored monitors, inoperative reconfiguration switches, and expediency of installation In order to achieve the reasonable low mission failure rates it is noted that at least dual and sometimes triple avionics are required V T

A79-36711 The design and selection of optimum propellers for general aviation aircraft H V Borst (Henry V Borst and Associates, Wayne, Pa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790575* 15 p 11 refs

Using the latest available methods and data for designing propeller blades and determining performance, a study of the general aviation propellers installations is given In this study four general aviation aircraft are considered covering the range of speed and power encountered in this field Propellers typical of those currently

being used are considered and their performance is calculated and compared with the ideal to find the efficiency improvements that might be possible A study for the aircraft considered showed that new propellers can be designed that will have improved performance that approaches that of the ideal or optimum The use of the new computer generated airfoils was also considered in the design of new propellers with promising results (Author)

A79-36712 * The analysis of propellers including interaction effects B W McCormick, A S Aljabri, S J Jumper, and Z N Martinovic (Pennsylvania State University, University Park, Pa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790576* 14 p 11 refs Grant No NsG 1308

Analytical and experimental studies have been undertaken on propellers operating in the unsteady flow field produced by interaction effects due to the fuselage, wing, and nacelles Methods have been developed and verified experimentally for determining the velocity field in which a propeller operates as well as its aerodynamic and dynamic response to this unsteady environment Methods are presented for predicting the net thrust of a propeller wing-body combination as well as the unsteady thrust and torque acting on the propeller Sample calculations as well as wind tunnel and flight test results are presented which illustrates the sensitivity of a propeller to flow field in which it is operating (Author)

A79-36713 Composite applications at Bell Helicopter O K McCaskill, Jr (Bell Helicopter Textron, Fort Worth, Tex). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790578* 13 p

The past, present and future usage of fiber reinforced plastics in Bell helicopters is presented In 1953 fiberglass composites were used in cabin structural areas of the 47H-1 which is still in active service Current production helicopters use composites as a facing material, sandwich panels, nose doors, fairings, passenger steps, and the cabin shell In helicopters being developed, fiberglass main rotor blades are expected to achieve retirement life after more than 10,000 hours due to gradual failure modes, elimination of corrosion and improved fatigue life Blade manufacturing methods and certification tests are described Other developmental applications are in control tubes of filament wound graphite epoxy and injection molded nylon/fiberglass fittings producing 20% weight saving, bellcranks with 30% weight saving and cost reduction of 50%, boost cylinders for 3000 psi and 270 F service, and engine cowlings and fairings with fire resistance Other applications such as vertical fins, landing gear skid tubes, floats, horizontal stabilizers and taildoor driveshafts are discussed A flight evaluation program conducted under a NASA contract to obtain information on the durability of advanced composite components in field service is described A T

A79-36714 Development of an aircraft composite propeller W B Harlamert and R Edinger (Hartzell Propeller, Inc , Piqua, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790579* 7 p

The current aircraft noise regulations effected the design of propellers where tip speeds were reduced to meet these regulations Reduced tip speeds were accomplished by reducing propeller rpm and/or propeller diameter To retain propeller performance, diameters were increased, or the number of blades increased, respectively These changes effected the propeller weight drastically A composite propeller blade has been developed that is significantly lighter than a blade fabricated from aluminum Additional advantages of the composite blade is strength and maintenance characteristics Considerable testing was accomplished to demonstrate the strength and fatigue characteristics of the blade (Author)

A79-36715 Design description of a four-place business jet using two WR-19 engines J Roskam (Kansas, University, Lawrence, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790580* 11 p

This paper describes the design of an advanced, four-place business jet airplane around two Williams-Research WR 19 engines In addition to the general layout, the performance, weight and balance characteristics of the airplane are described and illustrated by graphical examples. A detailed comparison in terms of fuel-used is made with the Learjet M35, the Cessna Citation I, the Foxjet and several other general aviation twins It is shown that the airplane described offers substantial advantages in terms of fuel economy over all these airplanes (Author)

A79-36716 The Learjet 'Longhorn' series - The first jets with winglets P T Reynolds (Gates Learjet Corp , Wichita, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790581* 7 p

The Gates Learjet model 28/29 configuration with winglets offers performance increases over Model 25 which has similar configuration except for the wing, both during cruise and takeoff and landing Cruise fuel flows are up to 26% lower than Model 25 for the same playload/speed combination Such effects as an increase in aspect ratio, an end plate effect and a forward component of the winglet aerodynamic force are discussed, noting NASA's pioneering work in the field Consideration is also given to some details of stability and control and it is noted that Model 28/29 is certified for operations up to 51,000 feet Models 54/55/56 incorporating the same wing/winglet concept and utilizing high bypass turbofan engines and featuring a larger fuselage are currently under development, with the first flight expected early in 1979 V T

A79-36717 Improving business jet performance - The Mark Five Sabreliner L M Timmons (Raisbeck Group, Seattle, Wash) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790582* 17 p 5 refs

By applying a unique combination of theoretical analysis, flight test development and advanced FAA certification methods, the Raisbeck Mark Five Sabreliner became a reality This configuration with advanced aerodynamics, systems and structure has been incorporated on both existing and new production versions of the aircraft It offers a minimum of 25% range increase while maintaining or reducing takeoff and landing field lengths The development approach used for the Mark Five system is detailed, including the rationale for each of the improvements incorporated FAA certification plan procedures used on this program are discussed Performance improvements realized in actual operation of the Mark Five system are also detailed to demonstrate the advantages from a customer's viewpoint (Author)

A79-36718 A general aviation flight test application of the on-board computer. P R Leckman (Rockwell International Corp , Bethany, Okla) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790583* 7 p

The Digital Data Acquisition System (DDAS) which includes minicomputers both in on-board and in ground-based equipment has been used in flight test programs Functions performed are monitor critical parameters, alert to exceed limits, engine cooling development, cruise performance, climb performance, stall speed, stress surveys, engine detonation survey, and weight and center gravity Operating procedures and implementation problems are discussed and it is concluded that using a DDAS will reduce the post flight data analysis man-hours, but requires more thorough preparation prior to flight testing As computers become more compact and available at reduced costs, their more widespread use in the flight test programs of general aviation aircraft manufacturers is expected V T

A79-36719 * Design of quiet efficient propellers G P Succi (MIT, Cambridge, Mass) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790584* 15 p 13 refs Research sponsored by the U S Environmental Protection Agency, Contract No NAS1-15154

A numerical computation scheme has been developed to determine the sound generated by propellers A comparison of these calculations to the noise data taken in the flight test of a propeller driven aircraft shows good agreement The method is then applied in a parametric study of fixed pitch propellers designed to reduce noise All these techniques reduce noise while maintaining shaft speed so that the method presented here may be used in a retrofit option for the general aviation fleet (Author)

A79-36720 Practical design of minimum induced loss propellers E E Larrabee (MIT, Cambridge, Mass) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790585* 11 p 7 refs

An efficient procedure, which may be adapted to pocket calculators, has been developed to determine the geometry of minimum induced loss propellers matched to a specified operating point characterized by disc loading, advance ratio, and number of blades Consistent procedures are described to account for the effects of arbitrary geometry, off design point operation, and propeller-body interaction (Author)

A79-36721 Crashworthiness analysis of field investigation of business aircraft accidents R G Snyder and T J Armstrong (Michigan, University, Ann Arbor, Mich) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790587* 15 p 17 refs Research supported by the University of Michigan

During the period 1964-1977 some 7,351 aircraft engaged in business flying, and 883 in corporate/executive operations, were involved in accidents reported by the NTSB These accidents were reviewed utilizing the University of Michigan Computerized Accident Files to provide an overall view of the incidence and nature of business/executive aircraft accidents relative to occupant crash injuries In addition more detailed case studies of selected accidents investigated including a Lear Jet 25B, Cessna 421, Beech Volpar Model 18, and Ted Smith Aerostar 601, are provided to illustrate specific types of crashworthiness, occupant protection, or post-crash emergency egress findings applicable to business/executive operations Post-crash fire was reported in 29 cases (16 3%) during the 3-year period (1975-1977) Emergency egress problems involving smoke and fire are discussed Data from 1975-1977 indicate that the chances of being fatally injured in an accident is significantly greater than receiving serious injury, suggesting a lack of crashworthy performance which may be predicted to improve as more accidents occur in which crew shoulder harnesses are installed and worn (Author)

A79-36722 * Nonlinear structural crash dynamics analyses R J Hayduk, R G Thomson (NASA, Langley Research Center, Hampton, Va), G Wittlin (Lockheed-California Co , Burbank, Calif), and M P Kamat (Virginia Polytechnic Institute and State University, Blacksburg, Va) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790588* 14 p 12 refs

Presented in this paper are the results of three nonlinear computer programs, KRASH, ACTION and DYCAST used to analyze the dynamic response of a twin-engine, low-wing airplane section subjected to a 8 38 m/s (27 5 ft/s) vertical impact velocity crash condition This impact condition simulates the vertical sink rate in a shallow aircraft landing or takeoff accident The three distinct analysis techniques for nonlinear dynamic response of aircraft structures are briefly examined and compared versus each other and the experimental data The report contains brief descriptions of the three computer programs, the respective aircraft section mathematical models, pertinent data from the experimental test performed at NASA Langley, and a comparison of the analyses versus test results Cost and accuracy comparisons between the three analyses are made to illustrate the possible uses of the different nonlinear programs and their future potential (Author)

A79-36723 Experimental verification of program KRASH - A mathematical model for general aviation structural crash dynamics G Wittlin (Lockheed-California Co , Burbank, Calif), D J Ahrens, and A W Bloedel (Cessna Aircraft Co , Wichita, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790589* 14 p 8 refs U S Department of Transportation Contract No FA75WA-3707

The results of four fully instrumented, full-scale crash tests involving a single-engine, high wing light airplane are described herein The tests were performed under a contract sponsored by the Federal Aviation Administration The range of impact conditions included initial airplane roll and/or yaw, a nose-down attitude, a flared nose-up attitude and impacts onto a rigid (concrete) and a flexible (soil) surface Photographs are presented showing the impact conditions, as well as some typical postcrash damage The crash test models, analyzed using digital computer program KRASH, are described Typical analysis versus test correlation results as well as a summary correlation for all four crash tests are presented The application of Program KRASH to assess structural design concepts with regard to crash dynamics characteristics is briefly described (Author)

A79-36724 Seat/Occupant crash dynamic analysis verification test program R F Chandler (FAA, Civil Aeromedical Institute, Oklahoma City, Okla) and D H Laananen (Pennsylvania State University, University Park, Pa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790590* 98 p 26 refs

The Federal Aviation Administration is developing a computer modeling program (SOMLA/Seat Occupant Model Light Aircraft) in an attempt to provide a practical engineering and design analysis tool for aircraft seat designers To validate the model, two series of well-instrumented controlled tests have been completed by the FAA Civil Aeromedical Institute These tests used two basic seat configurations, two different impact vector orientations, and two different impact levels to produce both elastic and plastic seat deformations Measurements of seat reaction loads, seatbelt loads, and dummy accelerations were made, and the tests were documented by high-speed motion picture film Each test condition was repeated to obtain a statistical measure of test variability The results of these tests, and their implications regarding the development of the model, are presented (Author)

A79-36725 * NASA general aviation crashworthiness seat development E L Fasanella (Vought Corp , Hampton, Va) and E Alfaro-Bou (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790591* 13 p 15 refs

Three load limiting seat concepts for general aviation aircraft designed to lower the deceleration of the occupant in the event of a crash were sled tested and evaluated with reference to a standard seat Dummy pelvis accelerations were reduced up to 50 percent with one of the concepts Computer program MSOMLA (Modified Seat Occupant Model for Light Aircraft) was used to simulate the behavior of a dummy passenger in a NASA full-scale crash test of a twin engine light aircraft A computer graphics package MANPLOT was developed to pictorially represent the occupant and seat motion (Author)

A79-36726 **Crash-resistant fuel systems for general aviation aircraft.** W T Edwards (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) and W M Perrella, Jr (FAA, Seattle, Wash) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790592* 13 p 6 refs

A significant percentage of general aviation aircraft accidents result in postcrash fires due to the ignition of spilled fuel This condition often causes further injury or even death to the occupants Testing was undertaken to examine the performance of light weight, flexible, crash-resistant fuel cells with frangible fuel line couplings Included in the experiments were four full-scale crash tests of a typical light twin-engined aircraft In three of these tests, the crash-resistant fuel system performed satisfactorily However, the fourth test, which used the lightest weight tanks, resulted in tank failures which indicated a possible lower strength limit to the tank material (Author)

A79-36727 **The impact of noise regulations on propeller design** D G M Davis (Dowty Rotol, Ltd , Gloucester, Essex, England) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790593* 11 p

Propeller noise is largely dependent upon tip speed and a reduction of this inevitably leads to either performance or weight penalty A new aerofoil section has been developed which permits blade loading to be increased Thus, slower revving propellers can be designed without degrading the performance or imposing a weight penalty The paper introduces the characteristic differences in performance of the new section with more conventional ones and looks at the design of a range of propellers to illustrate the trade between noise, performance and weight with each type (Author)

A79-36728 **Propeller aircraft noise around general aviation airports** F W J van Deventer (Delft, Technische Hogeschool, Delft, Netherlands) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790594* 15 p 7 refs

In recent years systematic flyover noise measurements of propeller driven general aviation airplanes were performed This paper presents a brief description of the measurement and data reduction techniques together with some results Computation methods are given to estimate the effect of powersetting on the noise level and to approximate the shape of the noise field around these aircraft They are used to compute Leq-contours around general aviation airports Contour plots are used to compare the relative effects of several measures for noise reduction on the ground Noise reduction at the source is the most effective way to achieve this goal (Author)

A79-36729 * **Preliminary QCGAT program test results** R W Koenig and G K Sievers (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790596* 11 p

The paper presents the NASA Lewis program to demonstrate that large engine technology can be applied to general aviation engines to reduce noise, emissions, and fuel consumption After a Phase I study, two contractors, Garrett AiResearch and AVCO-Lycoming, were selected to design, manufacture, assemble, test, and deliver their Quiet, Clean, General Aviation Turbofan (QCGAT) engines to NASA Noise, emission, and performance goals and how well they were met are discussed Noise goals involve take off noise 3 5 n mi from runway threshold, sideline noise at 25 n mi and approach noise 1 n mi from the runway at an altitude of 370 ft The AiResearch engines power a stretched Learjet 35 and the Lycoming a specially conceived Beech executive jet, resulting in differing power goals Thus the thrust goal for the Lycoming was 1622 lb while the AiResearch goal was 3937 lb Cruise thrust goals were 485 lb at Mach 0 6 at 25,000 ft and 903 lb at Mach 0 8 at 40,000 ft respectively The design of both engines, based on existing cores, is studied, noting such special QCGAT features as new reduction gears, combustor and power turbine Test results are given, indicating that while the goals for noise and thrust were met those for emissions were only partially met M E P

A79-36730 **Proper aircraft tire size selection - Optimum performance with minimum maintenance** L J Gehrett (Goodyear Tire and Rubber Co , Akron, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790598* 7 p

A79-36731 **Advanced braking controls for business aircraft** D M Longyear and E. A Hirzel (Crane Co , Hydro-Aire Div , Burbank, Calif) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790599* 14 p

Automatic braking capability is essential if a business aircraft is to compete with commercial ones in a Microwave Landing System (MLS) environment The principles involved in braking an aircraft are discussed and it is concluded that an essential feature required to assure optimum performance of the braking system is the skid control or antiskid system Consideration is given to some details of the brake/tire/runway theory, particularly to the tire friction phenomena It is suggested for business aircraft that their skid control system should be coupled to such equipment as autobrakes and autoflaps which will increase the number of possible landing sights, and more importantly, will improve the pilot's safety margins V T

A79-36732 **Aircon electrically heated acrylic** W Rothe (PPG Industries, Inc , Huntsville, Ala) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr. 3-6, 1979, Paper 790600* 5 p

A system for preventing the formation of ice on plastic aircraft transparencies by application of electric heat is described, and performance data for the system are presented The system is based on resistance wire technology in use with glass laminates It can be operated from any available voltage system, ac or dc, and is adaptable to a wide variety of aircraft Positive static drain is provided to reduce the effect of static discharge of aircraft instruments and prevent damage to the heating system C K D

A79-36734 **Canadair Challenger flight test status** R D Neal (Canadair, Ltd , Montreal, Canada) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790602* 7 p

The initial flight of the Canadair Challenger, an all new aircraft designed for the business jet market of the 1980s and 1990s, occurred two years after program go-ahead and 21 months after release of the first engineering drawings Three preproduction aircraft are assigned to the flight test program in Montreal and then at Mojave, California As part of the regular flight development effort, as well as assurance that a safe flight to Mojave could be accomplished, the general handling qualities and single-engine performance were evaluated in the Montreal test program The tasks identified for the Mojave test program included change of engine from 6700 lb to 7500 lb production engines, change of horizontal tail to production elevator configuration, installation of flight flutter vane system, complete ground vibration test, complete instrumentation and calibration The 5 1 by-pass ratio turbofan engine tested prior to the installation provides the lowest specific fuel consumption of any turbine engine now used on a business jet aircraft V T.

A79-36735 **A new light twin using bonded metal construction** B McCullough and L W Bingham, Jr (Gulfstream American Corp , Savannah, Ga) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790603* 15 p

This paper describes the design and certification program for a new light twin-engine aircraft The factors considered in the design of the aircraft, the flight testing, and the changes required for certification are described Some of the problems encountered in flight testing, and the solutions to these problems, are also discussed (Author)

A79-36736 * Some theoretical considerations of a stall proof airplane H L Chevalier (Texas A&M University, College Station, Tex) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790604* 15 p Grant No NsG-1407

For the stall proof airplane there should be a stabilizing pitching moment below the stall angle of attack of sufficient amount to prevent the attainment of the stall angle of attack which cannot be over-ridden by control deflections This paper presents (1) a development of the moment equations to show the theoretical considerations of a stall proof airplane and (2) the nonlinear moment characteristics that must be obtained to satisfy the stall proof requirements In addition, it is shown that an aerodynamic spoiler located on the under surface of the horizontal tail can be designed to meet these requirements of a stall proof airplane Wind tunnel results are shown to validate assumptions and predictions (Author)

A79-36737 * Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine B J Rezy, K J Stuckas, J R Tucker, and J E Meyers (Teledyne Continental Motors, Mobile, Ala) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790605* 35 p 23 refs Research supported by the Teledyne Continental Motors, Contract No NAS3-19755

A study was made to reduce exhaust emissions and fuel consumption of a general aviation aircraft piston engine by applying known technology Fourteen promising concepts such as stratified charge combustion chambers, cooling cylinder head improvements, and ignition system changes were evaluated for emission reduction and cost effectiveness A combination of three concepts, improved fuel injection system, improved cylinder head with exhaust port liners and exhaust air injection was projected as the most cost effective and safe means of meeting the EPA standards for CO, HC and NO The fuel economy improvement of 4 6% over a typical single engine aircraft flight profile does not though justify the added cost of the three concepts, and significant reductions in fuel consumption must be applied to the cruise mode where most of the fuel is used The use of exhaust air injection in combination with exhaust port liners reduces exhaust valve stem temperatures which can result in longer valve guide life The use of exhaust port liners alone can reduce engine cooling air requirements by 11% which is the equivalent of a 1 5% increase in propulsive power The EPA standards for CO, HC and NO can be met in the IO-520 engine using air injection alone or the Simmonds improved fuel injection system A T

A79-36738 Dual breakerless aircraft magneto R S Cerny and J J Wycallis (Bendix Corp , Engine Products Div , Sidney, N Y) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790606* 6 p

Advantages of the dual breakerless aircraft magneto are presented The system eliminates mechanical switching and actuation, thus preventing wear induced timing shift and degraded performance inherent in conventional magnetos The operation of both the conventional and the breakerless systems is detailed, showing that the latter provides more consistent performance while eliminating the regular maintenance required by the former A starting aid which has been developed to complement the breakerless magneto is also discussed M E P

A79-36739 Selection of aircraft turbocharger systems N Richardson (Garrett Corp , AiResearch Industrial Div , Los Angeles, Calif) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790608* 11 p

Selection of turbochargers and control systems is aided by analytical predictions of system performance and by comparisons of flight test data to the prediction model Consideration is given to the turbocharger design optimization, while a design tailored to a specific application is possible, it is customary to choose the best components from a selection already available Different control systems are evaluated and it is noted that the locations of the various operating limits in the control system operating ranges vary, depending on the desired manifold pressures and engine speeds, and the compressor and turbine used Steady state mass flow continuity through the turbo/control and engine system, and power balance between the turbocharger compressor and turbine are considered as the main physical principles on which performance calculation are based, and a performance prediction calculation flow chart is presented The inconsistencies between flight test data and predicted performance can be a basis for correcting the analytical model of the engine and turbo/control system V T

A79-36740 * Determination of cooling air mass flow for a horizontally-opposed aircraft engine installation S J Miley, E J Cross, Jr , N A Ghomi, and P D Bridges (Mississippi State University, State College, Miss) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790609* 11 p 5 refs Grant No NsG 1083

The relationship between the amount of cooling air flow and the corresponding flow pressure difference across an aircraft engine was investigated in flight and on the ground The flight test results were consistent with theory, but indicated a significant installation leakage problem A ground test blower system was used to identify and reduce the leakage The correlation between ground test cell determined engine orifice characteristics and flight measurements showed good agreement if the engine pressure difference was based on total pressure rather than static pressure (Author)

A79-36741 Fretting fatigue, with reference to aircraft structures J A Alic and A Kantimathi (Wichita State University, Wichita, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790612* 15 p 43 refs Grant No AF-AFOSR-77-3422

Present knowledge concerning the mechanisms of fretting fatigue is reviewed, with particular attention to the following factors stresses at and near the contacting surfaces, location of crack initiation sites with respect to regions of highest surface stress and the slip-nonslip boundary, contributions of surface damage to crack initiation, propagation of microcracks initiated by fretting, the effects of mean stress, and fretting fatigue under variable amplitude loading In the experimental program, a specially constructed apparatus was used to simulate conditions at the faying surface in a structural joint Fretting fatigue tests were carried out on 7075-T7351 aluminum alloy using stress ratios of +0 2, +0 5, and -0 2 (Author)

A79-36742 New technologies for general aviation aircraft K H Bergey (Oklahoma, University, Norman, Okla) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790613* 18 p 16 refs FAA-supported research

An assessment of new technologies for use in general aviation aircraft is covered The study presents 46 new or underused technologies including Wankel engines, crushed honeycomb sandwich panels, crash resistant fuel cells, that could be incorporated in general aviation aircraft with benefit to safety, performance, utility, and cost Social and political trends, such as statutory highway speed limits, and the need for improved fuel efficiency, as much as the technologies themselves, will affect the rate at which these technologies can be integrated into the fleet Four proposals of aircraft are given which could capitalize on some of the trends the report considers significant to general aviation The four consist of a high

speed single engine aircraft, a single engine turbofan five seater, a single engine crashworthy aircraft, and a twin engine ducted propulsor commuter/cargo aircraft M E P

A79-36743 **General aviation aircraft design for performance using small computers** J C Narramore (Cessna Aircraft Co , Wichita, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790614* 7 p 8 refs

A computerized preliminary design system for reciprocating engine aircraft has been developed which is applicable to a desk top mini-computer This system integrates several performance, aerodynamics, and structural weight estimation routines into a procedure capable of investigating a wide variety of aircraft design problems After the conceptual configuration and performance requirements are established, the mini-computer design system can be used to determine the aircraft and engine size which will satisfy the requirements and be the least expensive to build or operate Carpet plots can be used to overlay data showing performance relative to a baseline configuration for a hypothetical design case (Author)

A79-36744 **Recent results obtained with a new method for measuring aircraft power and drag in flight** F W Smetana and S R Fox (North Carolina State University, Raleigh, N C) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790616* 9 p

Progress is reported in the development of a method to extract thrust horsepower and drag simultaneously from accelerated flight maneuvers Although the flight data still are not as self-compatible as desired, the extracted drag and power obtained from a pullup-pushover agree reasonably well with the results from steady flight determinations for drag and wind tunnel tests for power Further work is necessary to define the proper power model and to make the level flight acceleration data more self-compatible (Author)

A79-36745 **Development of the Beechcraft Model 77** J I Elliott and M L Holcomb (Beech Aircraft Corp , Wichita, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790617* 17 p

The Model 77 Skipper is the result of an intensive development program to develop an economical and efficient two-place general aviation trainer The program was initiated as a flying test bed program which allowed great freedom for engineering evaluation of various aerodynamic, structural and mechanical concepts This included the evaluation of different types of tail surfaces, high lift and lateral control devices, engines, propellers, etc Along with the test bed, other tests were run with radio-controlled free flight and spin tunnel models The test bed program was followed by the production engineering, testing and certification of the chosen production configuration (Author)

A79-36746 * **Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane** J L Johnson, Jr , H C McLemore, R White, and F L Jordan, Jr (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr 3-6, 1979, Paper 790618* 83 p 8 refs

This paper summarizes the significant results of recent full-scale wind tunnel tests at the NASA-Langley Research Center of the Ayres S2R 800 Thrush Agricultural Aircraft The purpose of the tests was to provide fundamental aerodynamic, performance, and stability and control information of the airplane and dispersal equipment, and to study near-field wake interaction characteristics behind the aircraft. The aerodynamic tests included the use of a propeller thrust-torque balance to measure the efficiency of the propeller in the presence of the engine and to provide data for determining slipstream interference effects and slip-stream drag (Author)

A79-36747 * **New opportunities for future small civil turbine engines - Overviewing the GATE studies** W C Strack (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790619* 14 p

This paper presents an overview of four independent studies that explore the opportunities for future General Aviation Turbine Engines (GATE) in the 150-1000 SHP class Detroit Diesel Allison, Garrett/AiResearch, Teledyne CAE, and Williams Research participated along with several airframers These studies forecasted the potential impact of advanced technology turbine engines in the post-1988 market, identified important aircraft and missions, desirable engine sizes, engine performance and cost goals Parametric evaluations of various engine cycles, configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis Both fixed-wing and helicopter aircraft, and turboshaft, turboprop, and turbofan engines were considered All four companies predicted sizable performance gains (e g , 20% SFC decrease), and three predicted large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class Key technology areas were recommended for NASA support in order to realize these improvements (Author)

A79-36748 **Rolls-Royce RB 401-07 turbofan engine for business aircraft in the 1980's** M A Wilson and R J Cant (Rolls-Royce, Ltd , London, England) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790620* 17 p

Rolls-Royce has identified a potential market in the business aircraft of the 80's for more efficient, economical, quieter and cleaner engines in the 5000 lb to 6000 lb thrust class The mechanical design of the engine is characterized by using the low aspect ratio, low hub tip ratio titanium fan blades, the high pressure compressor, the vaporising type of annular combustor, the conventional two-stage design in the low-pressure turbine and the hydromechanical fuel control system A noise level test has shown that, even without any acoustic treatment in the intake or fan duct, a significant margin of noise level exists below the regulations It is concluded that greater range with higher rates of climb and cruising speed will all become achievable by applying current big engine technology to the small engine in a simpler form V T

A79-36749 * **A review of Curtiss-Wright rotary engine developments with respect to general aviation potential** C Jones (Curtiss-Wright Corp , Wood-Ridge, N J) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790621* 23 p 21 refs Contracts No NAS3-20030, No NAS3-20808

Aviation related rotary (Wankel-type) engine tests, possible growth directions and relevant developments at Curtiss-Wright have been reviewed Automotive rotary engines including stratified charge are described and flight test results of rotary aircraft engines are presented The current 300 HP engine prototype shows basic durability and competitive performance potential Recent parallel developments have separately confirmed the geometric advantages of the rotary engine for direct injected unthrottled stratified charge Specific fuel consumption equal to or better than pre- or swirl-chamber diesels, low emission and multi-fuel capability have been shown by rig tests of similar rotary engine A T

A79-36750 **Electromechanical actuation for business aircraft** D K Bird (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790622* 13 p 12 refs

The Air Force Flight Dynamics Laboratory's (AFFDL) approach to the utilization of electric power is to use direct electromechanical (EM) actuation for critical flight control application as in the fly-by-wire concept The integrated hinge concept, as

applied to any of the conventional trailing edge surfaces, i e , elevators, ailerons, or rudders is considered as the best potential for EM actuation Two hardware units were built (one for NASA and one for AFFDL), each of them featuring inside-out motor design using rare earth samarium-cobalt permanent rotors with electronic commutation and powered with 270 V dc electrical power Attention is paid to motor selection, current limiting and gear ratio selection, and some opinions concerning the future development of EM actuation and its future application to military, commercial transport, and business aircraft are given V T

A79-36751 * A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls J Roskam, M Rice, and H Eysink (Kansas, University, Lawrence, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790623* 13 p 8 refs Grant No NsG-1421

Mathematical models for electromechanical (EM), pneumatic and hydraulic actuations are discussed It is shown that EM and hydraulic actuators provide better and faster time responses than pneumatic actuators but EM actuators utilizing the recently developed samarium-cobalt technology have significant advantages in terms of size, weight and power requirements In terms of ease and flexibility of installation EM actuators apparently have several advantages over hydraulic actuators, and cost is a primary reason for the popularity of EM actuation for secondary control function since no additional systems need to be added to the aircraft While new rare earth magnets are currently in developmental stage, costs are relatively high, but continued research should bring prices down V T

A79-36752 A canister fuel pump for general aviation aircraft R R Goelz and R W Rothfusz (Airborne Manufacturing Co , Elyria, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790624* 9 p

A new family of canister-type fuel pumps for use on both rotary and fixed-wing aircraft in general aviation use will be described The pump, which features a wet-brush DC motor, offers advantages on aircraft where ease of maintenance and minimum downtime is very important Major features of the new design, pump performance, and maintenance cost savings will be discussed (Author)

A79-36753 * An experimental study of propeller-induced structural vibration and interior noise J T Howlett and J A Schoenster (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790625* 9 p 11 refs

This paper presents results of tests conducted to study fuselage sidewall dynamics and their effects on the cabin interior noise of a twin-engine, propeller-driven, light aircraft Data on the dynamic behavior were obtained by slowly sweeping the RPM of one of the engines while the aircraft was stationary on the ground This technique allowed frequency response plots of the sidewall structural accelerations to be obtained These accelerations are compared to similar results from a test using a mechanical shaker in order to evaluate the structural dynamic response caused by the harmonics of the propeller blade passage tone The dynamic response of the fuselage sidewall is also discussed as a noise transmission mechanism A second mechanism for noise transmission through the fuselage sidewall was investigated by opening the copilot's window The results illustrate the complex nature of the noise transmission mechanisms and the importance of correctly assessing noise paths (Author)

A79-36754 * Engine induced structural-borne noise in a general aviation aircraft J F Unruh and D C Scheidt (Southwest Research Institute, San Antonio, Tex) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790626* 15 p 8 refs Contract No NAS1-14861

This paper describes a study of engine induced structural-borne noise in a single engine light aircraft Cabin noise and fuselage vibration levels were recorded during ground tests for engine-attached, engine-detached, interior-installed, and interior-removed configurations By comparisons of the data, engine induced structure-borne noise is shown to be a primary source of cabin noise Corresponding fuselage vibration levels were quite high with energy concentrated mainly in the lower frequencies A measure of the noise control effectiveness of the interior trim was also obtained (Author)

A79-36755 * Summary of noise reduction characteristics of typical general aviation materials J Roskam, F Grosveld, and J van Aken (Kansas, University, Lawrence, Kan) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790627* 39 p 9 refs Grant No NsG-1301

The paper presents the results of a large number of systematic tests to determine noise reduction characteristics of general aviation materials Effects of material type (metallic and composite), thickness, panel stiffening, vibration damping materials, sound absorption materials and pressurization on noise reduction are included Several promising methods for reducing cabin interior noise in light airplanes are discussed based on the results (Author)

A79-36756 Effects of extended oil changes on aircraft piston engine wear and oil characteristics W E Garrelts (Illinois, University, Savoy, Ill) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790629* 13 p 6 refs

A79-36757 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline J W Sibole, Jr (Avco Corp , Avco Lycoming Williamsport Div , Williamsport, Pa) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790630* 11 p

Chemical analyses, CFR engine knock tests, and a full scale turbocharged aircraft engine detonation test were conducted to compare the detonation characteristics of Soviet Grade GOST 1012-72 fuel and a commercially available Grade 100 Low Lead Aviation Gasoline Chemical analysis indicated significant differences in the composition of the two fuels, particularly with respect to aromatic and tetraethyl lead contents CFR engine knock test data indicated that the GOST 1012-72 fuel clearly was lower in knock value than the 100 Low Lead fuel, and full scale engine detonation testing supported these results Modified detonation-imposed operating limitations were developed for the full scale aircraft engine model tested No conclusions have been made with respect to long-term effects by GOST 1012-72 fuel usage on engine condition and performance (Author)

A79-36758 Designing with damping materials to reduce noise and structural fatigue E O'Keefe (Speciality Composites Corp , Newark, Del) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790631* 15 p 9 refs

The principal advantages of increased structural damping in aircraft components are design-cost and weight savings The damping material is most conveniently presented, using the reduced temperature format which shows the loss factor and stiffness as a continuous function of both temperature and frequency When the structural environment and damping properties are known, the composite panel behavior can be accurately determined from standard beam equations In the present paper, some aspects of damping design for constrained layer dampers are discussed Several case histories are

examined, where damping was successfully used to minimize aircraft and helicopter vibration and resonant noise problems V P

A79-36759 * Wind tunnel performance of four energy efficient propellers designed for Mach 0 8 cruise R J Jeracki, D C Mikkelson, and B J Blaha (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790573* 22 p 44 refs

For the advanced turboprop to be competitive with proposed advanced turbofan-powered aircraft, it must have high propulsive efficiency at Mach 0 8 cruise above 9 144-km altitude with an acceptable cabin noise environment Four 8-bladed propeller models are designed employing various concepts to reduce compressibility losses Wind tunnel tests are conducted at zero model incidence to the free-stream flow Aerodynamic and acoustic test results are presented and discussed It is shown that the aeroacoustically designed configuration (SR 3) with 45 deg of tip sweep and an area-ruled spinner yields the highest propulsive efficiency (78 7% at Mach 0 8, 3 06 advance ratio, and 1 7 power coefficient), with an improvement of about 3% over the straight bladed configuration (SR 2, with zero-degree sweep) The phase-interference concept for noise reduction used in SR-3 yields about 5-6 dB reduction as compared to SR-2 S D

A79-36760 * Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C engine D V Cosgrove and E E Kempke (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790607* 35 p 7 refs

Results are presented for tests performed to assess the effects of exhaust manifold injection air flow rate on emissions and on exhaust gas temperature and turbine inlet temperature for a range of engine operating conditions (speed, torque, and fuel-air ratios) of a fuel-injected turbocharged six-cylinder air-cooled Teledyne Continental Motors TSIO-360-C engine Air injection into the exhaust gas at 80 F resulted in a decrease in hydrocarbons and carbon monoxide while exceeding the maximum recommended turbine inlet temperature of 1650 F at the full rich mixture of the engine The EPA standards could be met within present turbine inlet temperature limits using commercially available air pumps, provided that the fuel-air ratios were leaned in the taxi, climb, and approach modes S D

A79-36773 The Fairchild can-opener - Shturmovik of the eighties. *Air International,* vol 16, June 1979, p 267-272, 287

The close air support (CAS) Fairchild A10 Thunderbolt II is examined Discussion centers on the essentially fair-weather aircraft's suitability to the adverse weather and other demanding conditions of a Central European scenario Authorities contend that the aircraft is the best solution so far, to these problems The A10's features such as high survivability resulting from heavy armor and triple redundant systems, and great firepower including a 30 mm Gatling type cannon and AGM-65 Maverick missiles are cited The Tactical Air Command claims that attacking at an altitude of 100 ft or less at 350-370 knots the A10 will prove a difficult target Among the electronic equipment the aircraft carries are a ALQ-119 jamming systems pod, a ALR-46V radar warning receiver, and chaff and IR flare dispensers Modification of an A10 into a two seater for night and adverse weather duty is also discussed, as is a presentation of complete specifications M E P

A79-36774 Airbus picks up speed - and the junior A310 takes off *Air International,* vol 16, June 1979, p 278-286

The article details the commercial history and present situation of the Airbus, while presenting a cross section of the entire model array Features of the different models, such as the Krueger flaps, the Rolls Royce, Pratt and Whitney, and General Electric engines, are given in detail Separate sections present the Airbus designations and list the number and model type which have been ordered by each customer airline Development of the A 300 B10 into the A 310, noting the joint wing development by German and British design teams, is also discussed The A 310 will have a smaller tailplane and a digital automatic flight control system allowing Category II certification with provisions for upgrading to Category III Complete specifications of the A 310 are given and a comparison with the A 300 made Finally, projected Airbus sales are analyzed, since Great Britain has returned as a full risk sharing partner in the program M E P

A79-36775 In Soviet service V - Backfire *Air International,* vol 16, June 1979, p 289-291, 308

The article discusses the Soviet Backfire bomber and the roles for which the aircraft may be used While basically a tactical weapon, Arctic staging, in-flight refueling, and high altitude subsonic cruising would enable attacks on eastcoast U S targets The Backfire's low-risk design, which makes little use of new technology, and similarity to the TU-28P Fiddler is examined The 'Downbeat' bombing and terrain following navigation radar is analyzed Maximum take-off weight is about 260,000 lbs and length and width are 138 ft and 29 5 ft, respectively The engines are believed to be based on the TU-144 turbofan, and performance estimates such as maximum dash speed of close to Mach 2 at about 39,370 ft are presented Weapon load of the aircraft is about 21,000 lbs and use as a cruise missile launch platform is expected It is concluded that at the present the Backfire, while a serious threat to Central Europe, possesses little strategic value in the intercontinental sense M E P

A79-36797 # A starter for gas turbine engines (Ustroistvo dlia zapuska gazoturbinnogo dvigatelia) V I Daineko *Priborostroenie* (Kiev), no 24, 1978, p 75-79 In Russian

The present analysis deals with some aspects of calculating and designing air-injection-type starters for gas turbine engines The schematic arrangement of the starter is examined, and structural factors affecting the dimensioning of the device are discussed It is shown that the number of channels depends on the dimensioning constraints, the design and dimensions of the compressor inlet, and the nozzle throat diameter of the nozzle of each channel V P

A79-36974 # Dassault-Breguet - The Mirage 2000 (Dassault-Breguet - Les Mirage 2000) J Morisset *Air et Cosmos,* vol 17, May 19, 1979, p 27, 28 In French

The performance and design characteristics of the Mirage 2000 are outlined The aircraft, with an overall length of 15 3 m, is equipped with a SNECMA M 53-5 turbojet engine with a thrust of more than 10 tons at Mach 2,2 and 36,000 ft Its range of operation with two pilon tanks (1700 l each) is greater than 1500 km It can be equipped with two MATRA Super 530 and two MATRA 550 'Magic' air-to-air missiles Results of initial flight tests have been highly satisfactory C K D

A79-36975 # The Digibus multiplex at the heart of avionics (Le multiplex 'Digibus' au coeur de l'avionique) G Collin *Air et Cosmos,* vol 17, May 19, 1979, p 29, 30 In French

The Digibus digital bus developed for application in Mirage 2000, Mirage 4000, ANG, and F 1 is described Two EMD-Sagem system management computers with memories of 32 and 64 k words form the core of the Digibus A high degree of component standardization will permit adaptation of the system for use in ballistic missiles and submarines Schematic diagrams of the Digibus developed for the Mirage 2000 are provided C K D

A79-37044 # **Changing requirements in aircraft design** L M Nicolai (Defense Advanced Research Projects Agency, Arlington, Va) *Astronautics and Aeronautics,* vol 17, June 1979, p 22-31 10 refs

The evolution of paramount design requirements in the aircraft industry is outlined Particular attention is given to the technological, societal, environmental, and economic pressures responsible for the rapid changes in major design requirements during the 1970's The development of design requirements over the next 25 years is considered It is concluded that future design requirements for commercial aircraft will include performance and long life, improved fuel efficiency and overall economy of operation, and compliance with noise and exhaust emission standards Requirements for life-cycle costs, performance, and reliability in military aircraft will be expressed in higher kill rates and reduced cost for destruction of a given target Emphasis in general aviation design will be on fuel efficiency, safety, comfort and cost C K D

A79-37045 # **Impact of advanced technologies on aircraft design** J McCracken (Vought Corp, Dallas, Tex) and M R Robinson (Rockwell International Corp, Pittsburgh, Pa) *Astronautics and Aeronautics,* vol 17, June 1979, p 32-38 23 refs

Advanced aircraft system technologies and design process technologies that will characterize the next generation of aircraft are examined Gross-weight reductions, increases in mission functions, and expected improvements in reliability and maintainability offered

A79-37046 # **Computer graphics create the new wave of design** A Feder (Northrop Corp, Hawthorne, Calif) *Astronautics and Aeronautics,* vol 17, June 1979, p 42-47, 51

The application of interactive computer graphics in advanced aircraft design, engineering analysis and production design is discussed Advantages of this technology in terms of increased productivity, cost reductions and flexibility at each step of the design process are examined Two- and three-dimensional geometry projections are noted C K D

A79-37047 # **Some main points about general-aviation design practice.** M Newman (Douglas Aircraft Co, Long Beach, Calif) *Astronautics and Aeronautics,* vol 17, June 1979, p 48-50

A brief overview of general-aviation design practice is presented Particular attention is given to the influence of model-year marketing pressures and the high-volume, low-cost production techniques characterizing this portion of the aerospace industry on the incorporation of product-improvement features Data on general aviation aircraft production for major manufacturers are presented C K D

A79-37048 # **Design, meet production** G L Michaelson (Boeing Commercial Airplane Co, Renton, Wash) *Astronautics and Aeronautics,* vol 17, June 1979, p 52, 53, 59

The paper discusses the importance of considering production costs as well as performance in designing aircraft The potential for cost avoidance at different steps of the design, engineering and production sequence is considered Attention is given to problems in developing producible designs for commercial aircraft interiors C K D

A79-37050 # **A case study in design - The Gossamer Condor** P MacCready (AeroVironment, Inc, Pasadena, Calif) *Astronautics and Aeronautics,* vol 17, June 1979, p 60-63

The design strategy used in developing the Gossamer Condor, a man-powered light-weight wire-braced airplane, is discussed Low operating power was the major design consideration, high priority was also given to ease of construction, repair and modification Reflection on the performance of soaring birds and hang gliders contributed to the design concept, sophisticated design analysis techniques were used in moderation An unconventional design approach proved highly successful in developing an unconventional aircraft C K D

A79-37149 # **Joint Airworthiness Requirements - Their history and progress** A P Kennedy (Civil Aviation Authority, London, England) *Aircraft Engineering,* vol 51, May 1979, p 17-20

The formation process of Western European Joint Airworthiness Requirements (JAR) is examined The Association Européene des Constructeurs de Matériel Aérospatial (AECMA) consisting of Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom began work on such codes in 1970 The aims, background and results of the work now attained are discussed Separate sections deal with the airworthiness codes, Import/Export difficulties, certification of joint projects, JAR structure and general policy, and amendment procedure Under the Airworthiness Codes section the U K 's decision to write their own after World War Two is discussed, while the Import/Export section cites the case of the Fokker F-27 and F-28 certification In addition, a list of published documents is given Future JAR regulations for sailplanes with and without engines are also covered It is concluded that while work has been satisfactory in conception, adoption of JARs has been sluggish, which could erode the support they now have M E P

A79-37150 # **Inertial Referenced Flight Inspection System** P R Vousden (Litton Systems, Ltd, Rexdale, Ontario, Canada) *Aircraft Engineering,* vol 51, May 1979, p 21-25

The development and features of the Inertial Referenced Flight Inspection System (IRFIS) which allows less costly and more accurate calibration of Category I, II, and III Aircraft Instrument Landing Systems, is presented IRFIS utilizes aircraft velocity data measured by an Inertial Navigation System, while incorporating two mathematical error estimaters, a sub-optimal Kalman filter and a Bryson-Frazier smoother The Aircraft Position Sensor (APS) consisting of two infrared detector arrays mounted at 90 deg to each other in the aircraft pitch plane, is detailed as well as the ground mounted retroreflector Design of the APS has met these criteria all weather operation, no hazardous features, no interference with radio communications and no ground personnel or ground installation of expensive equipment An onboard computer incorporating a CRT display and cassette magnetic tape storage is covered Calibration procedure which consists of a 50 ft altitude pass over the runway is detailed Other applications such as aerial surveying, photogrammatic operations, and airborne precision spraying can also be enhanced with IRFIS based equipment M E P

A79-37238 **The estimation of induced-voltage peak magnitude and energy level under LTA/EMP excitation of low-loss aircraft cabling** W S McCormick (Wright State University, Dayton, Ohio) *IEEE Transactions on Electromagnetic Compatibility,* vol EMC-21, May 1979, p 136-146 8 refs Contract No F33615-75-D-0090

The important vulnerability parameters of peak voltage transient magnitude and voltage transient energy are estimated for the LTA/EMP induction problem Using basic linear system theory, straightforward expressions are derived to estimate these two survivability parameters The derived model is quite general including cable characteristics, varying terminating impedances, and varying points of cable excitation Using the developed model, a comparison of the LTA and EMP cases is made An illustrative example involving the yaw damper circuit of the USAF f 111 is also included (Author)

A79-37294 **The McDonnell Aircraft Company Lightning Simulation Laboratory** E H Schulte (McDonnell Aircraft Co, St Louis, Mo) *Journal of Environmental Sciences,* vol 22, May-June 1979, p 22-27 6 refs

The McDonnell Aircraft Company (MCAIR) Lightning Simulation Laboratory is equipped to conduct developmental lightning simulation tests as well as qualification tests on aircraft or aircraft assemblies This paper describes how these techniques are applied at MCAIR in some of the unique generators used for conducting high-voltage, high-current, swept stroke, and induced-transient simulated lightning tests This paper lists the various equipment and

facilities which are available at MCAIR for performing lightning simulation tests and gives examples of some of the tests performed (Author)

A79-37295 * # **Control considerations for CCV fighters at high angles of attack.** L T Nguyen, W P Gibert, and S B Grafton (NASA, Langley Research Center, Hampton, Va.) *NATO, AGARD, Symposium on Aerodynamic Characteristics of Controls, Naples, Italy, May 14-17, 1979, Paper* 11 p

Wind tunnel and piloted simulation studies show that the use of the CCV concept of relaxed static pitch stability on fighter aircraft at high angles of attack can result in pitch departures caused by inertia and/or kinematic coupling and in deep stall trim. These problems can be avoided by sufficient nose-down pitch control at high attack angles, and effectiveness of several pitch control configurations such as aft-mounted stabilators, canard mounted flaps, and all-movable canards was investigated. A variable incidence canard with a large travel range was the most effective means of obtaining the required pitch control, although very large deflections may be required on highly unstable configurations. Control laws were developed for cases where the high angle of pitch control requirement is not met, but they can limit aircraft roll capability and thus compromise maneuverability. A.T.

A79-37296 * # **A unique facility for V/STOL aircraft hover testing.** R. G. Culpepper (NASA, Langley Research Center, Hampton, Va.) and R. D. Murphy (U.S. Navy, Naval Air Systems Command, Washington, D.C.) *Workshop on V/STOL Aerodynamics, U.S. Naval Postgraduate School, Monterey, Calif., May 16-18, 1979, Paper* 28 p

The paper discusses the Navy's XFV-12A tethered hover testing capabilities utilizing NASA's Impact Dynamic Research Facility (IDRF) at Langley. The facility allows for both static and dynamic tethered hover test operations to be undertaken with safety. The installation which consists of the 'Z' system (tether), restraint system, static tiedowns and the control room and console, is presented in detail. Among the capabilities demonstrated were the ability to recover the aircraft anytime during a test, to rapidly and safely define control limits, and to provide a realistic environment for pilot training and proficiency in VTOL flight. M.E.P.

A79-37468 # **Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town.** P. J. Konig, A. J. v. d. Walt, P. H. Stoker, B. C. Raubenheimer (Potchefstroom University for Christian Higher Education, Potchefstroom, Republic of South Africa), M. A. Shea, and D. F. Smart (USAF, Geophysics Laboratory, Bedford, Mass.) In: International Cosmic Ray Conference, 15th, Plovdiv, Bulgaria, August 13-26, 1977, Conference Papers. Volume 4. Sofia, B'lgarska Akademiia na Naukite, 1978, p. 173-177. 6 refs. Research supported by the South African Council for Scientific and Industrial Research.

A fairly sharp increase of 2.3% in the intensity of the nucleonic component of cosmic rays was observed at 30,000 feet pressure altitude along a contour of constant calculated vertical cutoff rigidity on a research flight from Cape Town, South Africa, at 18 deg E longitude, to a point 2 deg W longitude. The increase seems to be an inherent feature of this region near the South Atlantic geomagnetic anomaly. Detailed cutoff rigidity calculations in vertical and inclined directions revealed that the observed increase may at least partly be ascribed to variation in effective cutoff rigidities along the route. However, the increase could also be attributed, at least as far as morphology is concerned, to the continuous precipitation in a restricted area of those high energy inner radiation belt protons that have short lifetimes. (Author)

A79-37573 # **Observation of atmospheric interactions at aeroplane altitude.** F. Fumuro, R. Ihara (Kwansei Gakuin University, Nishinomiya, Japan), T. Ogato, H. Sugimoto (Tokyo, University, Tokyo, Japan), and Y. Sato (Waseda University, Tokyo, Japan) In: International Cosmic Ray Conference, 15th, Plovdiv, Bulgaria, August 13-26, 1977, Conference Papers. Volume 7. Sofia, B'lgarska Akademiia na Naukite, 1978, p. 171-176.

A large gamma-ray family is observed with a emulsion chamber exposed at aircraft altitude (260 g/sq cm). This gamma-ray family represents the feature of atmospheric nuclear interactions directly. Experimental results are presented on the energy, transverse momentum, and angular distribution of secondary gamma rays. The analysis of this family is made by use of calculated results of three dimensional cascade theory and of the kinematical method. (Author)

A79-37725 **The 'cloud-in-cell' technique applied to the roll up of vortex sheets.** G. R. Baker (California Institute of Technology, Pasadena, Calif.) *Journal of Computational Physics*, vol. 31, Apr. 1979, p. 76-95. 36 refs. Contract No. AT(04-3)-767, Grant No. DAHC04-68-C-0006.

The cloud-in-cell technique is used to calculate the time evolution of a vortex sheet generated by a wing in an ideal fluid. Two cases are considered for the initial distribution of circulation: one corresponding to an elliptically loaded wing and the other simulating the wing with a flap deployed. Results indicate that small scale behavior plays an important role in the roll-up. Typically, small scale perturbations result in small structures which evolve into ever increasing larger structures by vortex amalgamation. B.J.

A79-37735 **Application of parameter identification techniques to analysis of flight data.** A. J. Ross (Royal Aircraft Establishment, Farnborough, Hants., England) *Progress in Aerospace Sciences*, vol. 18, no. 4, 1979, p. 325-349. 35 refs.

The paper presents an outline of the parameter identification techniques currently used to extract aerodynamic data from flight tests, the emphasis being on the determination of stability and control derivatives. Consideration is given to the following techniques: equation error methods, output error methods, generalized least squares method, and maximum likelihood methods. Some advantages and difficulties of the methods are discussed, and some examples of results obtained from research and demonstration flying are examined. B.J.

A79-37827 # **The evaluation of the weight of engine installations on transport aircraft (Sulla valutazione del peso degli impianti motopropulsori dei velivoli da trasporto).** G. Gabrielli. *Ingegneria*, Mar.-Apr. 1979, p. 65-69. 9 refs. In Italian.

Expressions for engine installation weight as a function of thrust developed at take off are derived for transport aircraft. Engine weight assessments are presented for both propeller and jet aircraft and are intended as an aid in the preliminary design of aircraft with externally mounted power plants. The engine weight expressions are empirical formulations based on statistical elements. J.M.B.

A79-37828 # **Radial equilibrium in axial turbomachines (L'equilibrio radiale nelle turbomacchine assiali).** G. De Michele (Franco Tosi S.p.A., Legnano, Italy), G. A. Danieli, and G. Florio (Calabria, Universita, Cosenza, Italy) *Ingegneria*, Mar.-Apr. 1979, p. 70-83. 7 refs. In Italian.

A review is presented of the theoretical foundations of the radial equilibrium model, a mathematical approach for fluid dynamic calculations applicable to axial turbines. The radial equilibrium model is based on a consideration of nonviscous, axisymmetric, potential flow in the meridian plane of the turbomachine. The radial distribution of a free parameter in the flow treatment provides a design tool for optimizing the fluid dynamic output of the turbomachine. J.M.B.

A79-37852 **Fossil fuel heat pumps for domestic, commercial and industrial space heating** R E Critoph (Open University, Milton Keynes, Buck, England) In International Conference on Future Energy Concepts, London, England, January 30-February 1, 1979, Proceedings London, Institution of Electrical Engineers, 1979, p 61-64

It is noted that fossil fuel heat pumps are more efficient than electric ones The present paper gives a description of the OUERG/Lucas gas-fueled heat pump, presents a schematic diagram and photographs of the device, and discusses predicted performances B J

A79-38058 # **Turbulent wake measurements with a laser velocimeter** J F Meyers (U S Army, Instrument Research Div, Hampton, Va) and D R Hoad (U S Army, Structures Laboratory, Hampton, Va) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 14th, Orlando, Fla , June 4-6, 1979, Paper 79-1087* 9 p 12 refs

An investigation has been conducted in the Langley V/STOL tunnel with a laser velocimeter to demonstrate the capabilities of this technique through measurements of airflow velocities in the wake region of a NACA 0012 wing in stall and cruise angles of attack (19 4 deg and 4 75 deg) A direction-sensitive, two component, fringe-type laser velocimeter with a focal length of 3 86 m to reach center span was used with high speed burst counter and minicomputer data acquisition and processing The size of the seeding particles was measured and the velocity lag error determined along with errors due to the instrumentation The measured velocities were found to have a bias uncertainty of 1 33 percent to 0 91 percent and a random uncertainty of + or 0 47 percent (Author)

A79-38090 **Fuel on fire - Rapid response to a military problem** D Boyle *Interavia,* vol 34, June 1979, p 554-556

Equipment developed by Graviner England for extinguishing fuel fires in aircraft is analyzed, considering that such a system has to operate in milliseconds if suppression is to be effective Two methods of detection are presented (1) detection of the impact shock wave through the fuel tank, and (2) detection of flame radiation The latter, by reacting only to a flame, eliminates the possibility of releasing extinguishant when no fire has occurred The ultraviolet sensor which consists of a hydrogen and inert gas filled glass bulb containing two metal electrodes is discussed in detail Its quick response time allows for several 'readings' per millisecond, thus reducing the chance of errant flashes or rays triggering the system An explosive charge releases the potassium cryolite extinguishant from the cone shaped suppressor unit The results of a demonstration for the U S Army are presented, noting various contract possibilities M E P

A79-38091 **Survivability in aircraft fires - New standards are needed** C Bulloch *Interavia,* vol 34, June 1979, p 557, 558

The fire resistance of aircraft cabin materials in respect to design and certification is discussed Improved testing procedures are called for as materials that have passed current specifications as 'self extinguishing' have been proven to propagate flame, noting criticisms that laboratory tests involving small samples do not adequately reproduce the aircraft cabin environment The FAA has modified a C 133 with a false floor and ceiling to create a widebody cabin with full instrumentation provided to record heat flux, smoke density, and gas concentration in various parts and levels of the cabin The complete data capability will include 128 channels of computer acquired information, gas sample analyses, test animal responses and video coverage of the cabin Results to date include fairly precise analysis of the time required for dangerous heat levels to occur A mathematical model of a cabin fire under development, and possible use of additives to reduce spilt fuel flammability are covered The lack of up-to-date FAA regulations is also discussed M E P

A79-38092 **Westland unveils WG30 transport helicopter** D Wood *Interavia,* vol 34, June 1979, p 575-577

The Westland WG-30 transport helicopter is previewed The medium size, high performance helicopter is intended for military and civilian use Complete specifications regarding capacity, dimensions, weights, and performance are given The WG-30 differs from the earlier Lynx in having increased rotor diameter, 'raft' mounted engine and rotor assembly, and a new automatic flight control system The use of a minimum number of cleat sizes is covered, noting, that as a result, the WG-30 has half the structural components of the Lynx with only a 30 lb weight penalty Lynx items retained in the newer model, include the nose and tail structure Twin Rolls Royce GEM 41-4 turboshaft engines with a maximum rating of 1,120 shp , allow a maximum cruise speed of 135 knots A duplex pitch, roll, and yaw system with computer based control and duplex heading hold is employed and a complete VOR, DME, ILS, and ADF package will be tested for IFR operation In the military role the WG-30 is seen as a tactical transport and for battlefield support With tropical performance modifications it is hoped the craft's market will extend to the Middle and Far East M E P

A79-38118 # **Rotor blade stability in turbulent flows** I Y K Lin (Illinois, University, Urbana, Ill), Y Fujimori (National Aerospace Laboratory, Tokyo, Japan), and S T Ariaratnam *AIAA Journal,* vol 17, June 1979, p 545-552 25 refs Grant No DAAG29-78-G-0039

The effect of turbulence in the atmosphere on the motion stability of a helicopter blade is investigated Modeling turbulence as a random field, statistically stationary in time and homogeneous in space, the method of stochastic average of Stratonovich (1967) is used to obtain equivalent Ito stochastic equations, from which the Fokker-Planck equation for the transition probability density and the equations for various stochastic moments can be derived As an exploratory study, only flapping and torsional motions are considered Equations of motion are derived which are reducible to those obtained previously by Sissingh and Kuczynski when the turbulence terms are removed The in-plane turbulence components appear in the coefficients of these equations, thus, they affect the stability of the flapping and torsional motions On the other hand, the normal turbulence component appears in the inhomogeneous terms in the equations, its statistical properties, while affecting the level of system response, do not change a stable solution to an unstable solution (Author)

A79-38123 * # **Transient ablation of Teflon in intense radiative and convective environments** N Arai (NASA, Ames Research Center, Moffett Field, Calif) *AIAA Journal,* vol 17, June 1979, p 634-640 13 refs

On the basis of this investigation of the high-temperature behavior of polytetrafluoroethylene (PTFE), the transient one-dimensional ablation of PTFE has been developed by taking into account the optical transmittance of both the amorphous zone and the crystalline zone of PTFE layer Results show that although the exposed surface receded at an apparently steady state, both the internal temperature and the thickness of the gel layer increase continuously due to the internal absorption of radiation (Author)

A79-38124 # **Effect of forward acceleration on aerodynamic characteristics of wings** S Ando (Nagoya University, Nagoya, Japan) and A Ichikawa *AIAA Journal,* vol 17, June 1979, p 653-655 7 refs

A new theoretical formulation is presented for a three-dimensional wing flying with nonuniform speed in an incompressible inviscid fluid General formulations are presented and some applications for the lift problem are given including the cases of slender wings and two-dimensional airfoils B J

A79-38131 **F-18 - A special report.** M Shohat and F C Berry, Jr *Military Electronics/Countermeasures,* vol 5, May 1979, p 29, 30, 32 (4 ff)

One of the concepts driving F-18 Hornet development is to produce a multimission aircraft designed for reliability and maintainability, and whose cost of ownership is reduced by comparison with present aircraft Medium and large scale integrated circuits, solid state electronics, switching, and computer memory are heavily used and derating of electronics equipment contributes directly to reliability from the outset The aircraft has built-in tests not only in the avionic systems but in some of the mechanical systems as well, with fighter and attack versions completely common in basic aircraft hardware and software It is also noted that the maintainability and reliability standards are now requirements, not goals as in earlier aircraft The entire full scale development program is reportedly valued at around $2 billion beginning in 1976, with 11 aircraft fully engaged in test flying by the year-end of 1979 and squadron service to begin in 1982 V T

A79-38132 **The intercept of covert radar** R G Siefker *Military Electronics/Countermeasures,* vol 5, May 1979, p 56, 94

The geometry of intercept falls into one of two general categories the interceptor either is or is not colocated with the target The definition of a new term called the 'radar advantage' establishing the edge that radar must hold in order to be undetected while tracking a target is given Two examples covering most typical cases are presented using a radar range vs intercept range chart In the first, a radar operator is tasked with not letting an electronic intelligence collector get close enough to intercept his radar, in the second, the radar designer is tasked to design a radar that can track a target at 10 km without the target's own ship sensors becoming aware of the covert act Either example can be worked backwards to aid the interceptor designer in system specification and required ranges V T

A79-38135 * # **Some observations on the mechanism of aircraft wing rock** C Hwang and W S Pi (Northrop Corp , Aircraft Group, Hawthorne, Calif) *Journal of Aircraft,* vol 16, June 1979, p 366 373 6 refs Contract No NAS2-8734

A scale model of the Northrop F 5A was tested in NASA Ames Research Center Eleven-Foot Transonic Tunnel to simulate the wing rock oscillations in a transonic maneuver For this purpose, a flexible model support device was designed and fabricated, which allowed the model to oscillate in roll at the scaled wing rock frequency Two tunnel entries were performed to acquire the pressure (steady state and fluctuating) and response data when the model was held fixed and when it was excited by flow to oscillate in roll Based on these data, a limit cycle mechanism was identified, which supplied energy to the aircraft model and caused the Dutch roll type oscillations, commonly called wing rock The major origin of the fluctuating pressures that contributed to the limit cycle was traced to the wing surface leading edge stall and the subsequent lift recovery For typical wing rock oscillations, the energy balance between the pressure work input and the energy consumed by the model's aerodynamic and mechanical damping was formulated and numerical data presented (Author)

A79-38136 # **Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft** M J Rutkowski (U S Army, Aeromechanics Laboratory, Moffett Field, Calif) *Journal of Aircraft,* vol 16, June 1979, p 401-406 23 refs

The AD-1 manned flight test program being conducted jointly by the Ames and Dryden Flight Research Centers of NASA is entended to evaluate the stability, control, and handling characteristics of oblique wing aircraft The results of the aeroelastic stability analysis carried out at Ames in support of the AD-1 program are presented for the oblique wing, both with and without ailerons When the wing is swept, the significant mode of instability is low-frequency, oblique-wing flutter With the oblique unswept, however, the critical mode is bending-torsion aileron flutter The latest version of the NASTRAN computer code, as well as the Ames PASS/FLUT program, was used in these studies (Author)

A79-38137 # **A tire runway interface friction prediction model concept** M K Wahi (Boeing Commerical Airplane Co , Seattle, Wash) *Journal of Aircraft,* vol 16, June 1979, p 407 416 39 refs Contract No F33657 74 C-0129

A thorough literature survey was conducted to establish the range of aircraft tires in use, types of runway surfaces in use, and a list of factors affecting tire runway interface phenomenon Both commercial and military aircraft tires and runways were studied Subsequently, a prediction model has been developed that correlates with existing tire test data to within plus or minus 5% The model consists of a prediction equation expressing the relationships between seven dimensionless groups (pi terms) needed to define the tire runway interface friction Due to lack of availability of uniform test data, a tire test program has been recommended to validate the said model (Author)

A79-38140 # **Aircraft design and strength /2nd revised and enlarged edition/ (Konstruktsiia i prochnost' samoletov /2nd revised and enlarged edition/)** V N Zaitsev and V L Rudakov Kiev, Izdatel'stvo Vishcha Shkola, 1978 488 p 48 refs In Russian

This second edition of the textbook has been extended to include a number of issues and problems associated with the progress made in aircraft design over the past few years Particular attention is given to new requirements concerning the strength, reliability, dynamic creep, and fatigue strength of an aircraft and its assemblies and components The structure diagrams of various systems and mechanisms are examined V P

A79-38145 # **Theoretical fundamentals of radio altimetry (Teoreticheskie osnovy radiovysotometrii)** A P Zhukovskii, E I Onoprienko, and V I Chizhov Moscow, Izdatel'stvo Sovetskoe Radio, 1979 320 p 133 refs In Russian

A theory of air and space-borne radio altimeters and vertical velocimeters is developed The principles of designing such instruments and obtaining information on height and vertical speed are outlined The operational characteristics of radio altimeters, associated with the random nature of a signal reflected from a statistically uneven surface are discussed The accuracy of radio altimeters is studied by statistical analysis and synthesis methods Techniques for calculating dynamic and other errors of radio altimeters are described V P

A79-38168 # **Profiling of two-dimensional and three-dimensional nozzles and calculation of their flows (Profilirovanie dvumernykh i prostranstvennykh sopel i raschet techeniia v nikh)** M Ia Ivanov and A N Kraiko In Gasdynamic lasers and laser photochemistry Moscow, Izdatel'stvo Moskovskogo Universiteta, 1978, p 52-62 43 refs In Russian

The paper deals with some problems associated with designing plane, axisymmetric, and three-dimensional nozzles for a desired flow at the exit section or for optimum thrust Some aspects of the calculation of nozzle flows for a given nozzle configuration, with allowance for nonequilibrium physicochemical processes, are discussed V P

A79-38387 **The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines** M J Rauckis and W J McLean (Cornell University, Ithaca, N Y) *Combustion Science and Technology,* vol 19, no 5-6, 1979, p 207 216 21 refs

The results of an experimental investigation of the effect of supplemental hydrogen (up to 30 percent of the total fuel energy) on the combustion process in a CFR engine are reported The hydrogen was added under otherwise constant conditions so that chemical

properties were varied under constant hydrodynamic conditions Calibrated cylinder pressure traces, averaged over many cycles, were incorporated into a two-zone thermodynamic analysis to determine the mass fraction burned as a function of crankangle The techniques employed enabled changes in the induction period and combustion duration of the order of 0 1 ms to be resolved The added hydrogen resulted in significant reductions in ignition delay or induction times, especially in lean mixtures Reductions were greater with increased fractions of hydrogen Once a turbulent flame was well established, the hydrogen had a relatively small effect on the burning rate The results are consistent with a description of the combustion process which includes an induction period dominated by chemical dynamic effects and a turbulent burning period dominated by turbulent transport effects Added hydrogen also led to improved efficiency and less cycle-to-cycle pressure variations (Author)

A79-38393 * Effects of forward velocity on sound radiation from convecting monopole and dipole sources in jet flow R Dash (NASA, Ames Research Center, Moffett Field, Calif) *Journal of Sound and Vibration,* vol 64, May 22, 1979, p 187-207 26 refs

A theoretical model is presented of the effects of forward velocity of an aircraft at arbitrary subsonic speed on sound radiated from convecting monopole and dipole sources embedded in the jet flow It is found that with increasing forward velocity there is a steadily increasing amplification (over the static case) of the sound radiated into the forward arc and a large reduction of the sound which is radiated into the rearward arc The same trend is also shown to result when there is a reduction in the exhaust velocity, with, however, a further rise in amplification in the forward quadrant and a drop in attenuation in the aft quadrant B J

A79-38399 Noise characteristics of heated high velocity rectangular jets R A Kantola (GE Mechanical Systems and Technology Laboratory, Schenectady, N Y) *Journal of Sound and Vibration,* vol 64, May 22, 1979, p 277 294 14 refs U S Department of Transportation Contract No OS 30034

A comprehensive experimental investigation of the noise emission from a rectangular jet has been carried out In order to provide information pertinent to the operating conditions of jet engines, this study was conducted with a wide range of jet velocities and temperatures A substantial effort has been made to present the information in this paper in such a fashion as to delineate the effects of turbulent mixing and acoustic shielding To aid in this process, a round jet with an equal area nozzle was also tested over the same ranges of velocity and temperature As a result of this study, it is concluded that an observed reduction in overall acoustic power of the rectangular jet, when compared to a round jet, is mainly the result of the shielding effects of the mean velocity and temperature fields rather than due to any turbulent mixing phenomenon Acoustic shielding predictions were found to be qualitatively valid in the vicinity of the peak intensity but were inadequate at shallow angles to the jet axis In order for shielding theory to properly predict the noise of non-circular jets, at shallow angles, it appears that it will be necessary to include the effects of jet spreading and subsequent degeneration to a circular jet as well as the effects of off-axis source locations (Author)

A79-38476 Sidestick/Throttle Controller - An alternate approach F Gregory (USAF, Washington, D C) *Society of Experimental Test Pilots, Technical Review,* vol 14, no 3, 1979, p 4-15

A simulation was made to determine if a pilot using a single hand Sidestick/Throttle Controller (SSTC) could provide precise and effective aircraft control comparable to that of a conventional center stick and left-hand throttle The construction of the SSTC, the Visual Motion Simulator (VMS) and the Differential Maneuvering Simulator (DMS) used during the evaluation conducted at the NASA Langley Research Center, together with the test procedures are described The VMS pilot comments were that the SSTC is an acceptable alternative to aircraft control and that preliminary data analysis indicates no significant difference between the conventional controller and the SSTC, that throttle manipulation appears as a subconscious act with the SSTC, and with the exception of roll sensitivity, the roll and pitch interface harmony and the mechanical characteristics of the SSTC were acceptable The DMS conclusions rated the SSTC as acceptable and equal or better than the conventional controls for a majority of DMS tasks, that hand fatigue can be expected with rapid and large displacement throttle manipulations while significantly displacing the SSTC from lateral or longitudinal neutral, and that preliminary data analysis indicates no significant difference in performance between the SSTC and conventional controller A T

A79-38477 A wind shear/downdraft drift angle warning system R A Greene *Society of Experimental Test Pilots, Technical Review,* vol 14, no 3, 1979, p 16-21 8 refs

This paper describes the development of an airborne system, which determines the reduction in excess thrust available during a landing approach The system measures, with no appreciable lag, the effective loss in available excess thrust-to-weight ratio due to downdraft drift angle and horizontal wind shear These signals are summed in terms of radians and acceleration g's and are presented to the flight crew in the form of a go-around alert (Author)

A79-38478 The test pilot in the airline industry or 'My bags are packed and I'm ready to go' C Kizer (United Air Lines, Inc , Chicago, Ill) *Society of Experimental Test Pilots, Technical Review,* vol 14, no 3, 1979, p 22-26

The engineering functions, personnel qualifications and the organization of the Flight Test Section at United Airlines are described and types of test flights, flight test requirements, and details of maintenance operations are outlined A Flight Test Audit Program which randomly selects fleet aircraft for flight checks and helps determine system function and reliability in the operating fleet environment, and a program to allow Flight Test Section a greater impact on the existing maintenance plan are depicted A T

A79-38479 Night/Adverse Weather A-10 evaluator program W H Shawler (Fairchild Republic Co , Farmingdale, N Y) *Society of Experimental Test Pilots, Technical Review,* vol 14, no 3, 1979, p 27-30

The program to extend the A-10 mission capability to the Night/Adverse Weather (N/AW) regime by demonstrating aircraft operability and survivability with low altitude attack and integrating tactics and sensors to destroy the threat is described The N/AW capability will increase the A-10 usable time to over 90% in the European environment with enhanced avionics such as Inertial Navigation System, Radar, Forward Looking Infrared, Radar Altimeter, and Laser Ranger The mission analysis to determine the required avionic subsystems and equipment is discussed together with the major tasks required to accomplish the program, including modification into a two-place N/AW evaluator, integration of the N/AW avionics, and demonstration of the N/AW capability The test program is described, noting that a crew of two is needed to accomplish the low altitude mission at night and/or adverse weather, at least two sensors should provide information at all times, and the cockpits should be designed with maximum flexibility with control provisions in both cockpits and capability to display sensor information both Heads Up and Heads Down A T

A79-38531 Identification of voltage transients on aircraft cabling under LTA excitation W S McCormick (Wright State University, Dayton, Ohio) and K J Maxwell (Technology Scientific Services, Inc , Dayton, Ohio) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-15, May 1979, p 372-377 Contract No F33615-75-D-0090

Lightning and electro-magnetic pulse-induced fuselage skin currents can magnetically or electrically flux couple onto aircraft cabling through dielectric 'holes' or apertures in the aircraft fuselage Using lightning transient analysis (LTA) input-output waveform records, frequency domain techniques are presented that locate the exact point of excitation The techniques are demonstrated using an RG-58 cable simulation and are then applied to the yaw damper circuit of a USAF F-111 (Author)

A79-38532 **A family of air traffic control radars** E Giaccari and G Nucci (Selenia S p A , Rome, Italy) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-15, May 1979, p 378-396 9 refs

Some 20 years of activity in the field of air traffic control radars is described The technical experience gained in evaluating the performance of ATC radars installed throughout the world is described in terms of target visibility in the clear, a ground clutter, and in adverse meteorological conditions A criterion to determine the significance of a flight test is described In the effort to establish a reliable method of measurement, the subclutter visibility over ground clutter is related to the linear dynamic range of the moving-target indicator (MTI) receiver and to the improvement factor (Author)

A79-38533 **Digital flight control research using microprocessor technology** R F Stengel (Princeton University, Princeton, N J) *(Flight Control Systems Criteria Symposium, U S Naval Postgraduate School, Monterey, Calif , July 1978) IEEE Transactions on Aerospace and Electronic Systems,* vol AES-15, May 1979, p 397-404 12 refs Contract No N00014-78-C-0257

The Flight Research Laboratory at Princeton University is engaged in an experimental program to investigate a variety of approaches to digital control by actual flight test Experimentation is being conducted with Princeton's 6-DOF variable-response research aircraft (VRA), which is equipped for direct side-force control, direct-lift control, feedback of all motion variables, and multiple-pilot command modes VRA avionics have been augmented by microprocessor digital flight control system (Micro-DFCS), which uses off-the-shelf computer components capable of operating in parallel or in series with the existing variable-response system The digital control laws operate in conjunction either with the 'bare airframe' dynamics of the VRA or with the dynamics of a simulated aircraft, provided by the existing variable-response system The initial flight control computer program CAS-1 provides three longitudinal control options direct (unaugmented) command, pitch rate command, and normal acceleration command (Author)

A79-38706 **Air Force Space Laser Communications** J R Roland and C E Whited (USAF, Space and Missile Systems Organization, Los Angeles Air Force Station, Calif) In ITC/USA/'78, Proceedings of the International Telemetering Conference, Los Angeles, Calif , November 14-16, 1978
Pittsburgh, Pa , Instrument Society of America, 1978, p 339-346

The background and status of the AF LASERCOM program are briefly reviewed The performance characteristics of the LASERCOM system make its potential application to certain satellite-satellite and satellite-aircraft links unique, while other potential LASERCOM links require a detailed cost analysis of the current investment in RF terminals and systems vs the cost of developing and deploying LASERCOM terminals and systems B J

A79-38814 # **Model study of transient processes in a hydraulic power amplifier (Badania modelowe procesow przejsciowych hydraulicznego wzmacniacza sily)** G Janowska and J Morawski *Instytut Lotnictwa, Prace,* no 72, 1978, p 3-24 In Polish

The paper deals with a hydraulic analog of a power amplifier incorporated in a helicopter control system The results of the analysis are discussed, with particular reference to the influence of the principal functional and structural characteristics of the amplifier on its transient response V P

A79-38816 # **Model study of aircraft disk brakes (Badanie modelowe lotniczych hamulcow tarczowych)** A Derkaczew *Instytut Lotnictwa, Prace,* no 72, 1978, p 53 81 7 refs In Polish

The model test for aircraft disk brakes, proposed in the present paper, is based on the use of modern concepts of similarity theory and the theory of friction and wear A group of parameters which affect decisively the similarity aspects of the test are identified, along with the conditions which must be satisfied to provide a modeling accuracy adequate for designing aircraft disk brakes V P

A79-38817 # **Tachystoscopic testing of onboard instruments (Badania tachistoskopowe przyrzadow pokladowych)** Z Kazimierska *Instytut Lotnictwa, Prace,* no 73, 1978, p 3-25 18 refs In Polish

Some problems in the tachystoscopic testing of aircraft indicator instruments are addressed The ergonomic optimization of some existing indicator instruments and proposed new ones is studied on the basis of some legibility tests, in which the minimum time necessary for correct reading was measured Results of legibility tests performed in the design process for some fuel gages and gyrocompasses with integral lighting are discussed P T H

A79-38819 # **A method of reducing aircraft turbine blade vibrations (O pewnej metodzie zmniejszania drgan lopatek turbin lotniczych)** W Klepacki *Instytut Lotnictwa, Prace,* no 74, 1978, p 11-40 In Polish

A vibration damper for aircraft turbine blades is described The effectiveness of the device is evaluated by measuring the stress in the blade itself and the neck of the blade root before and after the vibration damper is installed Stress amplitude reductions of up to around 70% are possible with the device A mathematical model of the damper is proposed, and an analog method of analysis is described These two methods give satisfactory results for predicting the effectiveness of the damper installation P T H

A79-38825 **High level maintenance below sea level** L M Kolsteeg (KLM - Royal Dutch Airlines, Engineering and Maintenance Div , Amsterdam, Netherlands) *Exxon Air World,* vol 31, no 2, 1979, p 22-26

The KLM Amsterdam Schiphol Airport engine overhaul shop is responsible for maintenance and overall engineering of about 200 CF6 engines Modular design and on condition maintenance philosophy, the two basic concepts of modern engine care, introduced new common industry terminology, Modules or Maintenance Units, Hospital and Hospital Visit, Shop and Shop Visit, Hospital Maintenance Unit and On Condition Maintenance which are defined Inspection methods including borescope, evaluation of magnetic slip detectors, Gamma-ray and oil sample checks are listed, noting that on condition maintenance philosophy, together with failure analysis, revealed the life-limited components which should be scheduled for replacement The engine component inspection, repair and maintenance steps through the shop are detailed, noting the role of production control, engineering, quality assurance, finance and production experts. Finally, the repaired components and modules are rebuilt into a complete engine and given a test cell performance run A T

A79-38882 * **Exploring team avionics systems by simulation** G A Brent and T M McCalla, Jr (Southern Illinois University, Carbondale, Ill) In Annual Simulation Symposium, 11th, Tampa, Fla , March 15-17, 1978, Record of Proceedings
Tampa, Fla , Annual Simulation Symposium, Long Beach, Calif , IEEE Computer Society, 1978, p 155-170 12 refs Grant No NsG 2238

Configurations of software and hardware in a no-critical element team architecture are under study for future general aviation aircraft avionics The team integrated avionics system, based on microprocessors, can monitor and partially interpret all flight instrument data,

engine parameters, and navigation information faster than a human pilot Simulation programs based on an event-oriented simulation language are being used to design team architectures J M B

A79-38885 An aircraft simulation using a product of exponentials as matrizant K R Penrose (USAF, Ogden Air Logistics Center, Hill AFB, Utah) In Annual Simulation Symposium, 11th, Tampa, Fla , March 15-17, 1978, Record of Proceedings Tampa, Fla , Annual Simulation Symposium, Long Beach, Calif , IEEE Computer Society, 1978, p 253-269

An aircraft simulation is described wherein direction cosine matrices are updated by premultiplication with exponential matrices which represent rotations occurring during 50 millisecond intervals Equations and algorithms are presented which determine the aircraft state in inertial and other coordinate systems, based on aerodynamics and environmental factors Techniques for fast, accurate real time execution are used throughout the simulation Error estimates are given where known (Author)

A79-38886 The dynamics of a general aviation pilot promotion campaign M A Duffy (Battelle Columbus Laboratories, Columbus, Ohio) In Annual Simulation Symposium, 11th, Tampa, Fla , March 15-17, 1978, Record of Proceedings Tampa, Fla , Annual Simulation Symposium, Long Beach, Calif , IEEE Computer Society, 1978, p 305-317

A dynamic simulation model has been developed to model causal connections between the supply of general aviation pilots, aircraft demand, and aircraft utilization Previous applications of the simulation model have included an assessment of the impact on general aviation activity of regulatory changes that would bring about increases in user costs In this paper, the impact of the program initiated by the General Aviation Manufacturers' Association (GAMA) to double the private pilot population by 1980 is studied According to the simulation model, if the GAMA program is successful there will be approximately 50,000 additional active general aviation aircraft by 1985 J M B

A79-38906 # A method for the calculation of 3D boundary layers on practical wing configurations J P F Lindhout, G Moek, E De Boer, B Van Den Berg (National Lucht en Ruimtevaartlaboratorium, Amsterdam, Netherlands) In Turbulent boundary layers Forced, incompressible, non-reacting, Proceedings of the Joint Applied Mechanics, Fluids Engineering and Bioengineering Conference, Niagara Falls, N Y , June 18-20, 1979 New York, American Society of Mechanical Engineers, 1979, p 35-46 13 refs

The paper describes a method for calculating three-dimensional turbulent and laminar boundary layers on nondevelopable surfaces A simple eddy viscosity model is incorporated in the method and consideration is given to the organization of computations with the aim of circumventing as much as possible stepsize limitations As an example, the method is applied to laminar boundary layer flow over a flat plate with attached cylinder and to turbulent boundary layer flow over an aircraft wing B J

A79-38943 Experimental data on the dynamic properties of several propeller vanes W A A Monna and A G M Driedonks (Koninklijk Nederlands Meteorologisch Instituut, De Bilt, Netherlands) *Journal of Applied Meteorology*, vol 18, May 1979, p 699-702 8 refs

The dynamic properties of three types of commercially available propeller vanes were investigated in a wind tunnel The same was done for the cup anemometer and wind vane as used on the 200-m mast at Cabauw, the Netherlands, as well as for the trivane, used for three-dimensional turbulence measurements For these instruments the distance constant, damping ratio and damped wavelength were determined as well as the propeller response to a constant air speed as a function of the yaw angle The results show differences from the manufacturer's specifications Compared with the other instruments, the trivane appeared to be about twice as fast in response to variations of the wind vector Among the other instruments there were no large differences (Author)

A79-38951 # Damage-tolerant fan blade design L Cernoch and H Kaehler (Avco Corp , Avco Lycoming Stratford Div , Stratford, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1119* 11 p 11 refs

A method of predicting the extent of local damage to fan blades resulting from bird ingestion was evolved and used in the development of the ALF 502 turbofan engine Projectile and target parameters were related to the impact conditions producing damage to fan blades, acceptable damage levels were determined by full-scale engine ingestion tests to ensure survivability in a damaged state Engine survivability under different ingestion conditions or with different blade designs was then predicted by application of the damage criterion (Kaehler, 1977) C K D

A79-38952 # *Propulsion system sensitivities for a strategic aircraft* R M Tyson (Rockwell International Corp , Los Angeles, Calif) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18 20, 1979, AIAA Paper 79 1121* 6 p

A study was conducted to identify advanced engine technologies which would have high payoffs for new strategic aircraft Technology candidates were assessed and their performance advantages identified using propulsion system performance sensitivities to component changes and vehicle takeoff gross weight sensitivities to propulsion system performance and weight changes The propulsion technologies with the highest potential for reducing strategic aircraft weight are those which allow reduced turbine cooling flow and those which increase takeoff specific thrust (Author)

A79-38953 # The multiple application core engine - Sizing and usage criteria E A Lehmann (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1123* 9 p

Sizing and usage criteria for an advanced technology engine core (high pressure rotor) for multiple application in a variety of aircraft types are discussed The multiple application core engine (MACE) considered consists of a high pressure compressor, combustor, and high pressure turbine designed for the composite fighter/bomber duty cycle Data packages for a family of six study engines derived from a common core having a base corrected compressor exit flow of about 5 6 lb/sec, scalable to 150%, were compared with optimum engine parameters for several advanced airframe types currently under study to determine what applications could be grouped with a single core size and what penalties in take-off gross weight or other mission parameters are necessary to accommodate core commonality Take-off gross weight appeared to be relatively insensitive to core size over a wide size range if the bypass ratio was varied to maintain the thrust requirement C K D

A79-38961 * # Evaluation of methods for prediction of propulsion system drag G D Kuhn, O J McMillan, S C Perkins, Jr (Nielsen Engineering and Research, Inc , Mountain View, Calif), and E W Perkins *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1148* 13 p 40 refs Contract No NAS2 9513

The results of a study directed toward compilation of a theoretical and experimental data base covering inlet/airframe and nozzle/afterbody integration are described, with the major emphasis on the evaluation of the adequacy for preliminary design purposes of the data base for afterbody/propulsion system interference effects Prediction methods that exist for afterbody/airframe interference effects are evaluated with respect to the requirements of breadth, ease of application and accuracy that are important for preliminary design (Author)

A79-38962 * # **The selection of materials technologies for full-scale development** G A Aronstamm (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1152* 8 p NASA-sponsored research

Candidate material technologies offering the largest application payoff for the least development costs and the least risk should be selected for full-scale development funding A cost/benefit methodology is developed to rate candidate material and process opportunities for future aircraft engine applications A development cost estimate and risk analysis is compared with the economic benefit to establish a ranking of the candidate advanced technologies Also included are examples of this methodology as applied to high-strength HIP turbine disks, advanced oxide dispersion strengthened burner liners, and ceramic first-stage high-pressure turbine vanes S D

A79-38963 # **Cost benefits from improved hot section life prediction technology** A J Dennis and T A Cruse (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79 1154* 9 p

Aircraft operating costs can be significantly reduced by increasing the life of engine hot section parts, the hot section consisting of the combustor and turbine Improvements in hot section technology are essential to meet the combined need for higher performance and greater durability The paper deals with improved analytical methods to predict hot section component lives more accurately, thus ensuring reduced aircraft operating costs Hot section component life prediction uses nonlinear stress strain analysis which requires improved time dependent plasticity material models The improved creep/fatigue life exhaustion model should be sensitive to actual mission usage Verification and demonstration of these methods aim at establishing confidence for application to hardware design Attention is given to structures technology for improved combustor liner creep/fatigue life S D

A79-38964 * # **General aviation turbine engine /GATE/ concepts** E J Lays and D L Murray (Williams Research Corp , Walled Lake, Mich) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1157* 14 p NASA sponsored research

The paper deals with only a portion of the work done by Williams Research Corporation for NASA It provides a look at possible new-generation powerplants that offer the potential for remarkable airplane performance gains with attendant safety, utility, productivity and life cycle cost benefits Attention is given to a turboprop engine concept and applications A turbofan engine having core components in common with the turboprop is also discussed and an airplane application shown Some of the more important findings are presented S D

A79-38965 # **A novel correlation of centrifugal compressor performance for off-design prediction** D P Kenny (Pratt and Whitney Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1159* 7 p

A method is proposed for generalizing the performance of centrifugal compressor impellers and diffusers with two simple correlations for each element These are based upon throat blockage as a function of leading edge incidence and static pressure effectiveness (measured from the throat) as a function of throat blockage Such correlations have been known for some time to provide unique relationships for diffusers It has now been found that this is also true for impellers These four generalized correlations then provide a simple means of predicting the off-design performance of centrifugal compressor stages This is particularly applicable in defining the effect of changes in diffuser throat area or impeller diffusion and throat area The method even lends itself to optimizing the overall geometry of a given centrifugal stage (Author)

A79-38966 # **Turbo-fan design for general aviation - The evolution of the RB 401** G M Lewis (Rolls-Royce, Ltd , Aero Div , Bristol, England) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1160* 11 p

The paper discusses the engineering and design aspects of the evolution of the business jet aircraft gas turbine engine RB 401 as a candidate engine for the general aviation market The discussion covers market requirement, cycle choice, technology base and engine configuration, initial project design, demonstrator engine test results, basis for redesign and some design features of RB 401-07 engine, RB 401-07 test results, and application of the RB 401 The results obtained from engine tests establish the RB 401-07 as a suitable candidate powerplant in the growing field of business jet aviation S D

A79-38967 # **Evaluation of an ejector-powered engine simulator at transonic Mach numbers** C E Robinson, G D Smith, and R J Matz (ARO, Inc , Arnold Air Force Station, Tenn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1165* 7 p

An experimental program was conducted in the AEDC Propulsion Wind Tunnel (16T) to evaluate an air-driven ejector for use as an airbreathing engine simulator The simulator was installed in the right nacelle of a 0 06-scale B-1 model The data obtained during this investigation are compared with data obtained using conventional testing techniques and with limited flight data The comparisons demonstrate that the concept of using an ejector-powered engine simulator is valid More extensive studies to document the capability of the simulator throughout the performance envelope of a typical aircraft should be conducted (Author)

A79-38968 # **A parametric study of support system interference effects on nozzle/afterbody throttle dependent drag in wind tunnel testing** C S Finnerty (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) and E A Price, Jr (ARO, Inc , Arnold Air Force Station, Tenn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1168* 14 p 10 refs

A series of wind tunnel tests were conducted in the Arnold Engineering Development Center 16 foot transonic wind tunnel These test results utilized an 11% F 16 nozzle/afterbody model During the test, Mach number, Reynolds number, angle-of-attack, nozzle pressure ratio, and horizontal tail deflection were varied as well as support system geometry The paper presents the support system interference effects resulting from the variations in the strut, wing-tip, and sting support systems Support system variations include wing-tip support blade position, support boom diameter, length, spacing, and sting taper location In general, the results presented indicate that the sting support with annular jet is the most interference free support system as compared to both the wing tip and strut support systems (Author)

A79-38969 * # **Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface** D M Straight (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18 20, 1979, AIAA Paper 79-1170* 13 p 17 refs

Cooling is one of the critical technologies for efficient design of exhaust nozzles, especially for the developing technology of non axisymmetric (2D) nozzles for future aircraft applications Several promising 2D nozzle designs have external expansion surfaces which need to be cooled Engine data are scarce, however, on nozzle cooling effectiveness in the supersonic flow environment (with shocks) that exists along external expansion surfaces This paper will present experimental film cooling data obtained during exploratory testing with an axisymmetric plug nozzle having external expansion and installed on an afterburning turbojet engine in an altitude test facility The data obtained shows that the shocks and local hot gas

stream conditions have a marked effect on film cooling effectiveness An existing film cooling correlation is adequate at some operating conditions but inadequate at other conditions such as in separated flow regions resulting from shock boundary-layer interactions (Author)

A79-38974 * # **Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect** A D Zalay, M R Brashears, A J Jordan, K R Shrider, and C D Vought (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1184* 8 p. 10 refs NASA-sponsored research

An experimental research program for measuring the flow field around a 70 percent scale V/STOL aircraft model in ground effect is described The velocity measurements were conducted with a ground-based laser Doppler velocimeter at an outdoor test pad The remote sensing instrumentation, experimental tests, and results of the velocity surveys are discussed The distribution of vertical velocity in the fan jet and fountain, the radial velocity in the wall jet and the horizontal velocity along the aircraft underside are presented for different engine rpms and aircraft heights above ground The study shows that it is feasible to use a mobile laser Doppler velocimeter to measure the flow field generated by a large scale V/STOL aircraft operating in ground effect (Author)

A79-38975 # **Infrared signature measurement techniques and simulation methods for aircraft survivability** G E Varney (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1186* 10 p.

This paper discusses the methodology of relating infrared signatures of aircraft weapon systems to their survivability in a combat situation Techniques to measure the infrared radiation signatures for gas turbine engines are presented for outdoor static test and wind tunnel model testing Infrared measurement instrumentation and data analysis methods are given that characterize the band total, spectral and spatial distribution Techniques for estimating the in flight aircraft signatures are also presented Use of these in-flight signatures in air combat simulator for estimating aircraft combat survivability are then discussed (Author)

A79-38976 # **Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks** C E Meece and C E Spaeth (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1189* 6 p. USAF-supported research

The rupture of a disk in a gas turbine engine, although it is a rare occurrence, invariably requires engine shutdown and frequently results in extensive damage to the engine For this reason disks are designed to be the most reliable parts in the rotating structure This emphasis on reliability coupled with typical variations in material properties, engine operating characteristics, and manufacturing tolerances has resulted in the retirement of most disks from service before their total useful lives are depleted Current disk lives are established so that at the end of the calculated lifetime one disk in one thousand will develop a very small crack at the limiting location The life prediction method employs classical damage summation techniques to deal with mission complexities and identifies for the disk population a life at which disks must be removed to ensure safe operation (Author)

A79-38977 * # **The strainrange partitioning behavior of an advanced gas turbine disk alloy, AF2-1DA** G R Halford and A J Nachtigall (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1192* 10 p. 14 refs

The low-cycle, creep-fatigue characteristics of the advanced gas turbine disk alloy, AF2-1DA have been determined at 1400 F and are presented in terms of the method of strainrange partitioning (SRP) The mean stresses which develop in the PC (tensile Plasticity reversed by compressive Creep) and CP (tensile Creep reversed by compressive Plasticity) type SRP cycles at the lowest inelastic strainrange were observed to influence the cyclic lives to a greater extent than the creep effects and hence interfered with a conventional interpretation of the results by SRP A procedure is proposed for dealing with the mean stress effects on life which is compatible with SRP (Author)

A79-38978 # **Aircraft engine design using experimental stress analysis techniques** B L Koff (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio) *(NATO, AGARD, Symposium on Stresses, Vibrations, Structural Integration and Engine Integrity, Cleveland, Ohio, Oct 23-27 1978) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1193* 12 p.

Experimental analyses are used more extensively in aircraft engine design today than ever before, primarily because of the demands for extended component life The paper is a perspective of prominent experimental techniques used in current aircraft engine stress analyses It addresses the verification of temperature, stress, steady state and dynamic deformation, pressure, and fatigue strength by employing advancements in instrumentation, including high-energy X-rays and high durability strain gages, computers and software to reduce vast amounts of data, increased photoelastic capabilities, and advancements for reproducing loading and environmental conditions in laboratory component tests These experimental techniques and disciplines have continued to advance in both capability and importance, and the state of the art in structural engineering would be significantly reduced without them (Author)

A79-38979 # **Development of a gas turbine combustor dilution zone design analysis** A S Novick, J R Arvin, and R E Quinn (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1194* 11 p. 13 refs

Recent advancements in developing an analytical technique applicable to gas turbine combustion design problems are presented A complex 3-D mathematical model computes the trajectories of a system of dilution jets within a combustor dilution zone and transition section The jet velocity centerline trajectories are obtained as the solution of an approximate differential equation Boundary and initial conditions are factored into the solution in a natural manner, consequently, the interactions of jets with each other and confining walls are included The analytical simulation and solution technique are detailed due to uniqueness of modeling the multi-jet trajectories and interactions in a confined environment Comparisons of the analytical predictions with available experimental data are shown Results illustrating practical combustor flow problems show that significant progress has been made toward the realization of a useful design capability (Author)

A79-38980 * # **Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines** E J Szetela (United Technologies Research Center, East Hartford, Conn.), R P Lehmann (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and A L Smith (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1195* 11 p. 16 refs

An analytical study was conducted to assess the impact of the use of broad specification fuels with reduced hydrogen content on the design, performance, durability, emissions and operational characteristics of combustors for commercial aircraft gas turbine

engines The study was directed at defining necessary design revisions to combustors designed for use of Jet A when such are operated on ERBS (Experimental Referee Broad Specification Fuel) which has a nominal hydrogen content of 12 8 percent as opposed to 13 7 percent in current Jet A The results indicate that improvements in combustor liner cooling, and/or materials, and methods of fuel atomization will be required if the hydrogen content of aircraft gas turbine fuel is decreased (Author)

A79-38981 * # **Test verification of a turbofan partial swirl afterburner** K J Hanloser (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) and R Cullom (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1199* 6 p 6 refs

Flamespreading velocities exceeding conventional turbulent flamespreading values were demonstrated in a strong centrifugal flow field This centrifugal flow field flamespreading concept was integrated into an F100 turbofan engine afterburner by introducing swirling airflow into the afterburner Successful tests were conducted on F100 Engine P072 at sea level and at altitude conditions in a test chamber This paper summarizes the design approach, engine design verification tests and performance data Engine tests showed the swirl afterburner increased fuel-air capability improving combustion stability at adverse conditions for combustion in the engine flight envelope No engine performance or durability degradation was observed (Author)

A79-38982 # **A European view on gas turbine engine monitoring of present and future civil aircraft** S G Danielsson (Scandinavian Airlines System, Stockholm, Sweden) and G Dienger (Lufthansa, Hamburg, West Germany) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1200* 9 p 7 refs

The engine condition monitoring (ECM) approaches currently in use for wide bodied aircraft by SAS and Lufthansa are compared Technical requirements for expanded ECM systems planned for introduction with the AIRBUS A310 (Lufthansa) and the AIRBUS A300B4 (SAS) are outlined The new systems will incorporate an engine module condition monitoring system which will allow assessment of actual module performance deterioration and degree of restoration required Expanded engine instrumentation and ACMS type data acquisition and recording equipment on board the aircraft will be required The software for ground-based data processing will feature engine module performance analysis, trending logic for engine and module parameters, combination of trend data with other ECM relevant information (maintenance actions, crew reports, engine history including test cell data), automatic flagging of suspicious units, and real time processing C K D

A79-38983 # **Fault-tolerant, high reliability electronic engine control system** V G Mosca, C Rabinowitz, and H Kreamer (United Technologies Corp , Electronic Systems Dept , Windsor Locks, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1202* 9 p 9 refs Contract No F33615-77 C-2055

The paper introduces and applies the principles of redundancy management techniques to the design of highly reliable fault-tolerant electronic engine controls The evaluation starts with a baseline electronic final control system design The baseline system is then altered to evaluate the benefit of successive applications of redundancy management techniques such as selective triple redundancy, majority voting, fault coverage, built-in test, and reliability mathematical modeling methods These trends and methods used in fly-by-wire system reliability are evaluated for applicability to fuel controls An optimum mix of MTBP, safety, and hardware complexity can be achieved through application of selected dual and triple redundancy at the functional modular level with a high-degree of software cross-strapping S D

A79-38984 * # **Application of digital controls on the quiet clean short haul experimental engines** A A Saunders, Jr (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) and A C Hoffman (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1203* 8 p 6 refs Contract No NAS3-18021

The digital control systems for the Under-the-Wing (UTW) and Over the-Wing (OTW) engines developed on the NASA/General Electric Quiet Clean Shorthaul Experimental Engine (QCSEE) program are described The system to control engine variables includes three major functional parts system sensors, digital control and system actuators One of the primary control system functions is to prevent the engine from exceeding speed or temperature limits The UTW control system also provides fault detection and condition monitoring The control system requirements for the OTW engine are essentially the same as the UTW engine, however the inlet Mach number control requirement is eliminated, and failure indication and corrective action and full authority digital control are added The digital controls scheduled the engine variables and maintained engine operation within all physical limits throughout the test program of approximately 200 hours of operation and provided stable and accurate control of both engines V T

A79-38991 # **The application of rapid solidification rate superalloys to radial wafer turbine blades** D B George, B T Brown, and A R Cox (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1226* 9 p 6 refs Contract No N00019-76 C-0552 ARPA Order 3152

The implementation of rapid-solidification rate (RSR) powder process alloy technology is expected to provide significant improvements in future advanced gas turbine engines The paper describes separately the technologies of RSR powder process materials and wafer cooling The synergistic combination of these two technologies is then reviewed in conjunction with a development plan devised to implement this technology in engines of the future It is shown that the high-temperature capabilities of radial wafer blades fabricated from the RSR powder process material makes them well suited to an advanced engine design S D

A79-38992 # **Partially variable area turbine nozzle** R H Andersen and R C Haubert (General Electric Co , Evendale, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1227* 9 p Research supported by the General Electric Co , Contracts No F33657-76-C-0213, No F33657-72 C-0206

The concept of the partially variable turbine nozzle is described, with special emphasis on design evaluation The evaluation program is discussed relative to air turbine rig tests, turbine blade stress effects and Fourier analysis, and engine testing For structural reasons, the partially variable turbine nozzle is a segmented design where three-vane sectors containing one variable vane each are used together with fixed two-vane sectors which fill out the nozzle It is shown that the partially variable turbine nozzle concept exhibits superior performance to the fully variable design because of reduced end-wall leakage S D

A79-38993 # **Engine demonstration test of a cooled laminated axial turbine** R W Vershure, Jr (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1229* 8 p Contract No F33615-76-C 2176

The first successful engine demonstration test of a cooled laminated axial turbine rotor is described A small integral turbine rotor was constructed with a unique fabrication method - the laminate process - which uses precision photoetched laminates bonded together to form a complete rotor The results of the rotor

component tests which led up to the engine test are discussed These component tests included material property data, NDE, overspeed, airflow, and blade vibration testing A 20 hour engine test was then conducted which demonstrated the mechanical integrity of a laminated turbine rotor Using an advanced optical pyrometer system, repeatable blade-to blade metal temperatures were recorded A close correlation was achieved between the measured blade cooling effectiveness and the predicted cooling effectiveness, 0 52 and 0 53 respectively This demonstration test showed that a very high heat-transfer performance is possible in small turbine engines using the laminate process (Author)

A79-38994 # **The monorotor gas turbine** C Rodgers *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1230* 10 p 6 refs

A monorotor gas turbine demonstrated both performance and endurance in a modified auxiliary power unit This unit featured a single-stage radial compressor and turbine integrated back to-back in a single casting Continuing development of the monorotor concept shows that, in addition to offering moderately high turbine inlet temperature capability without sophisticated internal air cooling, both manufacturing and life cycle costs can be significantly decreased This is a consequence of the extremely simple engine powerhead configuration which comprises the monorotor and integral shaft forming a single-mass, highly stable rotor assembly, single-piece compressor diffuser, turbine nozzle monostator assembly, inlet housing, and axial reverse flow combustor A second candidate aircraft application of the monorotor gas turbine concept appears to be in small, expendable, low cost, remote, pilotless vehicles This paper describes the development of a small monorotor gas turbine and examines its potential for increased cost savings both in manufacturing and operation (Author)

A79-38995 # **The role of three-dimensional flow analysis in the design of turbomachinery** K D Mach (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1231* 5 p 12 refs

The flow fields in turbomachinery, particularly in the turbines of gas turbine engines, are known to be the most complex The paper examines the current status or three-dimensional flow analysis as applied to turbomachinery Some typical results of a pertinent algorithm are presented The computational environment is much less restrictive than in the past, and computer results are almost always quicker to obtain than test results The probable course of future developments and their impact on the design of turbomachinery are discussed Combined numerical and experimental investigations of flow fields are recommended, with three-dimensional flow analysis to become an everyday design tool and a partial substitute for testing S D

A79-38996 # **Factors influencing nacelle design on the 747** M I K MacKinnon and B K Mehta (Boeing Commercial Airplane Co , Seattle, Wash) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1236* 9 p 7 refs

The paper briefly reviews the factors that have influenced nacelle design on the 747 airplane Currently available power plant installations for General Electric, Pratt and Whitney and Rolls-Royce engines are examined and compared Performance improvements for these existing nacelle types are discussed The possibilities for future nacelle developments on the 747 are outlined, including the use of power plant packages being developed for new airplanes, and advanced nacelle concepts such as long duct forced mixer nozzles and structurally integrated nacelles (Author)

A79-38997 # **Ignition of liquid fuel jets in a supersonic air stream** J A Schetz, S C Cannon (Virginia Polytechnic Institute and State University, Blacksburg, Va), and S Baranovsky *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1238* 11 p 15 refs

Water, kerosene and carbon disulfide were injected both transverse (90 deg) and oblique-upstream (45 deg) with respect to a hot supersonic (M = 1 65) vitiated air flow at various stagnation temperatures and injection pressures (and hence flow rates and momentum ratios) Attention is given to the behavior of the liquid fuel layer that had previously been found to form on the surface near the injector Results of wall and in-stream temperature measurements and photographic records in both the visible and infrared wavelength spectra are discussed For transverse injection at air temperatures up to 2260 F, little evidence of combustion is found for either kerosene or CS2, and the liquid layer is not expected to change radically in character with change in temperature For the oblique-stream injection, ignition occurred for CS2 at stagnation temperatures not less than 2030 F and possibly for kerosene S D

A79-39010 # **Project Sunrise** R J Boucher (Astro Flight, Inc , Venice, Calif) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1264* 6 p ARPA USAF sponsored research

The solar powered aircraft Sunrise is described, with special emphasis on the flight demonstration program, design features of the Sunrise air vehicle, aerodynamic configuration, airframe, solar power subsystem, propulsion subsystem, and flight envelope Calculated and measured performance are given The Sunrise Program demonstrated the feasibility of solar-powered flight Ways of harnessing the unique behavior and attributes of these solar-powered vehicles are now being explored S D

A79-39011 # **Electric propulsion for high performance light aircraft** A D Galbraith (Continental Group, Inc , Palo Alto, Calif) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1265* 10 p

An actual design example is presented for application to a representative light aircraft on the basis that its performance must match that of the gasoline engine drive train which is replaced Attention is given to concept description and analysis, derivation of requirements and design layout, lithium-aqueous electrolyte fuel cell, lithium recycling, metallic lithium as a fuel, propulsion motor and associated controls, and growth potential of the technology It is shown that a representative high-performance single engine airplane can be powered by an electric drive train which produces power, duration, and weight equal or comparable to a gasoline powerplant, utilizing current state-of the-art devices The resulting performance of the electric powered aircraft is comparable to turboprop aircraft and is independent of atmospheric air density, with the consequent advantages of high-altitude operation, speed, range, and weather avoidance S D

A79-39012 # **Small hole drilling and inspection with pulsed laser systems** A U Jollis (General Electric Co , Aircraft Engine Business Group, Cincinnati, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1268* 7 p

Advances in laser technology are described which have led to the development of methods and equipment for drilling and inspecting small holes in air-cooled aircraft engine structures These structures are made from high temperature alloys and incorporate cooling circuits which are comprised of small holes with large depth-to-diameter ratios The drill technique discussed in this paper utilizes solid state lasers while a scanning Helium/Neon laser beam is employed to inspect the holes between drill cycles The laser devices are combined with numerically controlled positioning tables and other auxiliary equipment to form automated laser drill and inspection machines for production application Process capabilities and equipment construction are reviewed and examples of drill operation are given (Author)

A79-39013 # **Advanced forging process for gas turbine engine fan blades** C R Cook (TRW, Inc , Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1269* 5 p 5 refs Contract No F33615-77-C-5002

Titanium 8Al-1Mo-1V alloy fan blades for the F100 engine have been precision forged using the isothermal forging process Forgings have been produced with dies operating at 1750 deg plus or minus 20 F The IN100 alloy forging dies accomplished 595 pressing operations without damage to the airfoil surfaces Form and thickness control of the blades was maintained well below tolerances required Metallurgical characteristics of the forgings were entirely acceptable Reduced material requirements and less machining for finishing result in lower manufacturing costs Blades are being evaluated for engine qualification (Author)

A79-39017 # **Methodology for prediction of V/STOL propulsion induced forces in ground effect** W H Foley (General Dynamics Corp , Aerospace Technology Dept , Fort Worth, Tex) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1281* 8 p 15 refs Navy-sponsored research

The paper presents the development of an empirical method to calculate the pure suckdown component of the forces acting on the planform of a hovering V/STOL aircraft The point of departure for the predictive methodology is the work of Karemaa et al (1973, 1978) wherein the net-induced force upon a planform is divided into three parts While examination of the diagrams for the effect of eddy size on suckdown and the effect of nozzle pressure ratio on suckdown indicates that turbulence can cause changes in suckdown on the order of 20%, it must be recognized that the net force also includes fountain buoyancy, which can be of the same order as suckdown but of opposite sign Thus, net force is determined as the difference between two relatively large numbers In this context, a second-order change in either of these numbers can result in a first-order change in aircraft performance It remains to work out a methodology for the prediction of fountain buoyancy and of the interference between the fountain and suckdown S D

A79-39018 # **The impact of operational requirements on V/STOL propulsion concept selection** W R Boruff and A J Roch, Jr (Vought Corp , Dallas, Tex) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18 20, 1979, AIAA Paper 79-1283* 9 p 10 refs

In recent years a wide variety of V/STOL propulsion concepts have been advanced as ways to perform vertical takeoff and landing This paper presents results of a recent Vought study that examines four supersonic V/STOL propulsion concepts Aircraft sized to common design criteria and missions are compared for three lift/cruise concepts and one lift plus lift/cruise concept Both fighter escort and deck launched intercept mission requirements are considered Sizing constraints include acceleration capability, sustained load factor, ceiling, maximum speed, specific excess power, vertical takeoff thrust to weight, and engine-out thrust-to-weight Results emphasize the importance of well founded operational requirements An engine-out vertical landing requirement is shown to be an important design driver Each propulsion system concept is sized by a different combination of mission and performance constraints, and each concept demonstrates a different sensitivity to variations in these requirements (Author)

A79-39019 # **V/STOL aircraft configuration effects on exhaust gas ingestion** E D Spong, J H Kamman, C L Hall, and E T Seiffertt (McDonnell Aircraft Co , St Louis, Mo) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1284* 8 p 7 refs

A test program was conducted to investigate thermal flowfield properties and inlet system ingestion characteristics for three- and four-nozzle V/STOL aircraft configurations, utilizing a planform model The results indicate strong configuration effects on ingestion and the necessity for careful nozzle simulation Potential methods of reducing ingestion are identified, which can be applied either in the design stage through optimum configuration arrangement or subsequent to configuration selection through shielding devices It is further demonstrated that thermal flowfield data acquired in the free jet, fountain and stagnation upwash regions can be used to understand the ingestion characteristics (Author)

A79-39020 * # **Static test of a large scale swivel nozzle thrust deflector** J F Federspiel (Rockwell International Corp , Columbus, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1285* 9 p 6 refs NASA supported research

Experimental results from a swivel nozzle thrust deflector test program are presented The deflector was installed behind a 36-inch fan with a tip turbine hot gas drive The maximum nozzle pressure ratio was 1 2 Nozzle thrust and flow coefficients are presented for a range of vectoring angles The results are also compared to small scale cold flow test results The comparison suggests a need for accurate simulation of nozzle entry pressure and temperature profiles on model tests (Author)

A79-39027 # **Evaluation of ground-launch firings for the improved 2 75-inch rocket** D M Bergbauer, J H Ferguson (U S Naval Ordnance Station, Indian Head, Md), R W Bergman (U S Army, Missile Research and Development Command, Redstone Arsenal, Ala), and R Bentley (Veda, Inc , Arlington, Va) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1297* 9 p

An improved 2 75-inch rocket, the Mk 66 Mod O, was developed by the Navy in the early 1970s Test results are presented for ground-launch firings of various modified designs Because of the variety and large amount of test data, summary information is presented For illustration, some specific data that are representative of rocket performance are included impact dispersion, spin rates, and burnout velocities Results indicate improved dispersion with increased roll rate at launcher separation Future plans for continued evaluation are briefly outlined S D

A79-39031 * # **Combined pressure and temperature distortion effects on internal flow of a turbofan engine** W M Braithwaite and R H Soeder (NASA, Lewis Research Center, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1309* 11 p 13 refs

The flow characteristics obtained experimentally for the compression of a 2-spool TF30-P-3 turbofan engine operating with 180 grad combined pressure and temperature distortion in the inlet flow are presented The analytical model (Mazzawy and Banks, 1976), 'tuned' during Lewis testing, was used for pretest predictions of the effects that these distortions would have on the engine flow characteristics and the limiting distortion values The effect of inlet flow distortion on the performance of the engine is discussed, including (1) the flow between a screen mounted in the inlet duct and the inlet guide vanes, (2) the flow through the compression system, and (3) the effects of the combined distortion and its orientation on the compressor stability limits It is concluded that the model used in this program was capable of predicting the effects of total pressure, total temperature and combined total pressure-total temperature distortions in terms of flow profiles, inlet flow angles and attenuation of the distortions through the compressor system It was also capable of predicting the trends of the limiting values experienced with various orientations of the combined distortions V T

A79-39032 # **What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions** E E Cohen (Hughes Helicopters, Culver City, Calif) *AIAA, SAE, and*

ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1314 7 p

It is argued that today's small turbine engines do not meet the requirements of small helicopters as well as does the turbocharged piston engine It is suggested that in developing advanced turbine engines for small helicopters, engine weight (unless it reduces the weight of the fuel system plus fuel) should be subordinate to other design considerations such as reduced fuel consumption, improved altitude performance, improved environmental acceptability, and increased engine reliability and maintainability The specific fuel requirements of small turbine and piston engines are compared, growth trends in demand for small rotocraft are presented C K D

A79-39033 # **Effect of maintenance plan and engine durability on helicopter propulsion system ownership cost** C E Curry and A C Wei (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1317* 6 p

Relative cost of ownership trade-offs between modular and nonmodular engine maintenance plans were evaluated The relative gain/loss of operational availability resulting from scheduled and unscheduled engine removals for various levels of engine maximum operating time were analyzed over a range of premature removal rates from 0 2 to 1 0 removals per thousand engine operating hours Conclusions were drawn suggesting that helicopter operators could select an operating parameter set that would tend to minimize their engine-ownership costs, which were shown to be significant cost elements in their total helicopter ownership cost (Author)

A79-39034 * # **Lean, premixed, prevaporized combustion for aircraft gas turbine engines** E J Mularz (NASA, Lewis Research Center, U S Army, Propulsion Laboratory, Cleveland, Ohio) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1318* 13 p 24 refs

The application of lean, premixed, prevaporized combustion to aircraft gas turbine engine systems can result in benefits in terms of superior combustion performance, improved combustor and turbine durability, and environmentally acceptable pollutant emissions Lean, premixed, prevaporized combustion is particularly attractive for reducing the oxides of nitrogen emissions during high altitude cruise The NASA Stratospheric Cruise Emission Reduction Program will evolve and demonstrate lean, premixed, prevaporized combustion technology for aircraft engines This multiphased program is described In addition, the various elements of the Fundamental Studies Phase of the program are reviewed, and results to date of many of these studies are summarized (Author)

A79-39035 * # **Lean stability augmentation for premixing, prevaporizing combustors** J B McVey and J B Kennedy (United Technologies Research Center, East Hartford, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1319* 12 p 5 refs Contract No NAS3-20804

An experimental program was conducted to investigate techniques for improving the lean combustion limits of premixing, prevaporizing combustors applicable to gas turbine engine main burners Augmented flameholders employing recessed perforated plates, catalyzed tube bundles, and configurations in which pilot fuel was injected into the wakes of V-gutters or perforated plates were designed and tested Stable operation of the piloted designs was achieved at equivalence ratios as low as 0 25, NOx emissions of less than 1 0 g/kg at simulated turbine engine cruise conditions were obtained A piloted perforated plate employing four percent pilot fuel flow produced the best performance while meeting severe NOx constraints (Author)

A79-39037 * # **The effect of fuel sprays on emissions from a gas turbine combustor** J A Nicholls, C W Kauffman, D G Pelaccio, D R Glass, and J F Driscoll (Michigan, University, Ann Arbor, Mich) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1321* 8 p 10 refs Grant No NsG-3148

A research gas turbine combustor which allows for independent control of drop size, fuel/air ratio, air inlet temperature, pressure, reference velocity, and residence time has been used to study the influence of fuel spray characteristics on primary zone emissions Local concentrations of oxides of nitrogen, carbon monoxide and unburned hydrocarbons at various locations in the flow, local gas temperature, gas velocity, and the turbulence intensity (measured with laser velocimetry) are obtained A comprehensive data analysis program to compute the local fuel/air ratio and the sum of the mole fractions of the species present confirms the validity of the emissions data Increasing drop size is correlated with an increase in unburned hydrocarbons, while increasing residence time is associated with sharp decreases in hydrocarbons and carbon monoxide and an increase in oxides of nitrogen J M B

A79-39038 * # **Emission characteristics of a premix combustor fueled with a simulated partial-oxidation product gas** R M Clayton (California Institute of Technology, Jet Propulsion Laboratory, Control and Energy Div , Pasadena, Calif) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1322* 8 p 5 refs Contract No NAS7-100

A two-stage gas turbine combustor concept employing a very fuel-rich partial oxidation stage is being explored for broadening the combustion margin between ultralow emissions and the lean stability limit Combustion and emission results are presented for a series of experiments where a simulated partial oxidation product gas was used in a premix combustor operated with inlet air state conditions typical of cruise power for high-performance aviation engines (12 atm and 850 F) Ultralow NOx, CO, and HC emissions and an extended lean burning limit were achieved simultaneously (Author)

A79-39047 # **The application of the Prop-Fan concept in preliminary design of a very advanced technology light twin /VATLIT '85/** F M W A Grosveld (Kansas, University, Lawrence, Kan) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1343* 13 p 12 refs

Design analysis for propeller and nacelle have been accomplished for application in preliminary design of a very advanced light twin engine airplane, using the uninstalled efficiency as a criterion The project engine is based on a prediction of the performance of a turbo-engine which could fit in the Prop-Fan concept The computerized procedure is based on the thermodynamic relations of the gas turbine and optimized for operations at high subsonic Mach number and at high altitude Results are presented which indicate significant improvement in installed propeller efficiency and specific fuel consumption, at performance comparable to that of a jet airplane (Author)

A79-39048 # **A streamlined control system development process** C H Borgmeyer (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1344* 7 p

The software development, the physical facilities and the engineering technology required for an advanced logic capability with full authority electronic control system in high reliability and performance multimission aircraft are described The need for increased use of simulations, the application of system identification methodology to update simulations, and techniques for fault analysis and logic verification are discussed It was found that the basic control design/development process can be improved by using multi-variable control techniques as a control mode design tool to quantify variable interactions, by expanding existing control logic technology into adaptive systems, redundancy management, and

fault accomodation, by upgrading the accuracy of existing simulations, developing an automated system identification procedures to review engine and rig data, and using a specific control development/integration facility to test complete or partial systems in open or closed loop This approach will enhance mission reliability since fault detection and fail operational procedures can be developed and engine life management modes designed and test verified for the expected variations in engine performance and design margin A T

A79-39059 # **Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts** K Ishihara (Kawasaki Heavy Industries, Ltd , Akashi, Japan) and M Funakawa (Okayama College of Science, Okayama, Japan) *JSME Bulletin*, vol 22, Apr 1979, p 529 536 7 refs

Lift fluctuations of a cambered blade with angle of attack under periodic gusts with nonuniform amplitude were studied by using vortex theory under the assumption that the gust amplitude on an airfoil varies linearly It was clarified that the nonuniformity of gust amplitude has a strong effect on fluctuating lift for small reduced frequency but does not for large reduced frequency (Author)

A79-39070 Installation for studying fatigue strength of materials in acoustic loading V A Kuz'menko, Iu M Golovanev, and L E Matokhniuk (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti*, Sept 1978, p 103, 104) *Strength of Materials*, vol 10, no 9, May 1979, p 1098, 1099 Translation

During flight, aircraft skins are subjected to intense acoustic fields from engine noise, breaks in the air flow, etc A facility was constructed to study the fatigue strength of aircraft structural materials and to determine the fatigue crack propagation velocity under acoustic loading The facility consists of a high intensity sound source, an air siren capable of generating both sinusoidal and broadband sound Photographs of siren noise spectra at constant and variable rotor speeds are presented B J

A79-39071 Method of determining non-steady-state force characteristics and flywheel effect of turbine blades from the streamflow pattern A V Dunaev *(Problemy Prochnosti*, Sept 1978, p 105, 106) *Strength of Materials*, vol 10, no 9, May 1979, p 1100-1102 5 refs Translation

The paper describes the AD-3 facility, a closed water tunnel with a working-part cross section of 140 x 80 mm, a maximum flow speed of 10 m/sec, and a total tunnel capacity of 0 7 cu m The facility has been developed for investigating load characteristics associated with unsteady flow past plane cascades of vibrating blades, taking into account inlet flow pulsations and flow viscosity (with and without flow separation) The facility permits simultaneous investigation of hydrodynamic damping and streamflow patterns in separated flow B J

A79-39088 # **Aeroelastic models for cryogenic wind tunnels** A Gravelle (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(Symposium on Cryogenic Wind Tunnels, Southampton, England, Apr 3-5, 1979) ONERA, TP* no 1979-39, 1979 6 p

The application of Mach and Froude similarity rules to cryogenic wind tunnel testing of aeroelastic models is examined It is shown that when stagnation temperatures are low and can be varied over a wide range, it is possible to obtain reasonable values for static loads and Reynolds numbers with flutter models The scaling of models of the Airbus A300B and the F1 fighter for testing in a S2 MA wind tunnel is discussed and compared with possible scalings of similar models for testing in a cryogenic facility C K D

A79-39089 # **Balance and sting design for cryogenic wind tunnels** M Bazin and M Dubois (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(Symposium on Cryogenic Wind Tunnels, Southampton, England, Apr 3-5, 1979) ONERA, TP* no 1979-40, 1979 9 p 15 refs

The paper deals with the problem of allowing for thermodynamic effects in the design and construction of aerodynamic balances and supporting rods (stings) of models in cryogenic wind tunnels The need for new solutions is demonstrated Particular attention is given to the development of metals and insulating materials capable of sustaining stresses and thermal gradients at wind tunnel temperatures between 100 and 300 K V P

A79-39090 # **Method of assessment of the antistatic protection of aircraft** J Taillet (ONERA, Châtillon-sous-Bagneux, Hauts-de Seine, France) *(Conference on Electrostatics, Oxford, England, Apr 17-20, 1979) ONERA, TP* no 1979-41, 1979 16 p 9 refs Research sponsored by the Direction des Recherches, Etudes et Techniques and Avions Marcel-Dassault-Breguet Aviation

The solutions proposed by ONERA to meet the requirements of a safe antistatic protection of aircraft are outlined A procedure is presented for testing the vulnerability of a protected or unprotected aircraft to static charging, as well as for assessing the validity of the methods used for this protection The performance of pertinent instruments is discussed A practical application is treated in some detail Careful application of the test procedure is expected to increase the reliability of navigation/communication subsystems in operational use S D

A79-39092 # **Contribution to the development of motor emission regulations (Contribution a la mise au point de la réglementation des émissions des moteurs)** M Pianko *(Groupe Sectoriel Franco-Soviétique, Sous-Groupe Effets du Transport Aérien sur l'Environnement, Réunion, 2nd, Moscow, USSR, Apr 25-29, 1979) ONERA, TP* no 1979 43, 1979 52 p In French

Methods used by the International Civil Aviation Organization to develop emissions standards for aircraft engines are discussed Attention is given to the approach used to establish acceptable limits for gaseous pollutants (NOx, CO, HC) within the context of a commonly accessible level of technology and to the problem of verifying conformity of individual engines or of engine types Two statistical hypotheses for certification tests are examined The first requires that the average engine of a given type satisfy emission limits the second requires that the vast majority (95 percent) of engines of a given type conform to emissions limits The implications for verification procedures of the choice of one or the other of these hypotheses, the conditions of the choice of test specimens (random choice or selection), and the presence or absence of a known value for the average deviation from emissions standards are analyzed C K D

A79-39093 # **A study of the evolution of noise exposure under different hypotheses of regulation (Etude de l'evolution de l'exposition au bruit sous diverses hypothèses reglementaires)** M Pianko *(Groupe Sectoriel Franco-Soviétique, Sous-Groupe Effects du Transport Aerien sur l'Environnement, Reunion, 2nd, Moscow, USSR, Apr 25-29, 1979) ONERA, TP* no 1979 44, 1979 60 p In French

The evolution of noise exposure around a small (two runways of 3600 m) airport as a function of time between 1990 and 2000 has been analyzed for two different regulatory scenarios the absence of any new noise regulations and progressive adaptation of aircraft types to a set of regulations given elsewhere The evolution of a representative fleet of long-, medium , and short range carriers was considered Noise curves for each aircraft at take-off and landing were calculated C K D

A79-39094 # **Broad-band ultrasonic transducers for non-destructive inspection of aeronautical components (Transducteurs ultrasonores à large bande pour le contrôle non destructif de pièces aéronautiques)** J -F de Belleval (ONERA, Châtillon-sous Bagneux, Hauts de-Seine, Compiègne Universite de Technologie, Compiegne,

France) *(NATO, AGARD, Meeting on Non-Destructive Inspection Methods for Propulsion Systems and Components, London, England and Milan, Italy, Apr 23-27, 1979) ONERA, TP* no 1979-45, 1979 11 p 8 refs In French

The method generally used to increase the bandwidth of piezoelectric transducers used in ultrasonic non-destructive inspection of aeronautical components, based on damping of the piezoelectric wafer on its rear face, entails a significant loss of sensitivity It is suggested that bandwidth could be increased and sensitivity improved by damping with a multilayer front face A computer program has been developed to analyze the propagation of a wave through several layers of different thicknesses and optimize the impedence and thickness of layers composing the transducer These results were confirmed by comparison with the responses measured for transducers having front faces composed of one or two layers

C K D

A79-39095 # **Experimental analysis methods for unsteady flows in turbomachines (Méthodes d'analyse expérimentale des ecoulements instationnaires dans les turbomachines)** R Larguier (ONERA, Châtillon sous Bagneux, Hauts de Seine, France) *(Association Technique Maritime et Aéronautique, Session, Paris, France, May 14-17, 1979) ONERA, TP* no 1979 59, 1979 25 p 29 refs In French Research supported by the Direction des Recherches, Etudes et Techniques

Measurement methods are described for characterizing unsteady flows in turbomachines They primarily concern the flow in a rotor, its wake, and boundary layers on stator or rotor blades The measuring instruments are pressure sensors or short time pressure detectors, hot-wire probes or hot film gages, and laser velocimeters For the flow aligned with the rotor, the analysis of pressure variations on the casing enables one to determine the shock wave configuration on supersonic compressor rotors, and to study the flow pattern in the presence of rotating separation For the rotor wake, the results agree with measurements by ordinary pressure sensors connected to the rotor The unsteady nature of the boundary layer on a stator or rotor blade is determined with hot wire probes or hot-film gages

S D

A79-39096 # **Estimation of compressible flows in turbomachines by an axisymmetric calculation method (Approche des écoulements compressibles dans les turbomachines par une méthode de calcul axisymétrique)** R Sovrano and Y Ribaud (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(Association Technique Maritime et Aéronautique, Session, Paris, France, May 14-17, 1979.) ONERA, TP* no 1979-60, 1979 16 p 6 refs In French Research supported by the Direction des Recherches, Etudes et Techniques

A matrix inversion method which allows extension of the symmetric flow approximation widely used for perfect fluids in nearly axial flow turbomachines to non-axial turbomachines (principally centrifugal compressors) is presented The proposed method can be used to analyze flow through turbomachines with widely varying geometries, and takes into account flow irreversibilities due to a possible off-design attack of the blades and friction losses in the blade channels As long as the Mach number is less than unity during all iterations, computation time is short The program converges rapidly even if local Mach numbers are greater than unity at a few points Results obtained by application of the method to a centrifugal compressor with splitter vanes are presented

C K D

A79-39500 **Application of Laser Doppler Anemometry to aeroacoustic research** J Haertig (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France) In Dynamic measurements in unsteady flows, Proceedings of the Dynamic Flow Conference, Marseille, France, September 11 14, 1978 and Baltimore, Md , September 18 21, 1978 Skovlunde, Denmark, Proceedings of the Dynamic Flow Conference 1978, 1979, p 535-549 13 refs

Experiments performed by Institut Franco-Allemand de Recherches de Saint-Louis (ISL) in the framework of an investigation of jet noise were conducted on a cold jet at relatively high velocities which, without attaining those of real engine jets, are not very far below The cold round free jet facilities of ISL and the Laser Doppler Anemometry (LDA) system are described Consideration is given to causality correlation measurement with results agreeing with those obtained at lower jet exit velocities, and to the relation of velocity field coherence with sound radiated by a free jet A large increase in coherence of the velocity field with higher excitation level was observed and it is noted that the convection velocity of these coherent structures is independent of the excitation Attention is given to a resonance in transonic jets, concluding that the method used in the experiments gives reliable data without disturbing the flow or the acoustic fields

V T

A79-39602 * **Satellite interferometer as an advanced navigation/communication system** G S Gopalapillai, G T Ruck, and A G Mourad (Battelle Columbus Laboratories, Columbus, Ohio) *Navigation,* vol 25, Winter 1978-79, p 405 418 10 refs Contract No NASw-2800 NASA Task 3

An orthogonal system of interferometry baselines aboard a geostationary satellite is proposed to be used for navigation, surveillance, and traffic control Position determination is based on the relationship between the measured phase differences, the known and unknown transmitter locations, and other systematic error model parameters using a generalized least squares estimation procedure It is shown that position accuracy is critically dependent on the baseline length and on the magnitude of the random component of the measuring errors Several trade-offs with respect to the system accuracies, the number of users, data rates, hardware costs, etc , are examined Simultaneous use of the same channels for navigation and data transfer is found feasible and five candidate or 'strawman' interferometer system proposals are presented It is concluded that the system's performance is excellent in comparison with present or planned systems, and that it is viable in meeting potential user's requirements

M E P

A79-39751 # **Vortex-induced oscillations - A selective review** T Sarpkaya (U S Naval Postgraduate School, Monterey, Calif) *ASME, Transactions, Journal of Applied Mechanics,* vol 46, June 1979, p 241 258 134 refs NSF-Navy-supported research

This paper reviews the vortex-induced oscillations in a few specific fundamental cases Research topics discussed are vortex shedding from a stationary bluff body, consequences of the synchronization phenomenon, wake-oscillator models, added mass, damping, and dynamic response measurements, flow-field models and the discrete-vortex method, mechanism of synchronization, and, finally, in-line oscillations Because of the selective nature of the review, a fairly comprehensive listing of recent contributions to the literature on these and related aspects of flow-induced oscillations research is an essential part of the exposition

(Author)

A79-39801 * # **Tone noise of three supersonic helical tip speed propellers in a wind tunnel** J H Dittmar, R J Jeracki, and B J Blaha (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 97th, Cambridge, Mass , June 11-15, 1979, Paper* 62 p 7 refs

Three eight bladed supersonic helical tip speed propellers were tested in the NASA Lewis Wind Tunnel at through flow Mach numbers of 0 6, 0 7, 0 75, 0 8, and 0 85 Such propellers are being considered as propulsors for a future energy conservative aircraft

The three propellers of equal performance incorporate different plan forms and different amounts of sweep in order to investigate their noise generation, which could cause a cabin environment problem The acoustically designed propeller SR-3 had 45 deg of tip sweep and was significantly quieter at Mach 0 8 cruise than the straight bladed propeller, SR-2 An intermediate 30 deg tip sweep propeller, SR 1m exhibited a noise level between the other two Enhanced pressure-time traces indicated that SR-2 and SR 1m exhibited shock-like pressure traces at Mach-0 8 cruise while the SR-3 did not Noise trends with varying helical tip Mach number and blade loading were also observed M E P

A79-39802 * # **Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics** D Groesbeck and U von Glahn (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 97th, Cambridge, Mass , June 11-15, 1979, Paper* 29 p 5 refs

The effects on acoustic characteristics of nozzle type and location on a wing for STOL engine over-the-wing configurations are assessed at full scale on the basis of model scale data Three types of nozzle configurations are evaluated a circular nozzle with external deflector mounted above the wing, a slot nozzle with external deflector mounted on the wing and a slot nozzle mounted on the wing Nozzle exhaust plane locations with respect to the wing leading edge are varied from 10 to 46 percent chord (flaps retracted) with flap angles of 20 deg (take-off attitude) and 60 deg (approach attitude) Perceived noise levels (PNL) are calculated as a function of flyover distance at 152 m altitude From these plots, static EPNL values, defined as flyover relative noise levels, are calculated and plotted as a function of lift and thrust ratios From such plots the acoustic benefits attributable to variations in nozzle/deflector/wing geometry at full scale are assessed for equal aerodynamic performance (Author)

A79-39803 * # **An improved method for predicting the effects of flight on jet mixing noise** J R Stone (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 97th, Cambridge, Mass , June 11-15, 1979, Paper* 26 p 20 refs

A method for predicting the effects of flight on jet mixing noise has been developed on the basis of the jet noise theory of Ffowcs-Williams (1963) and data derived from model-jet/free-jet simulated flight tests Predicted and experimental values are compared for the J85 turbojet engine on the Bertin Aerotrain, the low-bypass refanned JT8D engine on a DC 9, and the high-bypass JT9D engine on a DC-10 Over the jet velocity range from 280 to 680 m/sec, the predictions show a standard deviation of 1 5 dB J M B

A79-39804 * # ***Materials and structural aspects of advanced gas-turbine helicopter engines*** J C Freche (NASA, Lewis Research Center, Cleveland, Ohio) and J Acurio (U S Army, Propulsion Laboratory, Cleveland, Ohio) *Association Aéronautique et Astronautique de France, International Congress in Aeronautics, Paris, France, June 6-8, 1979, Paper* 63 p 122 refs

Advances in materials, coatings, turbine cooling technology, structural and design concepts, and component life prediction of helicopter gas-turbine-engine components are presented Stationary parts including the inlet particle separator, the front frame, rotor tip seals, vanes and combustors and rotating components - compressor blades, disks, and turbine blades - are discussed Advanced composite materials are considered for the front frame and compressor blades, prealloyed powder superalloys will increase strength and reduce costs of disks, the oxide dispersion strengthened alloys will have 100C higher use temperature in combustors and vanes than conventional superalloys, ceramics will provide the highest use temperature of 1400C for stator vanes and 1370C for turbine blades, and directionally solidified eutectics will afford up to 50C temperature advantage at turbine blade operating conditions Coatings for surface protection at higher surface temperatures and design trends in turbine cooling technology are discussed New analytical methods of life prediction such as strain gage partitioning for high temperature prediction, fatigue life, computerized prediction of oxidation resistance, and advanced techniques for estimating coating life are described A T

A79-39805 * # **Diagnostics of wear in aeronautical systems** L D Wedeven (NASA, Lewis Research Center, Cleveland, Ohio) *American Chemical Society, State-of-the-Art Symposium on Corrosion and Wear, 15th, Washington, D C , June 4-6, 1979, Paper* 4 p 17 refs

The use of appropriate diagnostic tools for aircraft oil wetted components is reviewed, noting that it can reduce direct operating costs through reduced unscheduled maintenance, particularly in helicopter engine and transmission systems where bearing failures are a significant cost factor Engine and transmission wear modes are described, and diagnostic methods for oil and wet particle analysis, the spectrometric oil analysis program, chip detectors, ferrography, in-line oil monitor and radioactive isotope tagging are discussed, noting that they are effective over a limited range of particle sizes but compliment each other if used in parallel Fine filtration can potentially increase time between overhauls, but reduces the effectiveness of conventional oil monitoring techniques so that alternative diagnostic techniques must be used It is concluded that the development of a diagnostic system should be parallel and integral with the development of a mechanical system A T

A79-39814 * # **Multivariable control altitude demonstration on the F100 turbofan engine** B Lehtinen (NASA, Lewis Research Center, Cleveland, Ohio), R L DeHoff (Systems Control, Inc , Palo Alto, Calif), and R D Hackney (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1204* 29 p 16 refs

The control system designed under the Multivariable Control Synthesis (MVCS) program for the F100 turbofan engine is described The MVCS program, applied the linear quadratic regulator (LQR) synthesis methods in the design of a multivariable engine control system to obtain enhanced performance from cross-coupled controls, maximum use of engine variable geometry, and a systematic design procedure that can be applied efficiently to new engine systems Basic components of the control system, a reference value generator for deriving a desired equilibrium state and an approximate control vector, a transition model to produce compatible reference point trajectories during gross transients, gain schedules for producing feedback terms appropriate to the flight condition, and integral switching logic to produce acceptable steady-state performance without engine operating limit exceedance are described and the details of the F100 implementation presented The engine altitude test phase of the MVCS program, and engine responses in a variety of test operating points and power transitions are presented A T

A79-39817 # **Payback period - An engineering cost/benefit method** D E Webb (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1235* 7 p

An aircraft engine cost/benefit analysis method which uses the payback period (ratio of investment to before-tax annual cash savings) as the basic parameter is described The payback period method provides a more accurate assessment of capital costs than does the conventional direct operating cost method, which considers only capital costs due to depreciation The application of payback period analysis to design improvements in the JT8D turbofan engine is presented C K D

A79-39818 * # **Autoignition of hydrogen injected transverse to a supersonic airstream** C R McClinton (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1239* 12 p 13 refs

A parametric study of autoignition characteristics of transverse fuel injector patterns for a hydrogen-fueled, supersonic-combustion ramjet was conducted in direct-connect tests over a range of simulated hypersonic flight conditions Autoignition limits, defined directly by visual observations and indirectly by measured wall pressure and temperature, are compared with a semi-empirical ignition limit model which accounts for first order effects on autoignition It is shown that to initiate combustion in the immediate region of the fuel injector, ignition must occur in the separation region ahead of the fuel jet Autoignition within this separation zone exhibits strong dependence on flow pressure and temperature, injector diameter, local boundary layer energy thickness, wall temperature, and on fluid dynamic interactions with adjacent downstream facing steps (such as inlet isolation steps) Secondary effects are also discussed The empirical model is used to define limits of test temperature, pressure, and scale required for autoignition in a current subscale engine test program (Author)

A79-39819 # **Predicted F100 engine response to circumferential pressure and temperature distortion** W A Walter and M Shaw (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1310* 6 p 5 refs

An analytical compressor flow model was used to investigate the F100(3) engine response to inlet circumferential distortion The response characteristics predicted and the use of these results in planning engine stability tests is presented Engine responses predicted for three different pressure patterns and three different temperature distortion profiles were combined into five distortion cases with the results showing that compression system response to combined pressure and temperature distortion depends upon the relative orientation, the individual amplitude, and circumferential extents of distortions It is concluded that improved engine stability tests can be designed using the Pratt and Whitney analytical distortion model, testing can be reduced by using the analytical model to extrapolate test results, and that analytical predictions are useful in planning engine distortion tests A T

A79-39873 **Dry friction in the aerospace industry (Le frottement sec dans l'industrie aérospatiale)** M Armbruster (Société Nationale Industrielle Aerospatiale, Laboratoire Central, Paris, France) *Revue Française de Mécanique,* 3rd Quarter, 1978, p 5-10 6 refs In French

An overview of applications of dry friction in the aerospace industry is given The characteristics of different dry friction materials, including polymers, metals and inorganics, and solid lubricants are described Three specific applications of dry friction in aerospace technology are examined dry lubricants for bearings used in satellites, dry journal bearings for helicopter blade assemblies, and dry spherical swivels in airplane control surfaces C K D

A79-39889 **The F-16 RIW program** H Balaban, G Harrison (Arinc Research Corp , Annapolis, Md), and D Cuppett (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 79-82 8 refs

The F-16 RIW program is considered to be the most complex warranty procurement to date, involving a multinational logistics cooperative effort Nine avionic line replaceable units (LRUs) are covered by the warranty, the coverage encompassing such elements as guaranteed MTBF, guaranteed turnaround times, and LRU/module-level maintenance This paper summarizes the background of the procurement, the major RIW features, and current issues that will influence the success of the RIW program (Author)

A79-39890 **The operational impact of Navy's first TAAF program** J R Farrell (U S Navy, Naval Material Command, Washington, D C) and H J Kindl (General Electric Co , Aerospace Electronic Systems Dept , Utica, N Y) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 116-120 5 refs

A Test, Analyze, And Fix (TAAF) reliability growth test program was carried out on Logic Unit 4 (LU-4), a part of the data analysis programming group AN/AYA 8 for the P-3C ASW patrol aircraft This device contains 9910 electronic parts and an electromechanical magnetic drum memory The testing involved a total of 2751 operating hours in a MIL-STD-781B Test Level E environment The test duration was determined from MIL-HDBK-217A failure rates and empirical failure rates of microcircuits from AYA-8 field data and the rule that the MTBF expected early in the test program is 10% of the prediction The cumulative MTBF was plotted, and a mean-square fit growth line was obtained with a slope of 0 44, which compares favorably with the planned growth of 0 4 Thirteen corrective actions were also validated by exposing test articles to at least 200 hours of test The testing showed that the equipment should have a MTBF in excess of 930 hours, which has been confirmed by subsequent field data P T H

A79-39893 **CERT technology applied to an airborne radar** H J Caruso, W Silver, D J Cichetti, and D M Kubilus (Westinghouse Product Qualification Laboratory, Baltimore, Md) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 131-135 7 refs

The effectiveness of Combined Environmental Reliability Testing (CERT) is examined, considering the questions of necessary degree of realism, return on investment, test program structure, and Life-Cycle Cost Impact Candidate CERT facility designs are described, noting that complex environmental stress profiles and combinations can be performed with no more facility operators than required for single-environment tests, and existing reliability facilities can be modified to CERT requirements The major advantage of CERT is its simultaneous disclosure of single environment failure modes, improving growth rate and more efficient use of available test time The value of CERT for disclosing synergistic failure modes is unresolved because such failure modes comprise only a small part of the total failure population or they are sensitive to as yet undefined variations in environmental combinations and dynamics It is concluded that the timely use of CERT in program phases or in combination with traditional test methodology can result in development cost reductions and schedule benefits A T

A79-39895 # **The aircraft air conditioner data revisited** H Ascher (U S Navy, Naval Research Laboratory, Washington, D C) and H Feingold (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 153-159 13 refs

Using Proschan's Air Conditioning data as a vehicle, this paper highlights some of the basic dissimilarities between repairable and nonrepairable system concepts Widespread confusion over these concepts has obscured a salient feature of these data - overhaul degraded air conditioners (Author)

A79-39900 **RELSIM-A systems reliability simulation code** E P Schelonka (California, University, Los Alamos, N Mex) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 194-197

A series of simulation programs designated RELSIM has been developed as part of the Los Alamos Scientific Laboratory Nuclear Safeguards Program to provide reliability projections for large interconnected arrays of digital components RELSIM is capable of

simulating the general case of up to several hundred units linked in networks having a full range of tandem and parallel network configuration options, including those with nonidentical components in parallel B J

A79-39912 **Development of in-flight steady-state failure rates** M B Shurman (*Boeing Aerospace Co., Seattle, Wash.*) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 323-325

Two complementary procedures for converting failure rate data to in-flight steady-state failure rates are described In the first approach, handbook-derived abort failure rate data and non-abort reliability data derived from field experience are used to calculate the nominal sortie duration for a given aircraft The second used total failure rate data from handbooks together with average maintenance hours per fix to compute the maintenance manhours per flight hour for unscheduled maintenance The final step in both methods is the calculation of a conversion constant to obtain in-flight steady state failure rates C K D

A79-39914 **Lower avionic temperature - Lower life cycle cost** D E Tuttle and M N Shwartz (Lockheed-California Co., Burbank, Calif.) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 332-337 8 refs Contract No N00163-77-C-0296

Results of a trade-off study evaluating the effects of environmental control system design on the reliability and maintainability of a modular avionics package for a V/STOL Type A aircraft are presented A baseline design offering the lowest total aircraft life cycle cost (LCC) was sought Differences in LCC were determined by summation of subsystem acquisition cost, aircraft gross takeoff weight (GTOW) specific cost, fuel cost, and cost to maintain over the projected life of the aircraft Reliability and weight were found to be driving factors in cost analysis Five environmental control systems were analyzed Minimum LCC was associated with a Freon vapor cycle system using recirculated air to provide component temperatures of 40 to 45 deg C C K D

A79-39915 **Reliability and maintainability contribution to Hornet mission success** R L McGee (McDonnell Douglas Corp., St Louis, Mo.) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 338-341

The development of the weapon system design of the Hornet fighter/attack aircraft to satisfy duel requirements of 3 7 mean flight hours between failures and 0 8 mission completion probability is discussed The impact of the mean flight time between failures requirement on maintainability, availability, and life cycle cost is examined Reliability data for different Hornet subsystems are presented C K D

A79-39919 **RTCA standards - Improved specs and regulations** W C Fuchs (Radio Technical Commission for Aeronautics, Washington, D C) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 381-383

The Radio Technical Commission for Aeronautics (RTCA) develops minimum performance standards for avionics and telecommunications. These standards have been employed as specifications by manufacturers, and have also served as the basis for government regulation of the aviation industry Subjects under consideration by RTCA committees during 1978 included ground proximity warning equipment, emergency locator transmitters, airborne Omega receivers, future civil aviation frequency spectrum requirements, and the role of mean-time-before-failure data in specifying safety standards. J M B

A79-39920 **The effect of endless burn-in on reliability growth projections** A G Bezat and L L Montague (Honeywell, Inc., Avionics Div., St Louis Park, Minn.) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 392-397

Current reliability prediction methods treat solid-state electronics equipment on the basis of a constant failure rate throughout the operating life of the equipment This paper presents an extensive data base (over 19 billion part hours), supported by theory, that shows failure rate of solid state electronics to be a decreasing function with operational age of individual equipment Data is presented in graphical form, including a best fit equation for the data The mechanics of prediction methods are shown, along with examples The entire concept is summarized as a family of growth curves, wherein the applicable curve is dependent upon the design/process maturity of the equipment at the time it is manufactured (Author)

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STAR ENTRIES

N79-23888*# National Aeronautics and Space Administration Langley Research Center Hampton Va
CHARACTERISTICS OF THE ADVANCED SUPERSONIC TECHNOLOGY AST-105-1 CONFIGURED FOR TRANSPACIFIC RANGE WITH PRATT AND WHITNEY AIRCRAFT VARIABLE STREAM CONTROL ENGINES
Hal T Baber Jr Mar 1979 134 p refs
(NASA-TM-78818) Avail NTIS HC A07/MF A01 CSCL 02A

Credence to systems weights and assurance that the noise study AST concept can be balanced were studied Current titanium structural technology is assumed A duct-burning turbofan variable stream control engine (VSCE), with noise reduction potential through use of a coannular nozzle was used With 273 passengers range of the AST-105-1 for a cruise Mach number of 2 62 is essentially transpacific Lift-to-drag ratio is slightly higher than for previous AST configurations It is trimmable over a center-of-gravity range of 4 7m (15 5 ft) Inherent high positive effective dihedral, typical of arrow-wing configurations in high-lift approach would limit AST-105-1 to operating in crosswinds of 11 6 m/sec (22 4 kt) or less with 75 percent of available lateral control Normal power takeoff with cutback results in noise in excess of Federal Aviation Regulation Part 36 but less than for conventional procedure takeoff Results of advanced (noncertificated) programmed throttle takeoff and approach procedures not yet optimized indicate that such can be an important additional method noise reduction S E S

N79-23889*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
THE SCIENCE AND TECHNOLOGY OF LOW SPEED AND MOTORLESS FLIGHT, PART 1
Perry W Hanson comp 1979 299 p refs Conf held at Hampton Va 29-30 Mar 1979 cosponsored by NASA and the Soaring Soc of America
(NASA-CP-2085 L-12973) Avail NTIS HC A13/MF A01 CSCL 02A

The proceedings of the Third International Symposium on the Science and Technology of Low Speed and Motorless Flight are reported Twenty-eight papers were presented in the areas of low speed aerodynamics new materials applications and structural concepts advanced flight instrumentation, sailplane optimal flight techniques and self launching and ultralight glider technology These papers are included in the document along with another paper which was not presented on proposed definitions for various categories of sailplanes and gliders

N79-23890*# Boeing Commercial Airplane Co Seattle Wash
LOW-SPEED SINGLE-ELEMENT AIRFOIL SYNTHESIS
John H McMasters and Michael L Henderson *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 1-31 refs

Avail NTIS HC A13/MF A01 CSCL 01A

The use of recently developed airfoil analysis/design computational tools to clarify enrich and extend the existing experimental data base on low-speed single element airfoils is demonstrated A discussion of the problem of tailoring an airfoil for a specific application at its appropriate Reynolds number is presented This problem is approached by use of inverse (or synthesis) techniques wherein a desirable set of boundary layer characteristics performance objectives and constraints are specified which then leads to derivation of a corresponding viscous flow pressure distribution Examples are presented which demonstrate the synthesis approach following presentation of some historical information and background data which motivate the basic synthesis process G Y

N79-23891*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AN EXPLORATORY INVESTIGATION OF THE EFFECT OF PLASTIC COATING ON THE PROFILE DRAG OF A PRACTICAL-METAL-CONSTRUCTION SAILPLANE AIRFOIL
Dan M Somers *In its* The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 33-64 refs

Avail NTIS HC A13/MF A01 CSCL 01A

An exploratory investigation was performed in the Langley low-turbulence pressure tunnel to determine the effect of a plastic coating on the profile drage of a practical-metal-construction sailplaine airfoil The mode was tested with three surface configurations (1) filled painted and sanded smooth (2) rough bare metal and (3) plastic-coated The investigation was conducted at Reynolds numbers based on airfoil chord of 1 100 000 2 200 000, and 3 300 000 at a constant Mach number of 0 10 The results indicate that at all three Reynolds numbers the order of the drag values of the three surface configurations starting with the highest drag, was filled painted and sanded smooth, rough bare metal and plastic-coated G Y

N79-23892*# Technische Hochschule Darmstadt (West Germany)
OPTIMUM TAIL PLANE DESIGN FOR SAILPLANES
Kay Mayland *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 65-80 refs
Avail NTIS HC A13/MF A01 CSCL 01C

Classical drag equations in a modern version were used to calculate the influence of tail modifications on the drag of a standard class sailplane The profile drag which depends on the Reynolds number is included in the calculations Minimum drag is compared with real drag for two lift coefficients Some results have no clear tendency but low tail area and relatively low tail aspect ratio give some advantages Optimum and real lift ratios between wing and tail plane are compared for the original sailplane G Y

N79-23893*# Stuttgart Univ (West Germany)
THE EFFECT OF DISTURBANCE ON A WING
Richard Eppler *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 81-92 refs
Avail NTIS HC A13/MF A01 CSCL 01A

Disturbances such as flap and aileron hinges and poorly faired spoilers were simulated in a computer wind tunnel The total drag of a single roughness element does not depend only on the size of that element Its position on the wing has a surprisingly strong effect In particular a roughness element on the convex side of a deflected flap or aileron causes a very substantial increase in drag Very few experimental data are available for comparison Good agreement with experiment can be achieved however by adapting a fictive step size The correlation between the real roughness-element size and the drag increase remains to be determined Simple, fundamental experiments are suggested which will allow a theoretical estimation of the drag increase due to roughness elements G Y

N79-23894*# Technische Univ Berlin (West Germany)
GENERATION AND BREAKDOWN OF AERODYNAMIC LIFT PHYSICAL MECHANISM
Wolfgang Liebe *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 93-102 refs
Avail NTIS HC A13/MF A01 CSCL 02A

A contribution is given to an old problem the explantion of the generation of aerodynamic lift Physical models are described which provide a better understanding of the phenomena involved G Y

N79-23895*# Bertelsen Mfg Co , Inc Neponset Ill
INTRODUCTION TO THE ARCOPTER ARC WING AND THE BERTELSEN EFFECT FOR POSITIVE PITCH STABILITY AND CONTROL
William D Bertelsen *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 103-130 refs
Avail NTIS HC A13/MF A01 CSCL 01C

A brief report offered on a wing design, new in geometry, construction and flight characteristics Preliminary wind tunnel data on a three-dimensional model was well as some full-scale man-carrying test results are included There are photos of all phases of the experiments and some figures which serve to illustrate the Bertelsen Effect a unique focus of aerodynamic forces in the arc wing system which allows the attainment of high lift coefficients with the maintenance of pitch stability and control G Y

N79-23896*# Stuttgart Univ (West Germany)
SOME NEW AIRFOILS
Richard Eppler *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 131-154 refs
Avail NTIS HC A13/MF A01 CSCL 01A

A computer approach to the design and analysis of airfoils and some common problems concerning laminar separation bubbles at different lift coefficients are briefly discussed Examples of application to ultralight airplanes canards and sailplanes with flaps are given G Y

N79-23897*# Princeton Univ N J
A COMPARISON OF THE AERODYNAMIC CHARACTERISTICS OF EIGHT SAILWING AIRFOIL SECTIONS
Mark D Maughmer *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 155-176 refs
Avail NTIS HC A13/MF A01 CSCL 01A

The operational characteristics of sailwings are discussed with emphasis placed on the importance of the trailing edge cable tension The three dimensional aerodynamic characteristics were obtained from wind tunnel tests and the results compared to determine the magnitude of the aerodynamic penalties paid for various structural simplifications For the sectional thickness ratios it is concluded that while the basic double-membraned sailwing has exceptional aerodynamic performance even superior for some applications to the conventional hardwing any notable deviation from this configuration results in an unacceptably large performance penalty S E S

N79-23899*# Rensselaer Polytechnic Inst Troy N Y
WING SHAPE OPTIMIZATION FOR MAXIMUM CROSS-COUNTRY SPEED, WITH MATHEMATICAL PROGRAMMING
Gunter Helwig *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 203-218 refs
Avail NTIS HC A13/MF A01 CSCL 01C

A computer program was developed to calculate numerically the speed and circling polars of an aircraft when the lift and drag characteristics of the wing airfoils are known The planform of the wing is described by variables which are optimized so that the cross-country speed of the glider is maximum for the particular type of thermal model Two thermal models are compared and shown that with a greater wing area than now normally used the performance can be increased Author

N79-23902*# National Aeronautics and Space Administration Langley Research Center Hampton Va
THE APPLICATION OF MICROPROCESSOR TECHNOLOGY TO IN-FLIGHT COMPUTATION
Patricia L Sawyer and Dan M Somers *In its* The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 267-284 refs
Avail NTIS HC A13/MF A01 CSCL 09B

A modular design of a general purpose microprocessor-based computer to perform in-flight computations for cross-country soaring pilots is described The basic requirements for the system are discussed Several specialized applications of the computer are presented including real-time pilot feedback and flight-test data acquisition and reduction S E S

N79-23903*# Massachusetts Inst of Tech , Cambridge
DESIGN OF PROPELLERS FOR MOTORSOARERS
E Eugene Larrabee *In* NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 285-303 refs
Avail NTIS HC A13/MF A01 CSCL 01C

A method was developed for the design of propellers of minimum induced loss matched to an arbitrary operating point characterized by disc loading (thrust or power) air density shaft speed flight speed and number of blades A consistent procedure is outlined to predict the performance of these propellers under off design conditions or to predict the performance of propellers of general geometry The examples discussed include a man powered airplane a hang glider with a 7 5 kW (10 hp) 8 000 rpm engine and an airplane-like motorsoarer S E S

N79-23904# Messerschmitt-Boelkow-Blohm G m b H , Ottobrunn (West Germany) Unternehmensbereich Flugzeuge
DEVELOPMENT OF AN AIRBORNE MILITARY SYSTEM (MRCA SYSTEM) [ENTWICKLUNG EINES FLIEGENDEN WAFFENSYSTEMS AM BEISPIEL MRCA]
Helmut Langfelder Feb 1977 19 p refs In GERMAN (MBB-UFE-1322-O) Avail NTIS HC A02/MF A01

The problems (technical, economic, political, and financial) encountered when launching a new program for the construction of a series of military aircraft are discussed The background to the 1969 options taken for MRCA Tornado are presented Two groups are involved PANAVIA (MBB 42 5 percent, German, BAC 42 5 percent British, FIAT 15 percent, Italian) and NAMMA (NATO MRC Agency) the former executing the program and the latter ordering 25,000 persons employed by 350 companies currently participate in this program in the three countries concerned This figure will increase to 70 000 persons by the end of the decade and involve some 800 aircraft costing 8 billion DM The program has thus so far been successful Author (ESA)

N79-23906 Cornell Univ , Ithaca, N Y
NUMERICAL CALCULATION OF INVISCID TRANSONIC FLOW THROUGH ROTORS AND FANS Ph D Thesis
Djordje Stevo Dulikravich 1979 249 p
Avail Univ Microfilms Order No 7910741

Steady transonic inviscid, potential lifting flows through two dimensional stationary air-foil cascades and three dimensional, rotating cascades mounted on a doubly infinite cylindrical hub were analyzed The exact full potential equation was derived in its canonical form with appropriate boundary and periodicity conditions for these cases Two separate computer programs were developed that numerically solve that equation, allowing for arbitrary airfoil shapes and blade taper sweep, dihedral and twist distribution as well as for the occurrence of the weak shocks The computational domain was formed using a sequence of geometric transformations of the physical domain providing the boundary fitted corrdinate system These algorithms can serve for the flow prediction about isolated propellers hovering rotors, wind turbines ducted fans, stators and finned missiles Dissert Abstr

N79-23908*# National Aeronautics and Space Administration, Washington, D C
AERODYNAMICS
N F Krasnov 1978 758 p refs Transl into ENGLISH of the book Aerodinamika Moscow Vysshaya Shkola Publishers, 1971 Sponsored by NASA and NSF Transl by Amerind Pub Co pvt Ltd New Delhi
(NASA-TT-F-765, TT74-52006) Avail NTIS HC A99/MF A01 CSCL 01A

The applications of aerodynamics particularly in rocket technology and modern high-speed aviation are studied along with the general laws of motion of a gas medium The first six

chapters of the book cover the following basic concepts and definition of aerodynamics kinematics of a fluid medium equations of motion of a gas in the general case (where variations in its physico-chemical properties are considered), the theory of shock waves, the method of characteristics (very widely used in the investigation of supersonic flows), and the general theory of the motion of a gas in two-dimensional space The practical applications or connections with the formulation of methods of aerodynamic calculations for flight vehicles and their individual elements are shown G Y

N79-23911*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
THEORETICAL FAN VELOCITY DISTORTIONS DUE TO INLETS AND NOZZLES
J Dennis Hawk 1979 12 p refs Presented at the Workshop on V/STOL Aerodyn Monterey Calif, 16-18 May 1979
(NASA-TM-79150 E-006) Avail NTIS HC A02/MF A01 CSCL 01A

Nonuniform velocity profiles imposed on the propulsion system fan can cause fan blade stresses and thrust losses A theoretical parametric study of the effects of inlets with 0 deg and 90 deg nozzle deflection on the velocity profile at a hypothetical fan is presented The parameters investigated are fan-to-nozzle spacing and inlet centerline offset The interaction between the inlet and nozzle is also investigated The study is made using a two-dimensional analysis A R H

N79-23912*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AIRCRAFT ICING
Bernard J Blaha comp 1979 147 p refs Workshop held at Cleveland 19-21 Jul 1978
(NASA-CP-2086 FAA-RD-78-109 E-027) Avail NTIS HC A07/MF A01 CSCL 01C

The results of a conference on the problems of aircraft icing are reported

N79-23913*# National Aeronautics and Space Administration Washington D C
AIRCRAFT ICING INTRODUCTION
John H Enders *In* NASA Lewis Res Center Aircraft Icing 1979 3 p
Avail NTIS HC A07/MF A01 CSCL 01C

The objectives of the Workshop were as follows (1) to assess the current understanding of fixed wing and rotorcraft operational icing environments and problems (2) to evaluate facilities requirements for R&D and certification purposes (3) to examine means of improving icing forecasts (4) to identify shortcomings in aeronautical icing knowledge which can be alleviated by new research and instrumentation development L S

N79-23914*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EXECUTIVE SUMMARY OF AIRCRAFT ICING SPECIALISTS WORKSHOP
Milton A Beheim *In its* Aircraft Icing 1979 p 1-16

Avail NTIS HC A07/MF A01 CSCL 01C

In a period of escalating development costs for new aircraft, there is growing interest in a renewed and coordinated icing research effort to achieve an updating or modernization of each aspect of the technological issues that are involved This includes the data base analysis methods test techniques and test facilities L S

N79-23915*# Air Force Geophysics Lab Hanscom AFB Mass
ICING OF AIRCRAFT SOME REMARKS WITH AN HISTORICAL SLANT FROM A CLOUD PHYSICIST
Robert M Cunningham *In* NASA Lewis Res Center Aircraft Icing
Avail NTIS HC A07/MF A01 CSCL 01C

Three areas of interest are commented on cloud physics nowcasting, and instrumentation A comparison is made of what was done 30 years ago to what might be done in light of developments in related areas of cloud physics, weather modification and instrumentation L S

N79-23916*# National Transportation Safety Board, Washington, D C
SAFETY HAZARD OF AIRCRAFT ICING
James C McLean Jr *In* NASA Lewis Res Center Aircraft Icing 1979 p 21-27

Avail NTIS HC A07/MF A01 CSCL 01C

The problem of aircraft icing is reported as well as the type of aircraft affected, the pilots involved, and an identification of the areas where reduction in icing accidents are readily accomplished M M M

N79-23917*# RCA Flight Operations Trenton, N J
CIVIL HELICOPTER ICING PROBLEMS
Peter B Sweenkey *In* NASA Lewis Res Center Aircraft Icing 1979 p 29-30

Avail NTIS HC A07/MF A01 CSCL 01C

The ice capabilities of rotary wing aircraft are examined Recommendations are given to improve the inadequacies of the weather forecasts pertaining to ice and to adopt a low maintenance anti-ice system M M M

N79-23918*# Cessna Aircraft Co Wichita, Kans
A REVIEW OF THE ICING SITUATION FROM THE STANDPOINT OF GENERAL AVIATION
Dennis W Newton *In* NASA Lewis Res Center Aircraft Icing 1979 p 31-38 refs

Avail NTIS HC A07/MF A01 CSCL 01C

An overview of the present situation in the field of aircraft icing with respect to certification and operation of nontransport category airplanes is given Problems of definition and inconsistencies are pointed out Problems in the forecasting and measurement of icing intensities are discussed The present regulatory environment is examined with respect to its applicability and appropriateness to nontransport airplanes M M M

N79-23919*# Army Research and Technology Labs , Fort Eustis Va Applied Technology Lab
OVERVIEW OF HELICOPTER ICE PROTECTION SYSTEM DEVELOPMENTS
Richard I Adams *In* NASA Lewis Res Center Aircraft Icing 1979 p 39-65 refs

Avail NTIS HC A07/MF A01 CSCL 01C

Helicopter ice protection design criteria was developed and technological shortcoming in meeting helicopter mission requirements is that of helicopter rotor blade ice protection Airframe components are protected using existing technology while the rotor blade protected using the cyclic electrothermal deicing concept M M M

N79-23921*# North Carolina State Univ Raleigh Dept of Mechanical and Aerospace Engineering
INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF SUBSONIC WINGS Final Report
Fred R DeJarnette and Neal T Frink 11 Jun 1979 148 p refs
(Grant NsG-1437)
(NASA-CR-158661) Avail NTIS HC A07/MF A01 CSCL 01A

An analytical strake design procedure is investigated A numerical solution to the governing strake design equation is used to generate a series of strakes which are tested in a water tunnel to study their vortex breakdown characteristics The strakes are scaled for use on a half-scale model of the NASA-LaRC general research fuselage with a 44 degrees trapezoidal wing An analytical solution to the governing design equation is obtained The strake design procedure relates the potential-flow leading-edge suction and pressure distributions to vortex stability Several suction distributions are studied and those which are more

triangular and peak near the tip generate strakes that reach higher angles of attack before vortex breakdown occurs at the wing trailing edge For the same suction distribution a conical rather than three dimensional pressure specification results in a better strake shape as judged from its vortex breakdown characteristics M M M

N79-23922*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AN INVESTIGATION OF A FULL-SCALE ROTOR WITH FOUR BLADE TIP PLANFORM SHAPES
Robert H Stroub May 1979 72 p refs Sponsored in part by AVRADCOM
(NASA-TM-78580 AVRADCOM-TR-79-14 A-7793) Avail NTIS HC A04/MF A01 CSCL 01A

A test of a full-scale helicopter rotor was conducted in the Ames Research Center 40- by 80-Foot Wind Tunnel to investigate performance loads and noise characteristics of rotors with various tip geometries Four blade tip geometries were investigated rectangular trapezoidal swept rectangular and swept trapezoidal The investigation was accomplished over an advance-ratio range of 0 2 to 0 375 and an advancing blade Mach number range of 0 72 to 0 97 The performance aspects are presented with power comparisons between tip shapes On a power basis the best overall tip shape was the swept-trapezoidal geometry J M S

N79-23923*# Vought Corp Hampton Va Technical Center
MINIMIZATION THEORY OF INDUCED DRAG SUBJECT TO CONSTRAINT CONDITIONS
John DeYoung Washington NASA Jun 1979 126 p refs (Contract NAS1-13500)
(NASA-CR-3140) Avail NTIS HC A07/MF A01 CSCL 01A

Exact analytical solutions in terms of induced drag influence coefficients can be attained which define the spanwise loading with minimized induced drag, subject to specified constraint conditions for any nonplanar wing shape or number of lift plus wing bending moment about a given wing span station Example applications of the theory are made to a biplane, a wing in ground effect, a cruciform wing a V-wing a planar-wing winglet and linked wingtips in formation flying For minimal induced drag the spanwise loading, relative to elliptic, is outboard for the biplane and is inboard for the wing in ground effect and for the planar-wing winglet A spinoff of the triplane solution provides mathematically exact equations for downwash and sidewash about a planar vorticity sheet having an arbitrary loading distribution Author

N79-23924*# Old Dominion Univ Norfolk Va
NUMERICAL OPTIMIZATION TECHNIQUES FOR BOUND CIRCULATION DISTRIBUTION FOR MINIMUM INDUCED DRAG OF NONPLANAR WINGS BASIC FORMULATIONS
Final Report
John Kuhlman Jun 1979 47 p refs
(Grant NsG-1357)
(NASA-CR-3154) Avail NTIS HC A03/MF A01 CSCL 01A

A theoretical method was developed for determining the optimum span load distribution for minimum induced drag for subsonic nonplanar configurations The undistorted wing wake is assumed to have piecewise linear variation of shed vortex sheet strength resulting in a quadratic variation of bound circulation and span load The optimum loading is obtained either through a direct technique, whereby derivatives of the drag expression are calculated analytically in terms of the unknown wake vortex sheet strengths Both techniques agree well with each other and with available exact solutions for minimum induced drag Author

N79-23925# Committee on Commerce, Science, and Transportation (U S Senate)
PROPELLED LIGHTER-THAN-AIR VEHICLES
Washington GPO 1979 157 p refs Hearings before the Subcomm on Sci Technol and Space of the Comm on Commerce, Sci and Transportation 96th Congr 1st Sess, 27 Feb, 1 Mar 1979
(GPO-43-457) Avail Subcomm on Sci Technol and Space

Testimony is presented dealing with potential uses for lighter than air vehicles These include the transportation and emplacement of very heavy assemblies and subassemblies encountered in the construction industry, particularly within developing areas where surface tractors roads, bridges, etc are lacking and long-endurance surveillance i e patrolling the recent extension of the national fisheries rights to the 200 mile offshore zone J M S

N79-23928# Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div
THEORY OF THIN WING IN A SUPERSONIC FLOW WITH CONSIDERATION OF THE NON-EQUILIBRIUM STATE OF EXCITATION OF OSCILLATING DEGREES OF FREEDOM
Ye P Aksenov and Yu N Grigoryev 9 Nov 1978 18 p refs Transl into ENGLISH from Uch Zap Perm Gos Univ (USSR), no 156, 1966 18 p
(AD-A065992, FTD-ID(RS)T-1775-78) Avail NTIS HC A02/MF A01 CSCL 20/4

The non equilibrium state in excitation of oscillating degrees of freedom was calculated The problem of the steady state in the supersonic gas flow surrounding the wings were studied S E S

N79-23929# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div
SUPERSONIC FLOW IN THE AREA OF ANTISYMMETRIC THIN CRUCIFORM WINGS WITH SUPERSONIC LEADING EDGES IN A HORIZONTAL PLANE, WITH CONSIDERATION OF FLOW SEPARATION ON THE EDGES
Stefan Staic 30 Oct 1978 19 p refs Transl into ENGLISH from Bul Inst Politehnic (Romania), vol 33, no 1 1971 p 103-118
(AD-A065993, FTD-ID(RS)T-1859-78) Avail NTIS HC A02/MF A01 CSCL 20/4

The flow in the supersonic regime in the area of a thin cruciform wing antisymmetric distribution of incident angles was studied A cruciform wing composed of two simple delta wings perpendicular to one another with Cartesion axes was designed S E S

N79-23931# Boeing Vertol Co, Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 6B ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA, BASIC CONFIGURATION WAKE EXPLORATIONS Final Report, 15 Mar 1977 - 13 Feb 1978
Phillip F Sheridan Sep 1978 374 p Prepared for Army Res and Technol Labs, Fort Eustis Va 4 Vol
(Contract DAAJ02-77-C-0020)
(AD-A061861 USARTL-TR-78-23F-Vol-6B) Avail NTIS HC A16/MF A01 CSCL 01/3

Spectrograms of the six velocity measurements taken from the single film transducers are presented The transducers were located outboard on the wake rake to the left and right of the split film transducers These plots are machine plotted spectrograms in the one-third octave band format J M S

N79-23932# Boeing Vertol Co, Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3A FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FREQUENCY BAND, BASIC INVESTIGATIONS AND HUB VARIATIONS Final Report, 15 Mar 1977 - 13 Feb 1978
Phillip F Sheridan Sep 1978 175 p Prepared for Armv Res and Technol Labs, Fort Eustis, Va 4 Vol
(Contract DAAJ02-77-C-0020)
(AD-A061766, USARTL-TR-78-23C-Vol-3A) Avail NTIS HC A08/MF A01 CSCL 01/3

Profiles of the RMS values of the wake flow angles and velocities in the 1 omega and 2 omega range are presented The format is waterline on the ordinate and velocity or flow angle on the abscissa Each graph shows a comparison of the baseline flow to the flow modified by some device or condition Build-up to baseline baseline wake exploration, and the effects of various hub caps are covered J M S

N79-23933# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3B FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FREQUENCY BAND, AIR EJECTOR SYSTEMS AND OTHER DEVICES Final Report, 15 Mar 1977 - 13 Feb 1978
Phillip F Sheridan Sep 1978 203 p Prepared for Army Res and Technol Labs Fort Eustis, Va 4 Vol
(Contract DAAJ02-77-C-0020)
(AD-A061767 USARTL-TR-78-23C-Vol-3B) Avail NTIS HC A10/MF A01 CSCL 01/3

Profiles of the RMS values of the wake flow angles and velocities in the 1 omega and 2 omega range are presented The format is waterline on the ordinate and velocity or flow angle on the abscissa Each graph shows a comparison of the baseline flow to the flow modified by some device or condition Air ejector systems, air ejectors and hub caps in the same configuration wings fairings and miscellaneous devices are covered J M S

N79-23934# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2B HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7 - 14, MIDSECTION Final Report, 15 Mar 1977 - 13 Feb 1978
Phillip F Sheridan Sep 1978 219 p Prepared for Army Res and Technol Labs Fort Eustis Va 4 Vol
(Contract DAAJ02-77-C-0020)
(AD-A061860 USARTL-TR-78-23B-Vol-2B) Avail NTIS HC A10/MF A01 CSCL 01/3

Harmonic analyses of the waveforms generated by each of the 53 pressure transducers, which covered the surface of the model fuselage and empennage are presented The analyses encompass the transducers in the middle section of the model Test conditions and configurations include baseline data climb and descent disk loading variation and application of strakes J M S

N79-23935# Messerschmidt-Boelkow G m b H Munich (West Germany) Unternehmungsbereich Flugzeuge- Entwicklung
A FINITE ELEMENT METHOD FOR THE COMPUTATION OF THE TRANSONIC POTENTIAL FLOW PAST AIRFOILS
Albrecht Eberle 23 Sep 1977 63 p refs In GERMAN ENGLISH summary
(MBB-UFE-1352-O) Avail NTIS HC A04/MF A01

A special finite element method for computing the transonic potential flow with shocks past airfoils is presented The artificial viscosity concept is used for the local supersonic flow regime Since in general classical elements do not meet the requirements of advanced numerical aerodynamics, particular attention was given to classing an appropriate element The usefulness of the method is demonstrated by a series of computed pressure distributions Author (ESA)

N79-23936# Messerschmitt-Boelkow-Blohm G m b H, Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung
AERODYNAMIC PROBLEMS IN ENGINE AIRFRAME INTEGRATION ON FIGHTER AIRPLANES
Kurt Lotter 26 Sep 1977 80 p refs In GERMAN ENGLISH summary Presented at 85th Wehrtech Symp Luftfahrttechn III Moderne Triebwerkstechnol Mannheim West Ger 21-22 Sep 1977
(MBB-UFE-1359-O) Avail NTIS HC A05/MF A01

Different types of intake are discussed together with engine mass flow/air intake matching problems Emphasis is given to intake/engine compatibility and instantaneous distortion measurements The sources and consequences of intake malfunctions are illustrated some typical supersonic fighter aircraft intakes are described Nozzle concepts are presented and interference effects between propulsive jet and external flow are shown The afterbody drag of fighter aircraft is given Improvements with convergent/divergent nozzles are shown Thrust reversal interference effects are mentioned Future trends are presented Author (ESA)

N79-23937# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung
AIRFOIL OPTIMIZATION FOR TRANSONIC FLOW USING THE METHODS OF FINITE ELEMENTS AND CHARACTERISTICS
Albrecht Eberle 2 Nov 1977 59 p refs In GERMAN ENGLISH summary
(MBB-UFE-1362-O) Avail NTIS HC A04/MF A01

A simple method for the optimization of airfoilds was derived from the principle of the elliptic continuation in the supersonic flow regime Contour deformations on arbitrary input airfoils are derived in such a way that the resulting supercritical flow is shockless The subsonic flow field was computed by the method of finite elements The supersonic problem was solved separately by the method of characteristics Author (ESA)

N79-23938# Oxford Univ (England) Engineering Lab
MEASUREMENT OF THE DRAG OF SLENDER CONES IN HYPERSONIC FLOW AT LOW REYNOLDS NUMBERS USING A MAGNETIC SUSPENSION AND BALANCE
T F Haslam-Jones 1978 119 p refs
(Contract MIN-DEF/PE-AT/2057/042)
(OUEL-1235/78) Avail NTIS HC A02/MF A01

In order to carry out a comprehensive experimental survey of aerodynamic force on slender axisymmetric bodies in rarefied hypersonic flow an electromagnetic jig and balance was built for use with the Oxford University low density tunnel The design of this apparatus was based on the magnetic jig for spheres built in the same laboratory The drag force measurements on sharp cones are given for freestream Reynolds numbers based on cone diameter of 120 to 1200 at free stream Mach numbers between 5 and 9 These data were obtained by using a contoured nozzle and free jets The results from the two types of flow devices overlapped and afforded direct comparisons between them Comparisons are made with other experimental results and the general correlation of all relevant data is discussed Author (ESA)

N79-23939# National Technical Information Service Springfield Va
AIRCRAFT WAKE VORTICES A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979
Guy E Habercom Jr Mar 1979 266 p Supersedes NTIS/PS-78/0122 NTIS/PS-77/0067 NTIS/PS-76/0072 and NTIS/PS-75/164
(NTIS/PS-79/0166/3 NTIS/PS-78/0122 NTIS/PS-77/0067 NTIS/PS-76/0072 NTIS/PS-75/164) Avail NTIS HC $28 00/MF $28 00 CSCL 01A

Wake vortices and turbulent flow across aircraft lifting surfaces were investigated in the Government-sponsored research Aerodynamic characteristics of vortices were reviewed with special attention made to trailing aircraft and aviation safety This updated bibliography contains 258 abstracts, 27 of which are new entries to the previous edition GRA

N79-23940*# Boeing Commercial Airplane Co, Seattle Wash
INFLIGHT FUEL TANK TEMPERATURE SURVEY DATA Final Report
A J Pasion May 1979 60 p refs
(Contract NAS3-20815)
(NASA-CR-159569 D6-48611) Avail NTIS HC A04/MF A01 CSCL 01C

Statistical summaries of the fuel and air temperature data for twelve different routes and for different aircraft models (B747 B707, DC-10 and DC-8) are given The minimum fuel total air and static air temperature expected for a 0 3% probability were summarized in table form Minimum fuel temperature extremes agreed with calculated predictions and the minimum fuel temperature did not necessarily equal the minimum total air temperature even for extreme weather long range flights R E S

N79-23943# Messerschmidt-Boelkow G m b H Munich (West Germany) Unternehmensbereich Flugzeuge- Entwicklung
THE TIME BUDGET AS A CRITERION FOR THE WORKLOAD OF AIR TRAFFIC CONTROLLERS

Guenther Och 13 Sep 1977 15 p refs In GERMAN ENGLISH summary
(MBB-UFE-1353-O) Avail NTIS HC A02/MF A01

A time optimization method for evaluating the capacity of air traffic controllers is presented As within a given time interval only a limited number of minutes can be used for active control the time consumption for the control of various flight phases was measured and used to calculate the number of flights which could be controlled during this interval A capacity profile for the entire air space of the Federal Republic of Germany was constituted from characteristic traffic patterns obtained for each control sector Author (ESA)

N79-23945# National Technical Information Service Springfield Va
DISCRETE ADDRESS BEACON SYSTEM A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979
William E Reed Apr 1979 149 p Supersedes NTIS/PS-78/0064 NTIS/PS-77/0035, NTIS/PS-76/0039
(NTIS/PS-79/0244/8 NTIS/PS-78/0064 NTIS/PS-77/0035 NTIS/PS-76/0039) Avail NTIS HC $28 00/MF $28 00 CSCL 17G

The development of the discrete address beacon system is treated in these Federally-sponsored research reports Topics include the data link, message formats antenna systems, signal propagation transponders and interface with the air traffic control radar beacon system This updated bibliography contains 140 abstracts, 27 of which are new entries to the previous edition GRA

N79-23946# Advisory Group for Aerospace Research and Development Paris (France)
TECHNICAL EVALUATION REPORT ON THE 27TH GUIDANCE AND CONTROL PANEL SYMPOSIUM ON THE V/STOL AIRCRAFT AT NIGHT AND IN POOR VISIBILITY
G C Howell (RAE, Bedford, Engl) May 1979 13 p
(AGARD-AR-142 ISBN-92-835-1319-3) Avail NTIS HC A02/MF A01

The desire of operators of all three services of the NATO nations to extend the use of helicopters and V/STOL aircraft into night and conditions of poor visibility has caused an expansion of activity in various technological fields but most particularly in the electro-optical and radar sensors of various kinds The integration of these new sensors into modern navigation, flight control and display systems is an important aspect - particularly in helicopters where space and weight are at a premium Also the pilot workload is already high in helicopters and V/STOL aircraft near the ground and any new technology must be introduced in a manner to keep the workload within bounds so as not to lose the benefits of the new sensors Author

N79-23947# General Dynamics/Fort Worth Tex
ENERGY MANEUVERABILITY DISPLAY VALIDATION Final Report, May 1976 - Apr 1978
A H Lusty Jr M K Fox, J M Norton and R J Wenham Apr 1978 121 p
(Contract F33615-76-C-3099)
(AFFDL-TR-78-35-Vol-1 AF Proj 2403) Avail NTIS HC A06/MF A01

Comparative testing of the F-16 aircraft energy maneuverability display (EMD) and a conventional display (CD) was performed in an F-16 simulation implemented on a large amplitude multimode aerospace research simulator The test subjects (fighter pilots) performed two basic maneuvers with each display Flight times were recorded for the turn and energy gain portions of each maneuver These times were statistically compared and engineering conclusions were made Results of the simulation tests show that (1) for the hard turn maneuver the CD (with well-chosen rules-of-thumb) and the EMD are equally effective, (2) for the energy gain maneuver the CD and the EMD are equally effective for the 'clean' configuration however, for configurations with stores, the use of the EMD shows a significant advantage, and (3) for the combined sustained energy turn and energy gain maneuver the EMD is more effective than the CD for all configurations tested A R H

N79-23948*# Hydraulic Research Textron, Valencia, Calif
AN ELECTRIC CONTROL FOR AN ELECTROHYDRAULIC ACTIVE CONTROL AIRCRAFT LANDING GEAR Final Report
Irving Ross and Ralph Edson Apr 1979 169 p refs
(Contract NAS1-14459)
(NASA-CR-3113) Avail NTIS HC A08/MF A01 CSCL 01C

An electronic controller for an electrohydraulic active control aircraft landing gear was developed Drop tests of a modified gear from a 2722 Kg (6000 lbm) class of airplane were conducted to illustrate controller performance The results indicate that the active gear effects a force reduction, relative to that of the passive gear from 9 to 31 percent depending on the aircraft sink speed and the static gear pressure J M S

N79-23949# Iowa Univ Iowa City Materials Engineering Div
SUBSTRUCTURING METHODS FOR DESIGN SENSITIVITY ANALYSIS AND STRUCTURAL OPTIMIZATION Interim Technical Report, May - Aug 1977
A K Govil J S Arora, and E J Haug Aug 1977 229 p refs
(Contracts DAAK11-77-C-0023 DAAA09-76-C-2013)
(AD-A065935 TR-34) Avail NTIS HC A11/MF A01 CSCL 01/3

This report presents an iterative method for optimal design of large scale structures that incorporates the concept of substructuring Design sensitivity analysis for the method is developed in a state space setting in which the symmetry of the structural stiffness matrix is utilized to define efficient adjoint calculations that yield explicit design derivatives The entire procedure is then presented as a convenient computational algorithm Applications of the method are given for optimal design of two and three dimensional truss idealized wing and framed structures Computer programs based on the present algorithm are presented for three truss structures (10 member plane cantilever truss 200 member plane truss, 63 member space truss), three idealized wing structures (18 element wing box beam, 39 element rectangular wing 150 element swept wing) and three framed structures (one-bay two-story plane frame, two-bay six-story plane frame 48 element space frame) Results obtained with the substructing formulation are compared first with results obtained without substructing and then with results obtained with other methods GRA

N79-23950# Iowa Univ , Iowa City Materials Engineering Div
FAIL-SAFE OPTIMAL DESIGN OF STRUCTURES WITH SUBSTRUCTURING Interim Technical Report, May 1977 - Aug 1978
D T Nguyen, A K Govil J S Arora, and E J Haug Aug 1978 188 p refs
(Contract DAAK11-77-C-0023)
(AD-A065936, TR-45) Avail NTIS HC A09/MF A01 CSCL 01/3

The problem of fail-safe structural design is defined An optimal design formulation for the problem is developed with substructuring An optimal design algorithm based on the state space gradient projection method is derived Optimal designs for several cases of an open and closed tail-boom structures for the Army Cobra helicopter are obtained and analyzed Constraints are imposed on stresses displacements buckling natural frequency and member sizes A user s manual for a computer program based on the algorithm is also described Author (GRA)

N79-23951# Kaman Avidyne Burlington Mass
NOVA-2S, A STIFFENED PANEL EXTENSION OF THE NOVA-2 COMPUTER PROGRAM Final Report
Lawrence J Mente and William N Lee Kirtland AFB, N Mex Air Force Weapons Lab Dec 1978 153 p refs
(Contract F29601-78-C-0019)
(AD-A066038, AD-E200233 KA-TR-153 APNL-TR-78-182) Avail NTIS HC A08/MF A01 CSCL 01/3

A stiffened panel extension is developed into the NOVA-2S and NOVA-2LTS computer programs which replace the NOVA-2 and NOVA-2LT programs for nuclear overpressure vulnerability

and analysis of aircraft These new versions are capable of analyzing a stiffened flat or cylindrical panel in both the elastic and inelastic response regions as well as retaining the capability of analyzing stiffeners and pure panels, individually In the stiffened panel analysis the stiffeners are treated discretely in either or both coordinate directions and are allowed various eccentric positions relative to the single-layered, multilayered and honeycomb panel skin configurations The stiffened panel analysis is evaluated successfully by comparing the analytical solutions with experimental results from 3 test programs that measured strains and displacement responses on stiffened panels An evaluation of the stiffened panel analysis versus the approach of analyzing individual elements of the stiffened panel is made by comparing the two approaches on the basis of response quantities at constant range and slant ranges at constant damage level Three stiffened panels that are very similar to those found on the B-52 aircraft were used and it was concluded that, in general the individual element approach is not adequate and the stiffened panel analysis should be used for these types of stiffened panels GRA

N79-23952# Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering

THE PRODUCTION FUNCTION AND AIRFRAME COST ESTIMATION M S Thesis

John A Long Dec 1978 75 p refs

(AD-A065570 AFIT/GOR/SM/78D-8) Avail NTIS HC A04/MF A01 CSCL 14/1

In recent years, men and governments have become keenly aware of the huge capital outlays necessary in the acquiring of new weapons systems Increased burden on limited capital has required more complete and careful planning This planning has led to the need for accurate and timely cost predictions of new systems Historically the variables affecting the future cost of aircraft airframes have been proven to be airframe weight and aircraft speed These are often combined with learning hypothesis to form an airframe cost model In this paper the production function of microeconomics is combined with weight, speed and learning to form a nonlinear cost estimation model Nonlinear least squares regression analysis was used in evaluating this model Although the results are inconclusive based on the data used weight and speed combined with learning still appear to be the best predictors of aircraft airframe cost Author (GRA)

N79-23954# Vought Astronautics, Dallas, Tex

VOLAR A DIGITAL COMPUTER PROGRAM FOR SIMULATING VSTOL AIRCRAFT LAUNCH AND RECOVERY FROM SMALL SHIPS VOLUME 1 PROGRAM DESCRIPTION Final Report

Julian Wolkovitch and Billy B Brassell Dec 1978 124 p refs

(Contract N62269-77-R-0389)

(AD-A066172 Rept-2-32000/8R-41672-Vol-1 NADC-77123-30-Vol-1) Avail NTIS HC A06/MF A01 CSCL 01/2

A digital computer program has been developed for simulating the launch and recovery of VSTOL aircraft operating from small ships Volume 1 of this report describes the program, Volume 2 is the user s manual The program known as VOLAR (Vought Launch and Recovery Dynamics Program) employs the computational technique of nonlinear covariance propagation This permits the time histories of the means and variances of all systems state variables to be computed from a single run, as opposed to the Monte Carlo technique which requires multiple runs plus subsequent averaging Typically VOLAR requires approximately 7 percent of the computer time required for comparable Monte Carlo simulations The program includes a general airframe mathematical model suitable for helicopters or fixed-wing aircraft The airwake of a small ship is also modeled and ship motion models are included Two alternative models of the human pilot are supplied one is based on verbal adjustment rules, the other is based on optimal control theory, utilizing performance index parameters deduced from manned simulator experiments The program is demonstrated for AV-8A recovery on a small ship The trends predicted by VOLAR are shown to agree with flight test data Author (GRA)

N79-23955# Vought Astronautics Dallas Tex

VOLAR A DIGITAL COMPUTER PROGRAM FOR SIMULATING VSTOL AIRCRAFT LAUNCH AND RECOVER FROM SMALL SHIPS VOLUME 2 APPENDICES Final Report

Julian Wolkovitch and Billy B Brassell Dec 1978 338 p refs

(Contract N62269-77-R-0389)

(AD-A066173 Rept-2-32000/8R-51672-Vol-2, NADC-77123-30-Vol-2) Avail NTIS HC A15/MF A01 CSCL 01/2

Partial Contents User s Manual Listing for Classical Pilot Model, Listing for Optimal Controller Pilot Model, Describing Functions of General Single-Valued Nonlinearities Representable by Straight-Line Segments and The I and R Arrays GRA

N79-23956# Air Force Flight Dynamics Lab , Wright-Patterson AFB, Ohio

PREDICTION OF THE ANGULAR RESPONSE POWER SPECTRAL DENSITY OF AIRCRAFT STRUCTURES Final Report, Jan 1976 - Jun 1978

Jon H Lee Michael Obal W and Dansen L Brown Dec 1978 98 p refs

(AD-A066141 AFFDL-TR-78-188) Avail NTIS HC A05/MF A01 CSCL 01/3

The design of airborne electro-optical systems requires the knowledge of angular vibration as well as linear vibration of aircraft structures Rather than predicting the angular vibration subject to aerodynamic and acoustic excitations an attempt is made here to relate the angular vibration directly to the linear vibration response With the Bernoulli-Euler beam used as a theoretical model, a relationship has been derived between the linear and angular vibration power spectral density functions Based on this relationship together with the angular root-mean-squared vibration amplitude as previously predicted by Lee and Whaley (AFFDL-TR-76-56, AF Flight Dynamcs Laboratory, Wright-Patterson AFB, Ohio), it is now possible to predict the angular power spectral density and a length scale associated with the angular measurement technique Tested on the typical flight test data of RF-4C and F-15 fighters CH-3E helicopter, and B-52 bomber the predicted angular power spectral density lies within a + or - 0 db band about the measurement Though crude, such a prediction is useful in the preliminary design stage in that one can quickly estimate the angular vibration environment prior to fabrication Author (GRA)

N79-23958# Analytic Sciences Corp Reading Mass

AVIONICS STANDARDIZATION POTENTIAL ANALYSIS Final Report, 16 May 1977 - 16 May 1978

Robert K Gates and Robert F Shipp 30 Nov 1978 89 p refs

(Contract F33615-77-C-1167 AF Proj 2003)

(AD-A066138, TASC-TR-1059-3, AFAL-TR-78-168) Avail NTIS HC A05/MF A01 CSCL 09/3

The objective of the Avionics Standardization Potential Analysis program is to develop a general methodology for evaluating the benefits accruing from the use of standard equipment across future USAF avionics systems The methodology has been developed using navigation avionics as being representative of avionics in general, in a study of standardization potential across navigation systems (SPANS) The methodology covers the process of establishing future avionics systems requirements through mission analysis identification of available equipment for the design of mission-responsive avionics suites, evaluation of future quantitative demands for avionics equipment synthesis of mission-capable avionics systems collection of relevant cost and reliability data and evaluation of standardization options using a computer-based Standardization Evaluation Program (STEP) GRA

N79-23959# National Technical Information Service Springfield Va

AEROSPACE COMPUTER SYSTEMS PART 1 AVIONICS APPLICATIONS, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - 1977

Brian Carrigan Apr 1979 210 p

(NTIS/PS-79/0312/3) Avail NTIS HC $28 00/MF $28 00 CSCL 09B

Studies of computer hardware and supporting software for aircraft applications are cited The bibliography includes research on onboard data processing equipment, as well as navigation and guidance computers This updated bibliography contains 203 abstracts, none of which is new to the previous edition GRA

N79-23960# National Technical Information Service, Springfield, Va

AEROSPACE COMPUTER SYSTEMS PART 1 AVIONICS APPLICATIONS, VOLUME 3 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1978 - Mar 1979

Brian Carrigan Apr 1979 97 p Supersedes NTIS/PS-78/0289, NTIS/PS-77/0126, NTIS/PS-76/0042

(NTIS/PS-79/0313/1 NTIS/PS-78/0289 NTIS/PS-77/0126, NTIS/PS-76/0042) Avail NTIS HC $28 00/MF $28 00 CSCL 09B

Equipment and computer programs for onboard data processing in support of aircraft guidance, flight control and air navigation are described in reports cited in this updated bibliography which contains 91 abstracts all of which are new to the previous edition GRA

N79-23963*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

COMBINED PRESSURE AND TEMPERATURE DISTORTION EFFECTS ON INTERNAL FLOW OF A TURBOFAN ENGINE

W M Braithwaite and Ronald H Soeder 1979 19 p refs Presented at the 15th Joint Propulsion Conf Las Vegas, 18-20 Jun 1979 cosponsored by AIAA, the Soc of Automotive Engr and ASME

(NASA-TM-79136, E-9984) Avail NTIS HC A02/MF A01 CSCL 21E

An additional data base for improving and verifying a computer simulation developed by an engine manufacturer was obtained The multisegment parallel compressor simulation was designed to predict the effects of steady-state circumferential inlet total-pressure and total-temperature distortions on the flows into and through a turbofan compression system It also predicts the degree of distortion that will result in surge of the compressor The effect of combined 180 deg square-wave distortion patterns of total pressure and total temperature in various relative positions is reported The observed effects of the combined distortion on a unitary bypass ratio turbofan engine are presented in terms of total and static pressure profiles and total temperature profiles at stations ahead of the inlet guide vanes as well as through the fan-compressor system These observed profiles are compared with those predicted by the complex multisegment model The effects of relative position of the two components comprising the combined distortion on the degree resulting in surge are discussed Certain relative positions required less combined distortion than either a temperature or pressure distortion by itself SES

N79-23964*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

LEAN, PREMIXED, PREVAPORIZED COMBUSTION FOR AIRCRAFT GAS TURBINE ENGINES

Edward J Mularz 1979 18 p refs Presented at the 15th Propulsion Conf Las Vegas, 18-20 Jun 1979 cosponsored by AIAA the Soc of Automotive Eng and ASME Prepared in cooperation with Army Aviation Res and Develop Command, St Louis Mo

(NASA-TM-79148 E-004, AVRADCOM-TR-79-18) Avail NTIS HC A02/MF A01 CSCL 21E

The application of lean, premixed prevaporized combustion to aircraft turbine engine systems can result in benefits in terms of superior combustion performanace improved combustor and turbine durability and environmentally acceptable pollutant emissions Lean, premixed prevaporized combustion is particularly attractive for reducing the oxides of nitrogen emissions during high altitude cruise The NASA stratospheric cruise emission reduction program will evolve and demonstrate lean premixed, prevaporized combustion technology for aircraft engines This multiphased program is described In addition the various elements of the fundamental studies phase of the program are reviewed and results to date of many of these studies are summarized Author

N79-23965*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EFFECT OF DEGREE OF FUEL VAPORIZATION UPON EMISSIONS FOR A PREMIXED PREVAPORIZED COMBUSTION SYSTEM

L P Cooper 1979 17 p refs Presented at the 15th Joint Propulsion Conf Las Vegas 18-20 Jun 1979, cosponsored by AIAA, SAE and ASME

(NASA-TM-79154 E-010) Avail NTIS HC A02/MF A01 CSCL 21E

An experimental and analytical study of the combustion of partially vaporized fuelair mixtures was performed to assess the impact of the degree of fuel vaporization upon emissions for a premixing-prevaporizing flametube combustor Data collected show near linear increases in nitrogen oxide emissions with decreasing vaporization at equivalence ratios of 0 6 For equivalence ratio of 0 72 the degree of vaporization had very little impact on nitrogen oxide emissions A simple mechanism which accounts for the combustion of liquid droplets in partially vaporized mixtures was found to agree with the measured results with fair accuracy with respect to both trends and magnitudes Author

N79-23966*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECT OF SHOCKS ON FILM COOLING OF A FULL SCALE TURBOJET EXHAUST NOZZLE HAVING AN EXTERNAL EXPANSION SURFACE

David M Straight 1979 20 p refs Presented at the 15th Joint Propulsion Conf Las Vegas 18-20 Jun 1979 cosponsored by AIAA, SAE and ASME

(NASA-TM-79157 E-013) Avail NTIS HC A02/MF A01 CSCL 21E

Experimental film cooling data obtained during exploratory testing with an axisymmetric plug nozzle having external expansion and installed on an afterburning turbojet engine in an altitude test facility is presented The shocks and local hot gas stream conditions had a marked effect on film cooling effectiveness An existing film cooling correlation was adequate at some operating conditions but inadequate at other conditions such as in separated flow regions resulting from shock boundary layer interactions RES

N79-23968*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECTS OF STEADY-STATE PRESSURE DISTORTION ON THE STALL MARGIN OF A J85-21 TURBOJET ENGINE

George A Bobula Mar 1979 28 p refs Prepared in cooperation with Army Aviation Research and Development Command Cleveland St Louis Mo

(NASA-TM-79123 E-9958 AVRADCOM-TR-79-12) Avail NTIS HC A03/MF A01 CSCL 21E

The effects of the inlet pressure distortions induced by five screen patterns on the performance of a J85-21 turbojet engine was conducted at the NASA Lewis Research Center Testing was in support of the HiMAT RPRV program at Dryden Flight Research Center Distortion patterns were chosen based on anticipated application of test results of the HiMAT installation Tests were conducted at a simulated Mach number and altitude condition of 0 9 and 10 973 meters Results are presented in terms of distortion levels and standard compressor performance parameters Author

N79-23969*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

EFFECT OF STEADY-STATE PRESSURE DISTORTION ON FLOW CHARACTERISTICS ENTERING A TURBOFAN ENGINE

Ronald H Soeder and George A Bobula Apr 1979 34 p refs Prepared in cooperation with Army Aviation Research and Development Command St Louis Mo

(NASA-TM-79134 E-9982, AVRADCOM-TR-79-19) Avail NTIS HC A03/MF A01 CSCL 21E

Flow angle static-pressure and total-pressure distributions were measured in the passage ahead of a turbofan engine operating with inlet pressure distortion Distortions were generated with five screen configurations and one solid plate configuration The screens and solid plate were circumferential and mounted on a rotatable assembly Reynolds Number Index upstream of the distortion device was maintained at 0 5, 0 35, or 0 2 and engine corrected low-rotor speeds were held at 6000 rpm and 8600 rpm Near the engine inlet, flow angle was largest at the hub and increased as flow approached the engine The magnitude of static-pressure distortion measured along the inlet-duct and extended bullet nose walls increased exponentially as the flow approached the engine Wall static-pressure distortion was also a function of distortion harmonic Author

N79-23971*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
AIRCRAFT ENGINE NOZZLE Patent Application
Norman E Sorensen and Eldon A Latham inventors (to NASA) Filed 23 Mar 1979 14 p
(NASA-Case-ARC-10977-1, US-Patent-Appl-SN-023436) Avail NTIS HC A02/MF A01 CSCL 21E

A variable area exit nozzle arrangement for an aircraft engine having a substantially reduced length and weight is described It comprises longitudinally movable radial vanes and fixed radial vanes The movable radial vanes are alternately disposed with respect to the fixed radial vanes Means for displacing the movable radial vanes along the longitudinal axis of the engine relative to the fixed radial vanes are determined The fixed radial vanes radially extend across the main exhaust flow of the engine NASA

N79-23973# Kaman Aerospace Corp Bloomfield Conn
DRIVESHAFT ALIGNMENT INDICATOR Final Technical Report, Nov 1975 - May 1978
Frank A Bill and Robert B Bossler Jr Jan 1979 117 p
(Contract DAAJ02-77-C-0006 DA Proj 1L2-62209-AH-76)
(AD-A065988, R-1547 USARTL-TR-79-3) Avail NTIS HC A06/MF A01 CSCL 01/3

The purpose of this program was to reduce the difficulty of drive-shaft alignment and to improve dynamic alignment by allowing inflight measurement on Army UH-1/AH-1 helicopters Under Contract DAAJ02-76-C-0010, a first-concept driveshaft alignment indicator was investigated The program included ground and flight tests on an Army UH-1 helicopter A second-generation concept was evolved which indicated improved accuracy and greatly reduced system cost The second-generation concept was investigated under Contract DAAJ02-77-C-0006 The investigation included design and manufacture of a prototype alignment measuring tool ground and flight tests and a survey of the existing driveshaft alignments of Army helicopters The survey included eight UH-1 at Bradley Field Connecticut ten UH-1 at Felker Field Fort Eustis, Virginia and ten UH-1 at Simmons Field Fort Bragg North Carolina Subsequently three AH-1 were measured at Felker Field and finally a UH-1 with sling load was measured at Kaman The significant measurements were static alignment hover at a 5-foot skid height, and low-speed high-power climb (70 knots forward speed, 1000 ft/minute climb) GRA

N79-23974# General Electric Co, Cincinnati Ohio Aircraft Engine Group
TURBINE DESIGN SYSTEM Final Technical Report, 1 Nov 1975 - 30 Nov 1977
R R Wysong, T C Prince, D T Lenahan R D Caney and J S Keith Nov 1978 117 p refs
(Contract F33615-75-C-2073 AF Proj 3066)
(AD-A066092, R78AEGXXX) Avail NTIS HC A06/MF A01 CSCL 21/5

A time-sharing computer system has been developed which provides for the interactive design and analytical performance evaluation of aircraft engine turbines The system is modularized to permit the user to deal with one functional aspect of the design at a time twelve modules are employed to encompass the turbine aerodynamic, heat transfer, and mechanical design The analytical and numerical methods employed in each module and their theoretical basis, are presented in this report Author (GRA)

N79-23977*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A SIMPLIFIED ROTOR SYSTEM MATHEMATICAL MODEL FOR PILOTED FLIGHT DYNAMICS SIMULATION
Robert T N Chen May 1979 28 p refs
(NASA-TM-78575 A-7538) Avail NTIS HC A03/MF A01 CSCL 01C

The model was developed for real-time pilot-in-the-loop investigation of helicopter flying qualities The mathematical model included the tip-path plane dynamics and several primary rotor design parameters such as flapping hinge restraint, flapping hinge offset, blade Lock number and pitch-flap coupling The model was used in several exploratory studies of the flying qualities of helicopters with a variety of rotor systems The basic assumptions used and the major steps involved in the development of the set of equations listed are described The equations consisted of the tip-path plane dynamic equation the equations for the main rotor forces and moments and the equation for control phasing required to achieve decoupling in pitch and roll due to cyclic inputs SES

N79-23978*# Calspan Corp Buffalo, N Y
ACTIVE CONTROL FOR THE TOTAL-IN-FLIGHT SIMULATOR (ACTIFS) Final Report
E G Rynaski D Andrisani II and N Weingarten Apr 1979 303 p refs Sponsored by NASA
(Contract F33615-73-C-3051)
(NASA-CR-3118, AK-5280-F-11) HC A14/MF A01 CSCL 01C

An identification procedure was developed that is used to systematically improve or update the mathematical model of the aeroelastic behavior of an airplane A mathematical model that was originally obtained by analytical or theoretical methods is made amenable to piecemeal acceptance of parameters estimated from the data taken during flight tests Linear optimal control theory was used to evolve a performance index specifying closed loop system dynamics Control laws for the proper pole placement of seven modes of motion of the TIFS airplane two rigid body and five elastic modes were specified according to criteria developed The phase variable canonical transformation was used to help specify a minimum complexity observer network that required no interconnections of the sensor outputs and no measurements of the control input A conceptual design example of a simplified observer feedback control law for structural mode control of the TIFS airplane is presented Gust alleviation techniques involving direct gust measurement and maneuver load control techniques were also developed resulting in a command augmentation system that simultaneously commands multiple surface deflections to a pilot command input ARH

N79-23979*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards, Calif
PRECISION CONTROLLABILITY OF THE F-15 AIRPLANE
Thomas R Sisk and Neil W Matheny May 1979 46 p refs
(NASA-TM-72861 H-1073) Avail NTIS HC A03/MF A01 CSCL 01C

A flying qualities evaluation conducted on a preproduction F-15 airplane permitted an assessment to be made of its precision controllability in the high subsonic and low transonic flight regime over the allowable angle of attack range Precision controllability, or gunsight tracking studies were conducted in windup turn maneuvers with the gunsight in the caged pipper mode and depressed 70 mils This evaluation showed the F-15 airplane to experience severe buffet and mild-to-moderate wing rock at the higher angles of attack It showed the F-15 airplane radial tracking precision to vary from approximately 6 to 20 mils over the load factor range tested Tracking in the presence of wing rock essentially doubled the radial tracking error generated at the lower angles of attack The stability augmentation system affected the tracking precision of the F-15 airplane more than it did that of previous aircraft studied Author

N79-23980# Messerschmitt-Boelkow-Blohm G m b H , Munich (West Germany)

EVALUATION OF A DIGITAL HELICOPTER CONTROL SYSTEM

Wolfgang J Kubbat 1977 13 p refs Presented at Assoc Aeron et Astronautique 3d European Rotocraft and Powered Lift Aircraft Forum Aix-en-Provence, France 7-9 Sep 1977 (MBB-UFE-1349-O) Avail NTIS HC A02/MF A01

An experimental digital control system for helicopter applications is described The system incorporates the functions of control and stabilization autopilot air data computation and strap down computation Realization of the system was made using a double processor computer The control system and the sensors are selfmonitored providing a fail safe capability for one channel It may also be used in redundant applicatons Successful flight tests were conducted Author (ESA)

N79-23981# Advisory Group for Aerospace Research and Development Paris (France)

TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SYMPOSIUM ON DYNAMIC STABILITY PARAMETERS

Lars E Ericsson (LMSC Sunnyvale Calif) Apr 1979 16 p Symp held at Athens, 22-24 May 1963 (AGARD-AR-137 ISBN-92-835-1320-7) Avail NTIS HC A02/MF A01

An evaluation of the symposium is given along with the presentations made in the areas of wind tunnel techniques flight testing techniques analytical techniques, motion analyses and nonlinear formulations and sensitivity and simulator studies In addition, a workshop session and roundtable discussion on the presentations are discussed Conclusions on the state of the art and recommendations for future activity complete the evaluation J M S

N79-23982# Aeronautical Research Labs Melbourne (Australia)

AN INTRODUCTION TO DYNAMIC DERIVATIVES 2 THE EQUATIONS OF MOTION FOR WIND TUNNEL PITCH-YAW OSCILLATION RIGS

G F Forsyth Aug 1978 22 p refs (ARL-Aero-Note-377, AR-001-296) Avail NTIS HC A02/MF A01

The equations of motion were developed for a simplified free flight pitch-yaw system and for spring-mounted and rigidly-driven wind tunnel systems For the spring-mounted system both initial displacement and forced-oscillation conditions were examined A simplified cable towed system was also derived J A M

N79-23984# ARO, Inc Arnold Air Force Station Tenn

MODEL DIFFUSER INVESTIGATION FOR PROPULSION WIND TUNNEL 16T Final Report, 21 Apr - 5 Sep 1978

L J David and M G Hale AEDC 9 Nov 1978 34 p refs (AD-A065822, AEDC-TSR-78-P48) Avail NTIS HC A03/MF A01 CSCL 20/4

A 1/16-scale model of the diffuser of the Propulsion Wind Tunnel (16T) was installed and tested in the Aerodynamic Wind Tunnel (1T) Objectives of the test were to evaluate the effectiveness of a number of geometric modifications of the diffuser to improve diffuser performance Thirteen configurations involving combinations of six geometric modifications were evaluated in the tunnel Mach number range from 0 60 to 1 50 Author (GRA)

N79-23985# Air Force Human Resources Lab , Brooks AFB Tex

CONTRIBUTIONS OF PLATFORM MOTION TO SIMULATOR TRAINING EFFECTIVENESS STUDY 2 AEROBATICS Interim Report, Mar 1976 - Nov 1977

Elizabeth L Martin and Wayne L Waag Sep 1978 32 p refs (AF Proj 1123) (AD-A064305, AFHRL-TR-78-52) Avail NTIS HC A03/MF A01 CSCL 05/9

W J Renton Sep 1978 195 p refs 2 Vol (Contract F33615-76-C-5205) (AD-A065500, Rept-2-53500/8CRL-96 AFML-TR-78-127-Vol-1) Avail NTIS HC A09/MF A01 CSCL 11/1

A ranked list of adhesive property data required to predict the response of the adhesive in a bonded joint under a variety of load and environmental conditions experienced by aircraft structures is presented The assessed merits and deficiencies of existing test procedures to provide the adhesive property data are given along with a set of standard recommended test procedures for providing reliable low cost data The utility ease of performance, and low cost of these various test methods for adhesives representing brittle and ductile structural behavior is demonstrated J M S

N79-24155# Vought Helicopter Inc Dallas, Tex

STRUCTURAL PROPERTIES OF ADHESIVES, VOLUME 1 Final Technical Report, Apr 1976 - Sep 1978

A transfer of training design was used to evaluate platform of simulator training with synergistic six-degree-of-freedom platform motion to the acquisition of aerobatic skills in the novice pilot Thirty-six pilot trainees with no previous jet piloting experience were randomly assigned to one of the three groups motion no-motion, and control Student performances was evaluated by instructor ratings and data cards It is concluded that from an operational viewpoint, the data revealed no practical value of platform motion cueing and questions the cost effectiveness of acrobatic simulator training F O S

N79-24158# Army Mobility Equipment Research and Development Command, Fort Belvoir Va

WATER ABSORPTION OF FLUIDS/OILS Final Report

Robert G Jamison Jun 1978 32 p (AD-A065915 MERADCOM-2250) Avail NTIS HC A03/MF A01 CSCL 11/8

The object of the investigation was to determine the effects of water absorption on the inhibitor systems and basestocks of various hydraulic fluids and engine oils From this experimentation a need was generated to develop a more accurate method for analyzing water in these fluids and oils The results subsequently obtained verified the fact that absorbed water affects the stability of the inhibited fluid and oil systems Author (GRA)

N79-24161# Army Armament Research and Development Command, Dover N J Large Caliber Weapon Systems Lab

EVALUATION OF NEW BONDING SYSTEMS FOR DEPOT-LEVEL MAINTENANCE OF AIRCRAFT HONEYCOMB PANELS Final Report

Raymond F Wegman Marie C Ross William Russell and Elizabeth A Garnis Dec 1978 55 p refs (AD-A066117 AD-E400280 ARLCD-TR-78019) Avail NTIS HC A04/MF A01 CSCL 11/1

Four adhesive systems, EA 9628 ADX 656 2 PL 7178 and M1113, are evaluated and reported to be improvements over adhesives presently used for bonding honeycomb structures in army helicopters These systems have increased durability and fatigue properties but do not change the stiffness of the panel Using corrosion-inhibiting primers can increase the life expectancy of the structure provided the application of the primer is very stringently controlled An investigation into fracture analysis of failed joints indicates that the origin of failure the mechanism of crack propagation and an estimate of the load the joint experienced at the time of failure can be detected by a careful analysis of the joint A nondestructive technique by which the degradation in a bonded panel can be followed using the Harmonic Bond Tester has been evaluated The technique detects changes in the adhesive the onset of corrosion in the bond line and the presence of voids Author (GRA)

N79-24163# McDonnell Aircraft Co St Louis Mo

DEFINITION AND NON-DESTRUCTIVE DETECTION OF CRITICAL ADHESIVE BOND-LINE FLAWS Final Report, 27 Jun 1975 - 31 Jul 1978

H T Clark Wright-Patterson AFB Ohio AFML Jul 1978 93 p refs

(Contract F33615-75-C-5209 AF Proj 486U)
(AD-A065584 AFML-TR-78-108) Avail NTIS HC A05/MF A01 CSCL 11/6

Fatigue tests were conducted on adhesive bonded aluminum specimens with intentionally induced adhesive bondline flaws Specimen design details, materials type of surface preparation The test loadings were selected to be representative of those on the bonded wide-body fuselage test article designed and built in the PABST program Tests conducted in this report show that bondline flaws loaded primarily in shear did not grow whereas those loaded by peel or tension forces did exhibit flaw growth Flaw growth rate was higher at the slow rate of two cycles per hour than for a fast-cycle rate of 30 Hz Bondline flaws grew incrementally with load cycles and could be tracked by state-of-the-art NDE Author (GRA)

N79-24169# Air Force Academy Colo Research Lab
AIRCRAFT ENGINE OIL ANALYSIS BY NEUTRON ACTIVATION TECHNIQUES Summary Report
Thomas A Menard Dec 1978 60 p refs
(AF Proj 2303)
(AD-A066202, FJSRL-TR-78-0016) Avail NTIS HC A04/MF A01 CSCL 11/8

At the present time all three military services use the Spectrometric Oil Analysis Program (SOAP) for the routine analysis of engine oil samples The purpose of this program is to continually monitor the amounts of wear metal contaminants found in engine oil as an indicator of engine wear and possible engine failure Use of such a program results in large savings by extending the time between oil changes and more importantly by indicating when engines should be taken out of service for preventive *maintenance The current program uses either atomic emission* or atomic absorption for the analysis The problems associated with the current methods are twofold First, the instruments *require a laboratory environment and the results from a particular* sample may take days to return to the user Under these conditions an engine might be operated to failure before notification of a failed oil sample Secondly, the instruments are fairly expensive This report summarizes the research which was done using Californium-252 as a neutron source in order to determine the feasibility of using such a source for analyzing USAF aircraft engine oil samples by neutron activation techniques The desired solution would be an inexpensive facility which could be located on every flightline and provide the individual concentration of 13 different elements in each oil sample prior to the aircraft being flown again GRA

N79-24172*# Boeing Commercial Airplane Co Seattle, Wash
DESIGN AND EVALUATION OF AIRCRAFT HEAT SOURCE SYSTEMS FOR USE WITH HIGH-FREEZING POINT FUELS Final Report
A J Pasion NASA May 1979 53 p refs
(Contract NAS3-20815)
(NASA-CR-159568 D6-48097) Avail NTIS HC A03/MF A01 CSCL 21D

The objectives were the design performance and economic analyses of practical aircraft fuel heating systems that would permit the use of high freezing-point fuels on long-range aircraft Two hypothetical hydrocarbon fuels with freezing points of -29 C *and -18 C were used to represent the variation from current* day jet fuels A Boeing 747-200 with JT9D-7/7A engines was used as the baseline aircraft A 9300 Km mission was used as the mission length from which the heat requirements to maintain the fuel above its freezing point was based J A M

N79-24178# Department of Energy Bartlesville Okla Energy Technology Center
STABILITY CHARACTERISTICS OF HYDROCARBON FUELS FROM ALTERNATIVE SOURCES
Dennis W Brinkman, M L Whisman, and John N Bowden Mar 1979 40 p refs
(BETC/RI-78/23) Avail NTIS HC A03/MF A01

Two samples of gasoline and six samples of jet fuel derived from coal tar sands or oil shale were subjected to accelerated storage stability tests at 43 3 and 93 3 C Two samples of commercial petroleum-based gasoline and one sample of a *petroleum based jet fuel also were evaluated in this program* for comparative purposes DOE

N79-24201# National Technical Information Service, Springfield Va
AIRCRAFT SONIC BOOM EFFECTS ON BUILDINGS A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979
Guy E Habercom Jr Apr 1979 82 p Supersedes NTIS/PS-78/0239 NTIS/PS-77/0219 NTIS/PS-76/0176
(NTIS/PS-79/0265/3 NTIS/PS-78/0239 NTIS/PS-77/0219 NTIS/PS-76/0176) Avail NTIS HC $28 00/MF $28 00 CSCL 01C

Research findings are cited on the effects of sonic booms *on buildings structural components forms, windows and walls* Test-house investigations are included along with damage analysis and vibration response Documentation is made on residential buildings Other topics contained in the volume range from theory to failure analysis GRA

N79-24202# Advisory Group for Aerospace Research and Development Paris (France)
RESEARCH AND DEVELOPMENT ACTIVITIES IN ITALY IN THE FIELD OF AEROSPACE STRUCTURES AND MATERIALS
L Lazzarino (Pisa Univ, Italy) Mar 1979 27 p refs Presented at the 47th Meeting of the AGARD Structures and Mater Panel Florence Italy, 25 Sep 1978
(AGARD-R-675, ISBN-92-835-1315-0) Avail NTIS HC A03/MF A01

The activities concerned with metallic and nonmetallic aerospace materials along with the fields of stress analysis, vibrations and aeroelasticity fatigue and crack propagation and particularly, interesting work aimed at resolving design problems and at facilitating the introduction of new technologies The main facilities developed are indicated M M M

N79-24214# Ohio State Univ Columbus Electroscience Lab
HIGH FREQUENCY NEAR FIELD SCATTERING BY AN ELLIPTIC DISK
Eric D Greer and W D Burnside Dec 1976 64 p refs
(Contract N62269-76-C-0554)
(AD-A065586, ESL-4583-1, NADC-79041-30) Avail NTIS HC A04/MF A01 CSCL 09/5

The analysis of the high frequency radiation pattern of an antenna mounted near an elliptic disk is the object of this research This is an analytic study of basic antenna types using GTD (ray optical) techniques The elliptic disk is modelled as a perfectly conducting flat plate and patterns are taken in the far field An *equivalent current modification is introduced to correct caustic* and pseudo-caustic regions where the GTD solution fails The validity of the solution is shown by comparing the predicted pattern against measured results The elliptic disk solution can be used to approximate antenna patterns of antenna mounted near arbitrary cross-section flat plates This solution can also be used as part of an elliptic cylinder solution for aircraft and ship models Author (GRA)

N79-24215# Ohio State Univ, Columbus Electroscience Lab
FUSELAGE-MOUNTED ANTENNA CODE USER'S MANUAL
W D Burnside, R J Marhefka, and E L Pelton Jul 1977 75 p refs
(Contract N62269-76-C-0554)
(AD-A065587 ESL-4583-2, ESL-784583 NADC-79042-30) Avail NTIS HC A04/MF A01 CSCL 09/5

This manual describes the input and output data associated with the volumetric computer code which has been delivered to the Naval Air Development Center The input data is defined in general terms and applied to the Boeing 737 aircraft Numerous examples are included to illustrate the various features of the computer code Author (GRA)

N79-24216# Ohio State Univ Columbus Electroscience Lab
WING-MOUNTED ANTENNA CODE USER'S MANUAL
R J Marhefka and W D Burnside May 1978 86 p refs
(Contract N62269-76-C-0554)
(AD-A065589 ESL-(78)4583-5 NADC-79044-30) Avail NTIS HC A05/MF A01 CSCL 09/5

This report provides the necessary information to run a FORTRAN IV computer code which is used to analyze antenna patterns The antenna can be in the presence of various structures which can be simulated by finite flat plates an infinite ground plane and a finite elliptic cylinder For example the radiation pattern of an antenna mounted on the wing of an aircraft can be analyzed The computer code is theoretically based on the Geometrical Theory of Diffraction approach Various examples are presented to illustrate the versatility of the code as well as its subtleties Author (GRA)

N79-24217# Ohio State Univ, Columbus Electroscience Lab
AN ITERATIVE APPROACH FOR COMPUTING AN ANTENNA APERTURE DISTRIBUTION FROM GIVEN RADIATION PATTERN DATA
E L Pelton R J Marhefka, and W D Burnside Jun 1978 45 p refs
(Contract N62269-76-C-0554)
(AD-A065590 ESL-(78)4583-6 NADC-79045-30) Avail NTIS HC A03/MF A01 CSCL 09/5

An iterative synthesis procedure is presented and applied to the problem of computing the complex aperture distribution of an antenna given its far field magnitude pattern The methods employed are applicable to antennas composed of either discrete or continuously distributed apertures flush-mounted in a finite or infinite ground plane The solutions obtainable with the procedure are particularly useful for subsequent numerical computation of an antenna s radiation pattern performance when introduced into a different structural environment Several example solutions are presented to demonstrate the procedure and to point out specific techniques found useful in its implementation Author (GRA)

N79-24220# Ohio State Univ Columbus Electroscience Lab
OPTIMUM FREQUENCIES FOR AIRCRAFT CLASSIFICATION
Lin Heng-Cheng and A A Ksienski Jan 1979 124 p refs
(Grant AF-AFOSR-2611-74 AF Proj 2304)
(AD-A065697 ESL-(78)3815-6 AFOSR-79-0255TR) Avail NTIS HC A06/MF A01 CSCL 17/9

The results are presented of a search for optimum frequencies to classify eight aircraft types by means of their radar returns The performance in terms of misclassification probabilities as a function of SNR is presented for different feature sets ranging from amplitude returns for a single frequency through amplitude and phase for various frequency pairs Author (GRA)

N79-24229# Ohio State Univ Columbus Electroscience Lab
AN ASYMPTOTIC RESULT FOR THE SCATTERING OF A PLANE WAVE BY A SMOOTH CONVEX CYLINDER
P H Pathak Mar 1978 41 p refs
(Contract N62269-76-C-0554)
(AD-A065588 ESL-(78)4583-3 NADC-79043-30) Avail NTIS HC A03/MF A01 CSCL 20/14

An approximate asymptotic high frequency result which is convenient for engineering applications is obtained for the field scattered by a smooth perfectly-conducting convex cylinder when it is illuminated by a plane wave This result is uniform in the sense that it remains valid within the transition regions adjacent to the shadow boundaries where the pure ray optic (or GTD) solution fails and it automatically reduces to the ray optic solution exterior to the transition regions where the latter solution becomes valid Furthermore this result is expressed in the convenient format of the GTD and it employs the same ray paths as in the GTD solution This uniform result is not valid in the close neighborhood of the cylinder hence a separate asymptotic result is presented for this special case in a form which is also convenient for applications The asymptotic results presented here are useful for predicting the patterns of antennas radiating in the presence of convex conducting cylindrical structures Author (GRA)

N79-24232# SRI International Corp, Menlo Park Calif
NAP-OF-THE-EARTH COMMUNICATION PROGRAM FOR US ARMY HELICOPTERS Final Report, 1 Mar 1976 - 31 Mar 1978
Bruce C Tupper and George H Hagn Jun 1978 331 p refs
(Contract DAAB07-76-C-0868 SRI Proj 4979)
(AD-A063089 USAAVRADCOM-76-0868-F) Avail NTIS HC A15/MF A01 CSCL 17/2

The communication problem, requirements and solutions for helicopters flying nap-of-the-earth (NOE) in the modern battlefield are given A model for predictions of communication ranges in irregular terrain (terrain noise environment and radio system parameters as variables) was developed Model inputs are median basic transmission loss man-made atmospheric and galactic noise, candidate radio system parameters (Transmitter ERP and required SNR at receiver), and the standard deviations of these parameters The model output is the probability of successful communication at a given range in irregular terrain The model was used in the European SCORES scenario to predict communication and mission effectiveness in the Fulda region for candidate radio systems Limited model validation data are given Quantitative test results for the TCATA FM-320 NOE communication test are given and discussed These tests compared the AN/ARC-117 Baseline radio with other radio candidates 40-W VHF Retransmission and HF/SSB In addition quantitative results are given for VHF/FM HF/SSB and satellite NOE systems tests J M S

N79-24342 British Library Lending Div, Boston Spa (England)
TWO-STAGE SUPERCHARGER SETS EFFICIENCY AND HEAD DISTRIBUTION UNDER FULL- AND PART-LOAD CONDITIONS
Hanns-Guenther Bozung Mar 1979 26 p refs Transl into ENGLISH from Motortech Z (West Germany) v 39 no 5 1978 p 209-215
(RTS-11613) Avail British Library Lending Div Boston Spa Engl

The following topics are discussed (1) exhaust gas turbocharger requirements (2) limits of single-stage exhaust gas turbocharging (3) possibilities of two-stage exhaust gas turbocharging (4) efficiency and (5) part-load performance G Y

N79-24350*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
DIAGNOSTICS OF WEAR IN AERONAUTICAL SYSTEMS
L D Wedeven 1979 5 p refs Presented at the 15th State-of-the-Art Symp on Corrosion and Wear Washington D C, 4-6 Jun 1979, sponsored by the Am Chem Soc
(NASA-TM-79185 E-052) Avail NTIS HC A02/MF A01 CSCL 20K

Maintenance costs associated with the transmissions and drive train greatly increase the maintenance burden and failure risk Detection measurements fall under two general categories of vibration and particle detectors The latter are more amenable to tracking wear Wear debris analysis can supply a great deal of information such as particle concentration rate of change in concentration composition particle size and shape principal metals etc It is not economically feasible to monitor all variables At least one role of the lubrication and wear specialist is to provide guidance in selecting the most appropriate variables to monitor R E S

N79-24378# Iowa Univ Iowa City Materials Engineering Div
DYNAMIC STRUCTURAL ANALYSIS WITH SUBSTRUCTURES Interim Technical Report, Sep - Dec 1978
Jasbir S Arora and Duc T Nguyen Dec 1978 34 p refs
(Contract DAAK11-77-C-0023)

(AD-A065937 TR-46) Avail NTIS HC A03/MF A01 CSCL 13/13

A method for dynamic structural analysis with substructures and the subspace iteration is developed The method does not use component mode synthesis concepts Therefore eigenproblem for each substructure is not solved The method uses only substructural stiffness matrices and the mass matrix for each finite element of the system The mass matrix for the entire structure or any of its substructures need not be computed However efficiency of the method is improved when mass matrix for the entire structure is computed and saved in the computer core Unlike component mode substitution methods, no approximating assumptions are made Thus natural frequencies and mode shapes for the finite element model employed are the same with or without the substructuring algorithm This is demonstrated by computing first ten natural frequencies and the corresponding mode shapes for an open truss helicopter tail-boom structure Author (GRA)

N79-24379# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

ANALYZE ANALYSIS OF AEROSPACE STRUCTURES WITH MEMBRANE ELEMENTS Final Report, May - Aug 1978

Vipperla B Venkayya and Victoria A Tischler Dec 1978 117 p refs

(AD-A065633 AFFDL-TR-78-170) Avail NTIS HC A06/MF A01 CSCL 13/13

This report contains documentation for the program ANALYZE The program library consists of a bar a membrane triangle a quadrilateral and a shear panel The equations of finite element analysis element formulations program organization and subroutine descriptions provide a comprehensive theoretical background for the program The input and output instructions together with the sample problem and the results should provide adequate information for the use of this program ANALYZE' is an in-house program and can be used on INTERCOM for problems up to 150 to 200 degrees of freedom and a comparable number of elements This program is extremely useful in training engineers in the use of finite element programs in the development of finite element models of large aerospace structures and in research in structural analysis and optimization Author (GRA)

N79-24773*# National Aeronautics and Space Administration Langley Research Center Hampton Va

STATISTICAL COMPARISONS OF AIRCRAFT FLYOVER NOISE ADJUSTMENT PROCEDURES FOR DIFFERENT WEATHER CONDITIONS

Arnold W Mueller and David A Hilton May 1979 35 p refs (NASA-TP-1430 L-12626) Avail NTIS HC A03/MF A01 CSCL 20A

Aircraft flyover noise spectra and effective perceived noise level (EPNL) values obtained under widely different weather conditions were adjusted according to a proposed national standard The results were statistically compared with the same measured spectra adjusted according to an alternate procedure and with reference spectra and EPNL values obtained under almost ideal weather conditions Three different ways to represent the weather condition through which the sound propagated were also evaluated J M S

N79-24779# Forschungsinstitut fuer Hochfrequenzphysik Werthhoven (West Germany)

DETECTION OF LOW FLYING AIRCRAFT BY ACOUSTICAL MEANS

J Schiller Jul 1978 52 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung (Rept-8-78) Avail NTIS HC A04/MF A01

Detection and location of very low flying aircraft is often impossible or at least very difficult to achieve by radar The idea of filling this detection gap by making use of the acoustic noise radiated from an aircraft is considered Some general thought is given to the problem of acoustically measuring parameters of targets that move with speeds close to sonic speed Some preliminary experiments allow a rough estimate of the detection range and bearing measurement errors to be made Author (ESA)

N79-24780# National Technical Information Service Springfield Va

AIRCRAFT SONIC BOOM STUDIES ON AIRCRAFT FLIGHT, AIRCRAFT DESIGN, AND MEASUREMENT A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979

Guy E Habercom Jr Apr 1979 197 p Supersedes NTIS/PS-78/0238, NTIS/PS-77/-0218 NTIS/PS-76/0175 (NTIS/PS-79/0264/6 NTIS/PS-78/0238 NTIS/PS-77/0218, NTIS/PS-76/0175) Avail NTIS HC $28 00/MF $28 00 CSCL 20A

The reports discuss aerodynamic design of aircraft and wings flight characteristics and maneuvers, supersonic transport characteristics acoustic fields and noise measurement government policies and regulations meteorological parameters shock waves, and supersonic and hypersonic wind tunnel tests along with other theoretical and general investigations This updated bibliography contains 188 abstracts 7 of which are new entries to the previous edition GRA

N79-24940# Joint Publications Research Service, Arlington Va

APPLICATION OF ELECTRON-BEAM WELDING TO AVIATION PRODUCTION

Henryk Zatyka *In its* Transl on Eastern Europe Sci Affairs, No 625 (JPRS-73266) 20 Apr 1979 p 22-36 refs Transl into ENGLISH from Tekhn Lotniczna i Astronautyczna (Warsaw) no 1 Jan 1979 p 29-33

Avail NTIS HC A03/MF A01

An electron beam furnace used in the serial production of small turbines and turbocompressors for nonaviation production in Poland, was modified to melt the metal required for welding aircraft turbines engine parts Technical parameters of the welding process were established and instrumentation to insure high output was developed and executed Metallurgical and strength tests were conducted on welded joints and conditions for welding a turbine were established which would insure a weld without faults and of the required strength Five turbine disks were welded and after further mechanical working were subjected to long term tests (2,000 hours) A R H

N79-24951*# National Aeronautics and Space Administration Washington D C

ADVANCED ROTORCRAFT TECHNOLOGY TASK FORCE REPORT

15 Oct 1978 189 p

(NASA-TM-80541) Avail NTIS HC A09/MF A01 CSCL 02A

The technological needs and opportunities related to future civil and military rotorcraft were determined and a program plan for NASA research which was responsive to the needs and opportunities was prepared In general the program plan places the primary emphasis on design methodology where the development and verification of analytical methods is built upon a sound data base The four advanced rotorcraft technology elements identified are aerodynamics and structures flight control and avionic systems propulsion and vehicle configurations Estimates of the total funding levels that would be required to support the proposed program plan are included A R H

N79-24955*# National Aeronautics and Space Administration Langley Research Center Hampton Va

STATUS OF KNOWLEDGE OF SONIC BOOMS

Domenic J Maglieri, Harry W Carlson, and Harvey H Hubbard Jun 1979 20 p refs Presented at the 97th Tech Meeting of the Acoustical Soc of America Cambridge, Mass 12-16 Jun 1979

(NASA-TM-80113) Avail NTIS HC A02/MF A01 CSCL 01A

The status of sonic boom technology with emphasis on the recent research results is summarized Included are definitions

of the boom carpets both primary and secondary a discussion of existing experience with primary booms including the status of overpressure predictions and boom minimization methodology through airplane design an indication of the boom waveforms and audibility and a discussion of focus booms resulting from aircraft maneuvers as well as the effect of abnormal atmospheric conditions on these maneuver booms M M M

N79-24956*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A VECTOR-CONTINUOUS LOADING CONCEPT FOR AERODYNAMIC PANEL METHODS
William B Kemp Jr May 1979 39 p refs
(NASA-TM-80104) HC A03/MF A01 CSCL 01A

An approach to the reduction of discretization errors in aerodynamic panel methods is presented The approach is based on preventing the occurence of induced velocity singularities at panel slope discontinuities by maintaining continuity of the velocity jump vector across the panels The approach was implemented in a two-dimensional incompressible panel method formulation and evaluated by application to several external and internal flow problems The method is shown to exhibit a second order accuracy trend and to produce smaller errors with velocity component boundary conditions imposed on the real flow than with equipotential boundary conditions imposed on the imaginary flow behind the panels For flows around airfoil sections with either sharp or blunt trailing edges the method gives excellent agreement with results from a well developed finite difference method The method is well behaved and is insensitive to irregularities in panel size distribution S E S

N79-24958*# National Aeronautics and Space Administration Langley Research Center Hampton Va
HELICOPTER ROTOR AIRFOIL Patent Application
Gene J Bingham inventor (to NASA) Filed 6 Mar 1979 21 p
(NASA-Case-LAR-12396-1 US-Patent-Appl-SN-017889) Avail NTIS HC A02/MF A01 CSCL 01A

An airfoil which has particular application to the blade or blades of rotor aircraft and aircraft propellers is presented The airfoil thickness distribution camber and leading edge radius are shaped to locate the airfoil crest at a more aft position along the chord and to increase the freestream Mach number at which sonic flow is attained at the airfoil crest The reduced slope of the airfoil causes a reduction in velocity at the airfoil crest at lift coefficients from zero to the maximum lift coefficient The leading edge radius is adjusted so that the maximum local Mach number at 1 25 percent chord and at the designed maximum lift coefficient is limited to about 0 48 when the Mach number normal to the leading edge is approximately 0 20 The lower surface leading edge radius is shaped so that the maximum local Mach number at the leading edge is limited to about 0 29 when the Mach number normal to the leading edge is approximately 0 20 The drag divergence Mach number associated with the airfoil is moved to a higher Mach number over a range of lift coefficients resulting in superior aircraft performance NASA

N79-24959*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
AN ANNULAR WING Patent Application
Harold J Walker inventor (to NASA) Filed 30 May 1979 25 p
(NASA-Case-FRC-11007-2 US-Patent-Appl-SN-043911) Avail NTIS HC A02/MF A01 CSCL 01A

An annular wing suitable for supporting in flight an aircraft characterized by the absence of directional stabilizer surfaces is described The wing comprises an annular body of a substantially uniformly symmetrical configuration characterized by an annular positive lifting surface and a chord line coincident with a segment of a line radiating along the surface of an inverted truncated cone whereby a decalage is established for the leading and trailing semicircular portions of the body relative to instantaneous line of flight and a dihedral is established for the laterally opposed semicircular portions of the body relative to the line of flight The direction of flight and the climb angle or glide slope are established by selectively positioning the center of mass of the wing ahead of the aerodynamic center along a radius coincident with an axis for a selected line of flight NASA

N79-24960*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LOW-SPEED WIND TUNNEL RESULTS FOR A MODIFIED 13-PERCENT-THICK AIRFOIL
Robert J McGhee and William D Beasley May 1977 41 p refs
(NASA-TM-X-74018) Avail NTIS HC A03/MF A01 CSCL 01A

Wind-tunnel tests were conducted to evaluate the effects on performance of modifying a 13-percent-thick low-speed airfoil The airfoil contour was altered to reduce the aft upper surface pressure gradient and hence delay boundary layer separation at typical lift coefficients for light general aviation airplanes The tests were conducted at a Mach number of 0 15 or less over a Reynolds number range from about 1 000 000 to 9 000 000 Author

N79-24961*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LOW-SPEED WIND-TUNNEL INVESTIGATION OF WING FINS AS TRAILING-VORTEX-ALLEVIATION DEVICES ON A TRANSPORT AIRPLANE MODEL
Delwin R Croom and G Thomas Holbrook Jun 1979 30 p refs
(NASA-TP-1453 L-12776) Avail NTIS HC A03/MF A01 CSCL 01A

The trailing-vortex-alleviation effectiveness of both a one- and a two-fin configuration (semicircular with a radius of 0 043 semispan) on a jumbo-jet transport airplane model in its landing configuration was investigated in the Langley V/STOL tunnel by the trailing-wing sensor technique The fins were located on the upper surface of the transport model wing along the 30-percent-chord line The fin configurations were effective in reducing the vortex-induced rolling moment by amounts varying from 28 to 60 percent on the trailing wing model located at a distance of 7 8 transport model wing spans downstream of the transport model The flow over the fins and over the transport airplane model wing downstream of the fins was observed to be separated and turbulent All fin configurations caused a reduction in maximum lift coefficient a positive increment in drag coefficient and an increment in nose-up pitching-moment coefficient on the transport airplane model J M S

N79-24963# Naval Postgraduate School Monterey Calif
THEORETICAL ANALYSIS OF TRANSONIC FLOW PAST UNSTAGGERED OSCILLATING CASCADES M S Thesis
Peter Carlton Olsen Sep 1978 135 p refs
(AD-A063083) Avail NTIS HC A07/MF A01 CSCL 20/4

An independent verification of the collocation method as a technique for calculating the lift on an oscillating airfoil in an unstaggered cascade immersed in transonic flow is presented Two formulations are shown one is purely numerical the second employs an analytic expansion for small frequency Author (GRA)

N79-24965# Boeing Aerospace Co Seattle Wash
FACTORS INFLUENCING THE ACCURACY OF AERODYNAMIC HINGE-MOMENT PREDICTION Final Report, Apr 1977 - Apr 1978
Wen-Fan Lin and Michael D Clarke Aug 1978 107 p refs (Contract F33615-76-C-3170 AF Proj 2403)
(AD-A066606 D180-24604-1 AFFDL-TR-78-72) Avail NTIS HC A06/MF A01 CSCL 01/3

This report is concerned with factors influencing the accuracy of aerodynamic hinge-moment analyses The formulation and coding of the hinge-moment analysis in the FLEXSTAB system of computer programs are reviewed The investigation is centered on the sensitivity of the hinge moments of the YF-16 airplane to paneling configuration, including the near-field/far-field techniques The results are compared with test data The effect of elasticity is also considered The other existing aerodynamic methods for predicting control-surface loading are also reviewed and discussed These methods include Datcom RHO 4 higher

order lifting-surface methods such as TEA 230 and the PAN AIR pilot program and new theoretical approaches employing asymptotic expansion methods to account for local hinge-line corner and side-edge effects Recommendations are made as to the best approach currently to employ in the panel methods as well as future research areas related to hinge-moment analysis Author (GRA)

N79-24966# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3B FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FREQUENCY BAND, AIR EJECTOR SYSTEMS AND OTHER DEVICES Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 203 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A061767 USARTL-TR-78-23C-Vol-3B) Avail NTIS HC A10/MF A01 CSCL 01/3

This is the second of the two sub-volumes comprising Volume III These documents present profiles of the RMS values of the wake flow angles and velocities in the 1 Omega to 2 Omega range The format is waterline on the ordinate and velocity or flow angle on the abscissa Each graph shows a comparison of the baseline flow to the flow modified by some device or condition This sub-volume covers air ejector systems air ejectors and hub caps in same configuration wings fairings and miscellaneous devices Author (GRA)

N79-24967# Boeing Vertol Co Philadelphia, Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2B HARMONIC ANALYSIS OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7-14, MID SECTION Final Report, Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 219 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A061860 USARTL-TR-78-23B-Vol-2B) Avail NTIS HC A10/MF A01 CSCL 01/3

This is the second of the nine sub-volumes of Volume II These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage This sub-volume covers the first eight of the twenty-seven runs devoted to surface pressure testing The analyses encompass the transducers in the middle section of the model Test conditions and configurations include baseline data climb and descent, disk loading variation and application of strakes Author (GRA)

N79-24968# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 6B ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA, BASIC CONFIGURATION WAKE EXPLORATIONS Final Report, Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 374 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A061861 USARTL-TR-78-23F-Vol-6B) Avail NTIS HC A16/MF A01 CSCL 01/3

This is the second of the three volumes of Volume VI containing one-third octave band spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data This sub-volume deals with the wake characteristics of the baseline configuration Author (GRA)

N79-24970# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung
THE COMPUTATION OF TRANSONIC FLOW IN WIND TUNNELS AT INLETS AND CASCADES USING THE FINITE ELEMENT METHOD
Albrecht Eberle 5 Apr 1978 55 p refs In GERMAN ENGLISH
(MBB-UFE-1421-O) Avail NTIS HC A04/MF A01

A very flexible finite element/volume approach to the solution of classical potential transonic flow problems was developed to be used with computer methods for calculating theoretical flow past airfoil profiles The solution assumes quasi two-dimensional flow Since orthogonal meshgrids are not needed the computer codes are extremely simple As examples of applications the computation of transonic ducted flow in nozzles wind tunnels inlets and plane cascades is shown Author (ESA)

N79-24971 British Library Lending Div Boston Spa (England)
FORCASTING THE QUANTITATIVE CHARACTERISTICS OF AIRCRAFT ICING
K G Abramovich G V Vasil'yeva and V M Prokhorova 2 Jun 1978 17 p refs Transl into ENGLISH from Tr Gidromet Nauch.-Issled Tsent SSSR (Leningrad) v 176, 1977 p 76-85 In ENGLISH and RUSSIAN
(BLL-Trans-1364-(9022 549)) Avail British Library Lending Div, Boston Spa Engl

The quantitative characteristics of aircraft icing from data on the condition of the atmosphere in cloud layers with the aid of statistical analysis by computer are presented The differences between the computed and actual intensities are relatively small for moderate icing For slight icing the computed values were enhanced while for severe icing they were depressed The temperature and height of cloud base varied considerably within the limits of each class of intensity resulting in high mean values M M M

N79-24974# National Aviation Facilities Experimental Center Atlantic City, N J
AN EVALUATION OF TURN ANTICIPATION TECHNIQUES AND OFFSET FLYING PROCEDURES USING A SINGLE-WAYPOINT RNAN SYSTEM Final Report, May - Nov 1977
Bernard Goldberg Donald Eldredge, and William Crimbring Jan 1979 88 p refs
(FAA Proj 044-326-350)
(AD-A066555 FAA-NA-78-41, FAA-RD-78-114) Avail NTIS HC A05/MF A01 CSCL 17/7

The purpose is to document the results of a three-phased cockpit simulation which was conducted to evaluate turn application techniques applicable for use with a single-waypoint, general aviation type area navigation system Techniques were evaluated for both centerline and offset tracking Performance was measured for two variables total system crosstrack error and flight technical error The major findings were (1) all turn anticipation techniques tested could be used for centerline tracking (2) no significant differences could be discovered between steady state and offset turn data, (3) a useable technique for turn anticipation during offset tracking is complex and contributes greatly to the pilot workload J A M

N79-24976* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
SELF STABILIZING SONIC INLET Patent
Brent A Miller inventor (to NASA) Issued 15 May 1979 5 p Filed 29 Mar 1978
(NASA-Case-LEW-11890-1 US-Patent-4,154 256 US-Patent-Appl-SN-891244, US-Patent-Class-137-15 1 US-Patent-Class-244-53B) Avail US Patent and Trademark Office CSCL 01C

An inlet suitable for a turbine engine in a STOL VTOL or CTOL aircraft is described A circumferentially extended slot is provided in the inner surface of the air inlet at the windward side and downstream of the throat region The slot communicates with a circumferential plenum chamber formed in the front of the air inlet just behind the lip Circumferentially extending rows of apertures are provided on the lip establishing two sets of apertures spaced circumferentially away from the slot in opposite directions The slot removes the boundary layer from the critical portion of the diffuser to minimize or eliminate flow pressure loss or separations resulting from diffusion or tuning The apertures are in a region of low static pressure on the lip of the inlet and serve as a source of suction to cause air flow into the slot
Official Gazette of the U S Patent and Trademark Office

N79-24977 Stanford Univ Calif
A VARIATIONAL THEOREM FOR LAMINATED COMPOSITE PLATES OF NONLINEAR MATERIALS AND APPLICATIONS TO POSTBUCKLING Ph D Thesis
Robert Elon Anderson 1979 206 p
Avail Univ Microfilms Order No 7912335

A prediction capability for the response under edge loading of anisotropic layered flat plates composed of orthotropic laminae possessing nonlinear stress-strain characteristics was investigated Confidence in the results presented for the prediction of laminated plate stress-strain response and the elasto-plastic postbuckling of one type of simply supported square laminated plate under axial compression loading is obtained by comparison of predictions based on current theory analysis and solution procedures with reliable experimental data and limiting case (isotropic and orthotropic) solution results It was concluded that advanced composite laminates consisting of arbitrarily oriented orthotropic filamentary laminae are tractable by variational analysis and that such laminates acting as uniaxially compressed postbuckled plates are as fundamentally sensitive to material nonlinearity as their conventional metal counterparts Dissert Abstr

N79-24978*# Douglas Aircraft Co Inc Long Beach Calif
CARGO LOGISTICS AIRLIFT SYSTEMS STUDY (CLASS) VOLUME 2 CASE STUDY APPROACH AND RESULTS
R J Burby and W H Kuhlman Oct 1978 98 p Prepared in cooperation with Flying Tiger Line
(Contract NAS1-14948)
(NASA-CR-158913) Avail NTIS HC A05/MF A01 CSCL 01C

Models of transportation mode decision making were developed The user's view of the present and future air cargo systems is discussed Issues summarized include (1) organization of the distribution function (2) mode choice decision making (3) air freight system and (4) the future of air freight SES

N79-24980*# *National Aeronautics and Space Administration* Langley Research Center Hampton, Va
A COOLING SYSTEM FOR AN AIRCRAFT HAVING A CRUISE RANGE FROM MACH 2 TO MACH 8 Patent Application
Pierce L Lawing and Laverne L Pagel inventors (to NASA) (McDonnell Aircraft Co) Filed 31 Jan 1979 21 p
(NASA-Case-LAR-12406-1 US-Patent-Appl-SN-008210) Avail NTIS HC A02/MF A01 CSCL 01C

The necessity of shielding an aircraft airframe constructed of material such as aluminum is eliminated by using a system which provides total cooling for an airframe designed to fly in the speed range of Mach 2 to Mach 8 Cooling is accomplished by passing a coolant through the aircraft airframe the coolant acting as a carrier to remove heat from the airframe The coolant is circulated through a heat pump and a heat exchanger which together extract essentially all of the added heat from the coolant The heat is transferred to the aircraft fuel system via the heat exchanger and the heat pump The heat extracted from the coolant is utilized to power the heat pump The heat pump is associated with a power turbine mechanism which is also driven by the extracted heat The power turbines are utilized to drive various aircraft subsystems the compressor of the heat pump and provide engine cooling This system is accomplished with a small increase in aircraft weight and a total result of a small increase in performance NASA

N79-24981# Douglas Aircraft Co Inc Long Beach Calif
FEASIBILITY AND COST EFFECTIVENESS OF AIRBORNE TIRE PRESSURE INDICATING SYSTEMS Final Report, Sep 1977 - Sep 1978
R Suiter Oct 1979 122 p refs
(Contract DOT-FA77WA-4070)
(AD-A065513 FAA-RD-78-134-1) Avail NTIS HC A06/MF A01 CSCL 01/3

The wheel mounted pressure readout gauges and devices and cockpit tire pressure warning indicators for air carrier transports having 6 10 and 18 wheels are studied Typical wheel mounted readout devices and eleven conceptual cockpit indicating systems are discussed Information on accuracy temperature compensation requirements weight installation cost system cost and system maintenance cost is provided A study of tire failures is made for 1973-1976 identifying rate of tire failures and aircraft damage costs resulting from tire failures Sixty-five percent of airframe damage cost is related to underinflation - induced or related tire failures which may be avoided by a property designed tire pressure indicating system Average airframe damage cost per departure for each study aircraft based on actual airline data is presented with comments on delay and cancellation costs Aircraft damage costs and tire maintenance costs may be avoided are compared to tire pressure indicating system life cycle costs to shot that tire pressure systems are basically feasible but marginally cost effective aircraft testing of promising systems is recommended M M M

N79-24982# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
PROCEEDINGS OF AFFDL FLYING QUALITIES SYMPOSIUM Interim Report, Aug 1973 - Sep 1978
G Thomas Black David J Moorhouse and Robert J Woodcock Dec 1978 639 p refs Symp held at Dayton, Ohio 12-15 Sep 1978
(AD-A066493 AFFDL-TR-78-171) Avail NTIS HC A99/MF A01 CSCL 01/2

The symposium was sponsored by the Air Force Flight Dynamics Laboratory as part of an effort to revise MIL-F-8785B Military Specification Flying Qualities of Piloted Airplanes Flying Qualities specialists were brought together from industry government agencies and university Topics for discussion were (1) experience and problems with MIL-F-8785B (2) revisions to MIL-F-8785B currently proposed by AFFDL/FGC (3) a new format for the flying qualities requirements, and (4) future requirements in general Full-length and informal papers were solicited to address any of the preceding topics In addition working sessions were organized to discuss the current revisions and future requirements from the viewpoints of different technical disciplines This report contains the papers and summaries of the working sessions as submitted by the authors GRA

N79-24983# Boeing Vertol Co Philadelphia Pa
HELICOPTER TRANSMISSION VIBRATION AND NOISE REDUCTION PROGRAM VOLUME 3 EVALUATION OF FIBER FP METAL-MATRIX HOUSING SPECIMENS Final Report, Mar - Oct 1978
Joseph W Lenski Jr Jan 1979 100 p refs
(Contract DAAJ02-74-C-0040 DA Proj 1G2-62207-AH-89) (AD-A066794 D210-11442-1-Vol-3 USARTL-TR-78-2C-Vol-3) Avail NTIS HC A05/MF A01 CSCL 01/3

The objective of the work performed under this contract was to demonstrate selective reinforcement of a cast magnesium housing by the use of high-modulus FP fibers via casting technology A series of housing element specimens were designed fabricated and tested to evaluate the application of state-of-the-art technology to the fabrication of a full-scale, fiber-reinforced metallic transmission housing Several typical housing section specimens were fabricated and tested to determine material properties These properties were compared with predicted values to develop the technology and analytical capability for the application of selective reinforcement of a full-scale helicopter transmission housing, with the final objective of reducing system deflections, noise, and vibration Author (GRA)

N79-24984# General Dynamics/Fort Worth Tex
COMPOSITE FORWARD FUSELAGE SYSTEMS INTEGRATION, VOLUME 2 Final Report, Apr 1977 - May 1978
B J Wallace, B J C Burrows, R T Zeitler A J Ledwig, and K G Wiles Sep 1978 149 p refs
(Contract F33615-76-C-5439)
(AD-A066560, AFFDL-TR-78-110-Vol-2) Avail NTIS HC A07/MF A01 CSCL 01/3

The Composite Forward Fuselage Systems Integration program has performed the development necessary to guide the integration of avionic and electrical systems into composite aircraft structure This volume of the report presents one phase of the

program, it presents that phase in which the induced effects of lightning are identified and modeled GRA

N79-24985# Sikorsky Aircraft Stratford Conn
AEROELASTICALLY CONFORMABLE ROTOR MISSION ANALYSIS Final Report
Robert H Blackwell and Sebastian J Cassarino Mar 1979 76 p refs
(Contract DAAJ02-77-C-0041 DA Proj 1L2-62209-AH-76)
(AD-A067338 SER-510017, USARTL-TR-79-5) Avail NTIS HC A05/MF A01 CSCL 01/3

An analytic study was conducted to assess the suitability of a conformable rotor for satisfying the requirements of a typical Army mission A conformable rotor blade is a blade designed to produce changes in blade twist with azimuth and flight condition which improve performance and reduce rotor loads This study quantified the performance advantages and rotor system load reductions possible with a conformable rotor by designing blades suited for the UH-60A mission and comparing calculated rotor behavior with that of the UH-60A rotor Relative to the UH-60A design the conformable blade employs a four-to-one reduction in torsional stiffness over the outer half of the blade a reduction in built-in twist from -16 to -12 degrees an increase from 20 to 30 degrees in tip sweep and reflex tab deflection inboard of the 80-percent radial position This design produces elastic response which increase twist in hover and reduces advancing blade twist in forward flight GRA

N79-24986# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-*Entwicklung*
POLAR LIFT AND DRAG DETERMINATION DURING FLIGHT TESTS [ERMITTLUNG VON AUFTRIERS UND *WIDERSTANDSPOLAREN IM FLUGVERSUCH*]
A Knaus 1 Mar 1978 70 p In GERMAN Presented at DGLR-Colloq Flugversuchserfahren im Milit Bereich Manching West Ger, 20-21 Apr 1978
(MBB-UFE-1410-0) Avail NTIS HC A04/MF A01

The various measurements and equipment necessary to determine the aerodynamic performance of an aircraft (stationary, normal flight maneuvering) are discussed Techniques developed for the Tornado test flight program are presented Measurements corresponding measurement parameters, and theoretical considerations are given For this aircraft, lift and drag characteristics were determined over a complete range of attack angles with an accuracy of between 4 percent and 5 percent Fully automated data handling techniques permit the results to be analyzed in minimum time Author (ESA)

N79-24987# General Accounting Office Washington, D C Procurement and Systems Acquisition Div
IS THE AV-8B ADVANCED HARRIER AIRCRAFT READY FOR FULL-SCALE DEVELOPMENT
30 Jan 1979 29 p
(PB-290826/7, PSAD-79-22) Avail NTIS HC A03/MF A01 CSCL 01C

The AV-8B Advanced Harrier aircraft reach the decision milestone for going into fullscale development GAO was advised by Department of Defense officials that the President and the Secretary of Defense decided not to request any funds for the AV-8B program and that the Under Secretary of Defense for Research and Engineering also refused to permit the Navy to obligate $108 million of the $123 million in full-scale development funds that was appropriated Unless this action is reversed by the Congress the AV-8B program will effectively be terminated GRA

N79-24988*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif
A SYSTEM FOR PROVIDING AN INTEGRATED DISPLAY OF INSTANTANEOUS INFORMATION RELATIVE TO AIRCRAFT ATTITUDE, HEADING, ALTITUDE, AND HORIZONTAL SITUATION Patent Application
Robert James inventor (to NASA) (James and Assoc Lancaster Calif) Filed 30 May 1979 45 p
(Contract NAS4-2199)
(NASA-Case-FRC-11005-1 US-Patent-Appl-SN-043942) Avail NTIS HC A03/MF A01 CSCL 01D

A display device is described which provides an aircraft pilot with combined inflight attitude heading, altitude and horizontal situation information This invention combines a commonly used and commercially available flight director-type devices for a display in combination with a miniature aircraft supported for angular displacement from a vertical orientation to indicate heading error or heading offset An extended course deviation indicator bar is also provided which projects into juxtaposition with the miniature aircraft for providing a true picture of the aircraft s horizontal situation relative to a selected VOR ILS or MLS course NASA

N79-24989# Lockheed-California Co Burbank Advanced Avionics Dept
ANALYSIS OF THE IMPACT OF A 270 VDC POWER SOURCE ON THE AVIONIC POWER SUPPLIES IN THE S-3A AIRCRAFT Final Report, Nov. 1977 - Nov 1978
27 Nov 1978 232 p refs
(Contract N62269-78-C-0007)
(AD-A066526 LR-28780 NADC-79012-60) Avail NTIS HC A11/MF A01 CSCL 09/5

The objective of this analysis was to determine the total platform impact on an S-3A avionic suite outfitted with 270 V DC switched mode regulators in lieu of standard 115/200 V 400 Hz transformer coupled series regulators and to quantify the resulting impact in terms of changes to aircraft weight mission performance fuel usage, reliability and LCC Author (GRA)

N79-24990# Draper (Charles Stark) Lab Inc Cambridge Mass
A REVIEW OF THE 3M DATA BASE FOR FAULT-TOLERANT SYSTEM INCENTIVES Final Report, Jul 1977 - Dec 1978
Albert L Hopkins Jr Jan 1979 37 p refs
(Contract N00014-76-C-0502)
(AD-A066697 R-1244) Avail NTIS HC A03/MF A01 CSCL 17/2

This report covers the second phase of the subject contract whose first phase was the study of a hierarchical form of a fault-tolerance data communication network The second phase task involved an examination of the Navy's 3-M (maintenance material management) data base to see if any evidence was readily available or easily extractable to affirm or refute the hypotheses underlying fault-tolerant system design A large volume of aggregate data was examined for three aircraft types the E-2C the P-3C, and the S-3A Several broad conclusions were reached with respect to the fault-tolerant system design hypotheses Some observations and interferences are presented to conclude this report Author (GRA)

N79-24991# *Honeywell Inc Minneapolis Minn* Systems and Research Center
COLOR DISPLAY DESIGN GUIDE Final Report, 15 Apr 1977 - 31 Dec 1978
Marjorie J Krebs James D Wolf, and John H Sandvig Oct 1978 224 p refs
(Contract N00014-77-C-0349)
(AD-A066630 HONEYWELL-78SRC79 ONR-CR-213-136-2F) Avail NTIS HC A10/MF A01 CSCL 01/3

The objective was to develop a design guide for the use of color in advanced avionics displays Study results are presented in two parts Part I presents principles for use of color, plus supporting data where such data exist Principles of Part I are general and can be applied in virtually any application involving color coding of display information Part II represents the application of these principles to real-world cockpit displays Recommended color codes are developed for application to electronic displays in fighter/attack aircraft Examples of representative display formats incorporating the recommended coding are provided Author (GRA)

N79-24992# Vought Corp Dallas Tex
AAES/TA-7C CONTROL AND DISPLAY INTERFACE Final Report, May - Oct 1978
J R Perkins D E Lautner, and A J Marek Oct 1978 62 p refs

(Contract N62269-78-C-0126)
(AD-A067219 Rept-2-54-00/8R-3512 NADC-77326-60) Avail NTIS CSCL 09/3

This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator) The simulator system being developed is based on the AAES Prototype Design evolved by the Vought corporation under contract N62269-75-C-0391 The simulator system will ultimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment The evolved simulator design is formulated around the TA-7C aircraft electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections The designs developed under this contract were limited to electrical-avionic system definition and design primarily in the control and display areas Simulator structural system installation and wire harness designs are planned for development under a follow-up contract The designs developed under this contract include the full application of the AADS technologies to the TA-7C electrical and avionic subsystems and systems The AAES technologies include HVDC (High Voltage DC) Power Generation SOSTEL (Solid State Electrical Logic) Power Distribution and Management and AMUX (Avionic Multiplexing) Author (GRA)

N79-24993# Advisory Group for Aerospace Research and Development Paris (France)
PROCESSING OF AIRBORNE RECONNAISSANCE DATA FOR IN-FLIGHT DISPLAY AND NEAR REAL-TIME TRANSMISSION
G vanKeuk (Forschungsinst fuer Funk und Math) Mar 1979 67 p refs
(AGARD-AR-135, ISBN-92-835-1310-X) Avail NTIS HC A04/MF A01

Communication on aircraft beyond the horizon is discussed The fundamental relationships between several parameters and interactions and between human factors and technology to assist operational and technical users were examined S E S

N79-24994*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
PREMIXED PREVAPORIZED COMBUSTOR TECHNOLOGY FORUM
1979 262 p refs Conf held at Cleveland, Ohio, 9-10 Jan 1979
(NASA-CP-2078 E-9933) Avail NTIS HC A12/MF A01 CSCL 21E

The Forum was held to present the results of recent and current work intended to provide basic information required for demonstration of lean, premixed prevaporized combustors for aircraft gas turbine engine application Papers are presented which deal with the following major topics (1) engine interfaces (2) fuel-air preparation (3) autoignition (4) lean combustion, and (5) concept design studies

N79-24995*# Pratt and Whitney Aircraft Group East Hartford Conn
TURBULENCE CHARACTERISTICS OF COMPRESSOR DISCHARGE FLOWS
Howard P Grant *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 5-31

Avail NTIS HC A12/MF A01 CSCL 21E

Turbulence measurements were conducted in a large gas turbine engine (JT9D) at the entrance to the diffuser duct joining the compressor discharge to the combustor inlet Hot film probe and hot wire probe measurements were obtained at temperatures from 450K (350F) (idle) to 608K (635F) (rich approach) At I D (25 percent span) and mid-span locations the turbulence intensity increased slightly from 6 + or - percent at idle condition to 7 or - 1 percent at rich approach At O D (75 percent span) the turbulent intensity increased more rapidly, from 7 5 + or - 0 5 percent at idle to 15 + or - 0 5 percent at rich approach The spectra showed turbulent energy distributed uniformly over a 0 1 to 5 KHz bandwidth (down 3db) at all operating conditions corresponding to random turbulence with velocity wave lengths of 2 cm to 1 meter travelling at the mean velocity of 100 m/sec Tests results are given in tables and graphs A R H

N79-24996*# General Electric Co Cincinnati Ohio
TURBULENCE MEASUREMENTS IN THE COMPRESSOR EXIT FLOW OF A GENERAL ELECTRIC CF6-50 ENGINE
Jack R Taylor *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 33-45

Avail NTIS HC A12/MF A01 CSCL 21E

Ruggedized cooled film probes were used to measure CF6-50 compressor exit turbulence properties at three different engine idle condition test points The turbulence probe was coupled to a constant temperature anemometer and signal conditioning system An on-line readout system connected to the anemometer was used to check the data as it was acquired At engine idle conditions the turbulence intensity ranged from 4 8 percent to 5 6 percent and the length scale ranged from 5 64 cm to 6 95 cm The length scale values are somewhat larger than the passage height at the measurement plane (5 54 cm) which indicates that the shape of the turbulent eddies are elongated in the axial direction The microscale values range from about 0 73 cm to about 0 98 cm Power spectral density distributions show that a large proportion of the turbulent energy at the measurement plane is concentrated at frequencies below one kilohertz A R H

N79-25001*# United Technologies Research Center East Hartford Conn
AUTOIGNITION OF FUELS
Louis J Spadaccini *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 95-107 ref

Avail NTIS HC A12/MF A01 CSCL 21E

An autoignition test section and a premixing fuel injector developed to determine the autoignition characteristics of a variety of aircraft fuels are described Parametric tests to map the ignition delay characteristics of Jet-A fuel were conducted at pressures of 10 15 20 25 and 30 atm inlet air temperatures up to 900K and fuel-air equivalence ratios of 0 3 0 5 0 7 and 1 0 Residence times in the range of 1 to 50 msec were obtained by interchanging spool pieces to create six different mixer/vaporizer lengths (6, 23 53 84 99 and 130 cm) and by testing at two different airflow rates (0 5 and 1 0 kg/sec) The resulting free-stream velocities were in the range 20 to 100 m/sec As expected the results indicate that the ignition delay times decrease with increasing air temperature and pressure Also the data show that for lean mixtures ignition delay times decrease with increasing equivalence ratios A R H

N79-25004*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECT OF FUEL/AIR NONUNIFORMITY ON NITRIC OXIDE EMISSIONS
Valerie J Lyons *In its* Premixed Prevaporized Combustor Technol Forum 1979 p 131-134

Avail NTIS HC A12/MF A01 CSCL 21E

A flame tube combustor holding jet A fuel was used in experiments performed at a pressure of 3 Mpa and a reference velocity of 25 meters/second for three inlet air temperatures of 600 700 and 800 K The gas sample measurements were taken at locations 18 cm and 48 cm downstream of the perforated plate flameholder Nonuniform fuel/air profiles were produced using a fuel injector by separately fueling the inner five fuel tubes and the outer ring of twelve fuel tubes Six fuel/air profiles were produced for nominal overall equivalence ratios of 5 and 6 An example of three of three of these profiles and their resultant nitric oxide NOx emissions are presented The uniform fuel/air profile cases produced uniform and relatively low profile levels When the profiles were either center-peaked or edge-peaked the overall mass-weighted nitric oxide levels increased A R H

N79-25011*# General Electric Co Cincinnati Ohio
ADVANCED LOW EMISSIONS CATALYTIC COMBUSTOR PROGRAM AT GENERAL ELECTRIC
W J Dodds *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 215-227 refs

Avail NTIS HC A12/MF A01 CSCL 21E

The Advanced Low Emissions Catalytic Combustors Program (ALECC) is being undertaken to evaluate the feasibility of employing catalytic combustion technology in aircraft gas turbine engines as a means to control emission of oxides of nitrogen during subsonic stratospheric cruise operation The ALECC Program is being conducted in three phases The first phase which was completed in November 1978 consisted of a design study to identify catalytic combustor designs having the greatest potential to meet the emissions and performance goals specified The primary emissions goal of this program was to obtain cruise NO emissions of less than 1g/kg (compared with levels of 15 to 20 g/x obtained with current designs)/ However, good overall performance and feasibility for engine development were heavily weighted in the evaluation of combustor designs G Y

N79-25012*# Pratt and Whitney Aircraft Group East Hartford, Conn
ADVANCED LOW EMISSIONS CATALYTIC COMBUSTOR PROGRAM AT PRATT AND WHITNEY
G J Sturgess *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 229-245

Avail NTIS HC A12/MF A01 CSCL 21E

The feasibility of employing catalytic combustion technology to control the emissions of oxides of nitrogen for subsonic stratospheric cruise aircraft operations is the objective of this NASA contract The existing Enivornmental Protection Agency standards for the landing and takeoff cycle were also required to be satisfied Work for the first phase of a proposed three phase effort is reported and is concerned with analytical design studies G Y

N79-25013*# Pratt and Whitney Aircraft Group East Hartford Conn
LEAN, PREMIXED, PREVAPORIZED COMBUSTOR CONCEPTUAL DESIGN STUDY
Anthony J Fiorentino *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 247-254

Avail NTIS HC A12/MF A01 CSCL 21E

The seven month study program has the objective to identify and evaluate promising lean premixed prevaporized combustor concepts utilizing variable geometry and/or other flow control techniques The general approach taken to accomplish this objective is outlined and consists of combustor design design analysis and design ranking The schedule being taken to achieve this program is shown Although the ultimate goal of this program is the significant reduction of cruise oxides of nitrogen both the EPA emission standards and combustor performance levels outlined are retained as goals as well G Y

N79-25014*# General Electric Co Cincinnati Ohio
LEAN, PREMIXED, PREVAPORIZED COMBUSTOR CONCEPTUAL DESIGN STUDY
E E Ekstedt *In* NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 255-263

Avail NTIS HC A12/MF A01 CSCL 21E

Phase 1 of the Lean Premixed-Prevaporized Comubstor Design Study is a nine month analytical study effort with no experimental or testing activities included The program has the objective to design and analyze advanced combustor concepts with features for fuel premixing and prevaporization upstream of the combustion zone for use in future subsonic aircrafts with features for fuel premixing and prevaporization upstream of the combustion zone for use in future subsonic aircraft engines All of the designs also embody some form of variable geometry for combustor flow modulation The primary criterion for these designs is low oxides of nitrogen emissions at stratospheric cruise conditions Four combustor concepts are being designed for the NASA/GE Energy Efficient Engine (EEE) envelope and cycle Current status of the program is that the four concepts sized for the EEE were designed and are currently undergoing analysis and evaluation G Y

N79-25015*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
MULTIVARIABLE CONTROL ALTITUDE DEMONSTRATION ON THE F100 TURBOFAN ENGINE
B Lehtinen R L DeHoff (Systems Control Inc Palo Alto Calif) and R D Hackney (Pratt and Whitney Aircraft Group West Palm Beach Fla) 1979 31 p refs Presented at the 15th Joint Propulsion Conf Las Vegas Nev 18-20 Jun 1979 sponsored by AIAA Soc of Automotive Engr, and ASME
(NASA-TM-79183 E-050) Avail NTIS HC A03/MF A01 CSCL 21E

The F100 Multivariable control synthesis (MVCS) program was aimed at demonstrating the benefits of LGR synthesis theory in the design of a multivariable engine control system for operation throughout the flight envelope The advantages of such procedures include (1) enhanced performance from cross-coupled controls (2) maximum use of engine variable geometry and (3) a systematic design procedure that can be applied efficiently to new engine systems The control system designed under the MVCS program, for the Pratt & Whitney F100 turbofan engine is described Basic components of the control include (1) a reference value generator for deriving a desired equilibrium state and an approximate control vector, (2) a transition model to produce compatible reference point trajectories during gross transients (3) gain schedules for producing feedback terms appropriate to the flight condition and (4) integral switching logic to produce acceptable steady-state performance without engine operating limit exceedance J A M

N79-25016*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
FUNDAMENTALS OF GAS TURBINE COMBUSTION
Melvin Gerstein (Univ of Southern Calif Los Angeles) 1979 52 p Workshop held at Cleveland, 6-7 Feb 1979
(NASA-CP-2087 E-026) Avail NTIS HC A04/MF A01 CSCL 21E

Combustion problems and research recommendations are discussed in the areas of atomization and vaporization combustion chemistry combustion dynamics and combustion modelling The recommendations considered of highest priority in these areas are presented S E S

N79-25017*# Williams Research Corp Walled Lake Mich
ADVANCED GENERAL AVIATION TURBINE ENGINE (GATE) CONCEPTS Final Report
E J Lays and G L Murray 26 Jun 1979 189 p refs
(Contract NAS3-20758)
(NASA-CR-159603 WRC-78-113-15) Avail NTIS HC A09/MF A01 CSCL 21E

Concepts are discussed that project turbine engine cost savings through use of geometrically constrained components designed for low rotational speeds and low stress to permit manufacturing economies Aerodynamic development of geometrically constrained components is recommended to maximize component efficiency Conceptual engines airplane applications airplane performance engine cost and engine-related life cycle costs are presented The powerplants proposed offer encouragement with respect to fuel efficiency and life cycle costs and make possible remarkable airplane performance gains M M M

N79-25018*# Solar Turbines International San Diego Calif
INTERNALLY COATED AIR-COOLED GAS TURBINE BLADING Final Report, Aug 1977 - Dec 1978
L Hsu W G Stevens and A R Stetson Mar 1979 102 p refs
(NASA-CR-159574 SR79-R-4655-15) Avail NTIS HC A06/MF A01 CSCL 21E

Ten candidate modified nickel-aluminide coatings were developed using the slip pack process These coatings contain additives such as silicon chromium and columbium in a

nickel-aluminum coating matrix with directionally solidified MAR-M200 + Hf as the substrate alloy Following a series of screening tests which included strain tolerance dynamic oxidation and hot corrosion testing the Ni-19A1-1Cb (nominal composition) coating was selected for application to the internal passages of four first-stage turbine blades Process development results indicate that a dry pack process is suitable for internal coating application resulting in 18 percent or less reduction in air flow Coating uniformity based on coated air-cooled blades was within + or - 20 percent Test results show that the presence of additives (silicon chromium or columbium) appeared to improve significantly the ductility of the NiA1 matrix However the environmental resistance of these modified nickel-aluminides were generally inferior to the simple aluminides A R H

N79-25019*# Notre Dame Univ Ind
TIME OPTIMAL CONTROL OF A JET ENGINE USING A QUASI-HERMITE INTERPOLATION MODEL M S Thesis
John G Comiskey May 1979 171 p refs
(Grant NsG-3048)
(NASA-CR-158711 EE-791) Avail NTIS HC A08/MF A01 CSCL 21E

This work made preliminary efforts to generate nonlinear numerical models of a two-spooled turbofan jet engine and subject these models to a known method of generating global nonlinear time optimal control laws The models were derived numerically directly from empirical data as a first step in developing an automatic modelling procedure J A M

N79-25020*# General Electric Co Cincinnati Ohio Aircraft Engine Group
DESIGN STUDY AND PERFORMANCE ANALYSIS OF A HIGH-SPEED MULTISTAGE VARIABLE-GEOMETRY FAN FOR A VARIABLE CYCLE ENGINE Final Report
T J Sullivan and D E Parker Mar 1979 228 p refs
(Contract NAS3-20041 R79AEG288)
(NASA-CR-159545) Avail NTIS HC A11/MF A01 CSCL 21E

A design technology study was performed to identify a high speed multistage variable geometry fan configuration capable of achieving wide flow modulation with near optimum efficiency at the important operating condition A parametric screening study of the front and rear block fans was conducted in which the influence of major fan design features on weight and efficiency was determined Key design parameters were varied systematically to determine the fan configuration most suited for a double bypass variable cycle engine Two and three stage fans were considered for the front block A single stage core driven fan was studied for the rear block Variable geometry concepts were evaluated to provide near optimum off design performance A detailed aerodynamic design and a preliminary mechanical design were carried out for the selected fan configuration Performance predictions were made for the front and rear block fans Author

N79-25021*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
INTERFERENCE EFFECTS OF AIRCRAFT COMPONENTS ON THE LOCAL BLADE ANGLE OF ATTACK OF A WING-MOUNTED PROPELLER
J P Mendoza Jun 1979 43 p refs
(NASA-TM-78587 A-7812) Avail NTIS HC A03/MF A01 CSCL 01C

The aerodynamic interference effects on a propeller operating in the presence of different wing-body-nacelle combinations was studied The unsteady blade angle of attack variation with azimuth angle by varying the pitch and yaw of the nacelle was minimized Results indicate for the particular configuration of interest the minimum blade angle of attack variation occurred with the nacelle pitched downward 4 5 deg and yawed inward 3 0 deg S E S

N79-25022*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OPERATING CONDITION AND GEOMETRY EFFECTS ON LOW-FREQUENCY AFTERBURNER COMBUSTION INSTABILITY IN A TURBOFAN AT ALTITUDE
Richard R Cullom and Roy L Johnsen Jun 1979 31 p refs
(NASA-TP-1475 E-9886) Avail NTIS HC A03/MF A01 CSCL 21E

Three afterburner configurations were tested in a low-bypass-ratio turbofan engine to determine the effect of various fuel distributions inlet conditions flameholder geometry and fuel injection location on combustion instability Tests were conducted at simulated flight conditions of Mach 0 75 and 1 3 at altitudes from 11 580 to 14 020 m (38 000 to 46 000 ft) In these tests combustion instability with frequency from 28 to 90 Hz and peak-to-peak pressure amplitude up to 46 5 percent of the afterburner inlet total pressure level was encountered Combustion instability was suppressed in these tests by varying the fuel distribution in the afterburner Author

N79-25023*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
INDUSTRY TESTS OF NASA CERAMIC THERMAL BARRIER COATING
Curt H Liebert and Francis S Stepka Jun 1979 26 p refs Presented at 6th Intern Vacuum Metallurgy Conf San Diego Calif 23-27 Apr 1979 Sponsored by Am Vacuum Soc
(NASA-TP-1425 E-9846) Avail NTIS HC A03/MF A01 CSCL 21E

Ceramic thermal barrier coating (TBC) system was tested by industrial and governmental organizations for a variety of aeronautical marine and ground-based gas turbine engine applications This TBC is a two-layer system with a bond coating of nickel-chromium-aluminum-yttrium (Ni-16Cr-6Al-0 6Y in wt percent) and a ceramic coating of yttria-stabilized zirconia (ZrO2-12Y2O3 in wt percent) Seven tests evaluated the system s thermal protection and durability Five other tests determined thermal conductivity vibratory fatigue characteristics and corrosion resistance of the system The information presented includes test results and photographs of the coated parts Recommendations are made for improving the coating procedures J M S

N79-25024*# Douglas Aircraft Co Inc Long Beach Calif
SIMULATED PROPELLER SLIPSTREAM EFFECTS ON A SUPERCRITICAL WING
H Robert Welge and James P Crowder Jun 1978 72 p refs
(Contract NAS2-9472)
(NASA-CR-152138) Avail NTIS HC A04/MF A01 CSCL 21E

To quantify the installed performance of high speed (M = 0 8) turboprop propulsion systems an experimental program designed to assess the magnitude of the aerodynamic interference of a propeller slipstream on a supercritical wing has been conducted The test was conducted in the NASA Ames 14-foot wind tunnel An ejector-nacelle propeller slipstream simulator was used to produce a slipstream with characteristics typical of advanced propellers presently being investigated A supercritical wing-body configuration was used to evaluate the interference effects A traversing total pressure rake was used to make flow field measurements behind the wing and to calibrate the slipstream simulator The force results indicated that the interference drag amounted to an increase of ten counts or about 3% of the wing-body drag for a two engine configuration at the nominal propeller operating conditions However at the higher swirl angles (11 deg vs 7 deg nominally) the interference drag was favorable by about the same magnitude Author

N79-25025# ARO Inc Arnold Air Force Station, Tenn
OPTICAL IN SITU VERSUS PROBE MEASUREMENTS OF NITRIC OXIDE CONCENTRATION AS A FUNCTION OF AXIAL POSITION IN A COMBUSTOR EXHAUST Final Report, 21 Jul - 27 Aug 1977
J D Few R J Bryson and H S Lowry III AEDC Mar 1979 37 p refs
(AD-A067329 AEDC-TR-78-32) Avail NTIS HC A03/MF A01 CSCL 21/2

Nitric oxide (NO) concentration was measured at three axial stations (6 5, 12 and 25 nozzle diameters downstream of a combustor nozzle exit) in a jet engine combustor exhaust by a

gas-sampling probe in conjunction with conventional gas analyzers and an optical resonance absorption technique The gas analyzer system permitted measurements of NO, NO sub x, CO CO sub 2 and C sub x H sub y (total hydrocarbons) whereas the optical absorption technique permitted measurement of NO only The combustor was exhausted into a test cell of slightly less than atmospheric pressure and was operated at an inlet air temperature of 589 K a total pressure of 344 3 kPa, and a fuel-to-air ratio (f/a) of 0 02 A multiprobe rake was used to acquire emissions total pressure and temperature and static pressure data at the measurement stations The measurements of total pressure total temperature and measured static pressure were used to determine static temperature and pressure profiles at each measurement station which are required for determining NO concentration by the optical absorption technique GRA

N79-25026# Calspan Corp Buffalo N Y
BLAST INDUCED DISTORTION EXPERIMENTS ON AN ENGINE INLET Final Report, Feb 1977 - Jan 1978
Albert O Davis and Michael G Dunn 30 Jan 1978 73 p refs
(Contract DNA001-77-C-0097)
(AD-A066811, AD-E300477 DNA-4513F) Avail NTIS HC A04/MF A01 CSCL 20/4

This report briefly reviews the results of the Kaman AviDyne/AEDC experimental program funded by DNA The purpose of this program was to develop an experimental technique that could be used to define the nuclear-blast-induced distortion at the inlet/engine interface of aircraft and air-breathing missiles The results of the test program have been evaluated as has the potential impact of these results on other air-breathing engines with inlets having different L/D values Author (GRA)

N79-25027# Pratt and Whitney Aircraft West Palm Beach Fla Government Products Div
REGRESSION SIMULATION OF TURBINE ENGINE PERFORMANCE ACCURACY IMPROVEMENT (TASK 4) Final Technical Report, 30 Sep 1977 - 30 Sep 1978
Joseph A Sabatella Jr and James S Johnson 30 Sep 1978 96 p refs
(Contract F33615-77-C-2109)
(AD-A066398, PWA-FR-10608 AFAPL-TR-78-103) Avail NTIS HC A06/MF A01 CSCL 21/5

The Regression Simulation of Turbine Engine Performance (RSTEP) Task IV program was an analytical study to identify and evaluate approaches to improve the accuracy of regression surfaces for use in TEVCS/ARES procedures The Central Composite Design (CCD) data selection pattern was studied and found to be a flexible accurate and economical alternative to the orthogonal Latin Square design selector The impact of the number of independent variables and the number of data points was systematically investigated Two methodologies which provided significant improvement in the accuracy of the regression surfaces were also identified Author (GRA)

N79-25029# Ford Motor Co Dearborn, Mich
BRITTLE MATERIALS DESIGN, HIGH TEMPERATURE GAS TURBINE CERAMIC TURBINE ROTOR TECHNOLOGY Interim Report, 1 Oct 1977 - 31 Mar 1978
Arthur F McLean and Robert R Baker Feb 1979 87 p refs
(Contract DAAG46-71-C-0162)
(AD-A067176 AMMRC-TR-79-11 IR-13) Avail NTIS HC A05/MF A01 CSCL 11/2

This report contains progress during the last six months and a summary of earlier progress on the DOE supported programs within the joint DARPA/DOE Brittle Materials Design High Temperature Gas Turbine Program and constitutes the final report of work under DOE funds A separate report will cover the progress on the DARPA supported Ceramic Turbine Testing Program The summary of previous work supported by DOE includes progress on reaction bonded and hot pressed silicon nitride materials technology Several NDE techniques were considered for the detection of flaws in complex-shaped silicon nitride components Improvements to the hot press bonding process resulted in a significant improvement in the yield of flaw-free hot press bonded rotors M O R and cold spin tests of rotor blade rings revealed the presence of undetected subsurface flaws in both the blades and the rim Blade bend testing indicated that blade strength degraded during hot press bonding During this reporting period an investigation of hot press bonding temperatures and time at temperature defined a region of zero microstructural and strength degradation This study involved 19 hot press bondings from which curves were generated defining the changes in color porosity hardness phase and strength as a function of time and temperature GRA

N79-25033*# Oklahoma State Univ Stillwater
HANDLING QUALITIES OF LARGE FLEXIBLE CONTROL-CONFIGURED AIRCRAFT Semiannual Status Report, 1 Jan - 30 Jun 1979
Robert L Swaim 22 Jun 1979 10 p refs
(Grant NsG-4018)
(NASA-CR-158694) Avail NTIS HC A02/MF A01 CSCL 01C

The approach to an analytical study of flexible airplane longitudinal handling qualities was to parametrically vary the natural frequencies of two symmetric elastic modes to induce mode interactions with the rigid body dynamics Since the structure of the pilot model was unknown for such dynamic interactions the optimal control pilot modeling method is being applied and used in conjunction with pilot rating method J A M

N79-25034*# National Aeronautics and Space Administration Langley Research Center Hampton Va
CAPTURING AND TRACKING PERFORMANCE OF THE HORIZONTAL GUIDANCE AND CONTROL SYSTEMS OF THE TERMINAL CONFIGURED VEHICLE
Charles E Knox Jun 1979 35 p refs
(NASA-TM-80068 L-11442) Avail NTIS HC A03/MF A01 CSCL 01C

A twin-jet commercial transport equipped with digital navigation guidance and control systems and advanced electronic display system was used for airborne operational research The results of flight tests which evaluated a second-order horizontal-path guidance control law and the autopilot and airplane response are presented This evaluation was accomplished through analysis of recorded flight data and through pilot opinion of the airplane maneuvers during automatic path-capture scenarios and path tracking Four different path captures were flown at a ground speed of approximately 160 knots and repeated at approximately 300 knots Path tracking tracking error was measured in terms of cross track error along two paths one pat at cruise speeds and one at airport-terminal-area speeds The path tracking accuracy and the smoothness of the airplane maneuvers were judged satisfactory for high speeds however at lower speeds the control law design should be improved so that tracking will be more accurate for operations in the airport terminal area J M S

N79-25035# Systems Technology, Inc Hawthorne Calif
ANALYSIS OF DIGITAL FLIGHT CONTROL SYSTEMS WITH FLYING QUALITIES APPLICATIONS VOLUME 1 EXECUTIVE SUMMARY Final Report, Mar 1977 - Jun 1978
Richard F Whitbeck Sep 1978 28 p
(Contract F33615-77-C-3026 AF Proj 2307)
(AD-A066809 STI-TR-1101-1-Vol-1 AFFDL-TR-78-115-Vol-1) Avail NTIS HC A03/MF A01 CSCL 01/3

Revisitation and extension of classical sampled data approaches for the analysis of discretely controlled continuous systems is the focus of this report A review of basic linear analysis topics required to support later developments is given These topics include Laplace z- and advanced z-transform facts, partial fraction expansion data holds and the switch decomposition technique Extension of switch decomposition for the vector signal case is given A new direct transform domain approach for analyzing two-rate sampled systems is developed This approach also applies for multi-rate sampled systems in restricted circumstances Utility of this approach resides in its operator notation and conventions for manipulation in connection with vector block diagram algebra This in turn, expedites development of pulse transfer functions and of response recursion relations

for multivariable closed-loop systems This is accomplished without resorting to the more complicated switch decomposition method Multi-rate sampling analysis procedures are used to sharpen the concept of frequency response for discretely excited, continuous systems All methods of analysis presented in this report are closed-form and exact in that no approximation is required in the mathematical development of any result GRA

N79-25036# Systems Technology Inc Hawthorne Calif
ANALYSIS OF DIGITAL FLIGHT CONTROL SYSTEMS WITH FLYING QUALITIES APPLICATIONS VOLUME 2 TECHNICAL REPORT Final Report, Mar 1977 - Jun 1978
Richard F Whitbeck and L G Hofmann Sep 1978 230 p refs
(Contract F33615-77-C-3026)
(AD-A067177 STI-TR-1101-1-Vol-2 AFFDL-TR-78-115-Vol-2) Avail NTIS HC A11/MF A01 CSCL 01/3

Revisitation and extension of classical sampled data approaches for the analysis of discretely controlled continuous systems is the focus of this report A review of basic linear analysis topics required to support later developments is given These topics include Laplace, z- and advanced z-transform facts partial fraction expansion data holds and the switch decomposition technique Extension of switch decomposition for the vector signal case is given The w -domain is defined by a bilinear transformation of the z-domain Properties of the w -domain are developed A new direct transform domain approach for analyzing two-rate sampled systems is developed This approach also applies for multi-rate sampled systems in restricted circumstances Utility of this approach resides in its operator notation and conventions for manipulation in connection with vector block diagram algebra This in turn expedites development of pulse transfer functions and of response recursion relations for multivariable, closed-loop systems This is accomplished without resorting to the more complicated switch decomposition method Multi-rate sampling analysis procedures are used to sharpen the concept of frequency response for discretely excited, continuous systems Frequency response in this case pertains to steady-state responses at the input frequency and its positive aliases All methods of analysis presented in this report are closed-form and exact in that no approximation is required in the mathematical development of any result GRA

N79-25037# Advisory Group for Aerospace Research and Development Paris (France)
TECHNICAL EVALUATION REPORT ON THE 25TH GUIDANCE AND CONTROL PANEL SYMPOSIUM ON GUIDANCE AND CONTROL DESIGN CONSIDERATIONS FOR LOW ALTITUDE AND TERMINAL AREA FLIGHT
M A Ostgaard (AFFDL Wright-Patterson AFB Ohio) Mar 1979 13 p Symp held at Dayton Ohio 17-20 Oct 1977
(AGARD-AR-129 ISBN-92-835-1316-9) Avail NTIS

Lack of well defined operational concepts and requirements are outlined for the development efforts to fulfill low altitude operational needs and stimulate concepts that are cost effective Crew workload which is the predominant factor in low altitude operation is discussed The application of control technology to provide gust alleviation is presented SES

N79-25038# Committee on Commerce Science and Transportation (U S Senate)
AIRCRAFT AND AIRPORT NOISE REDUCTION
Washington GPO 1978 402 p refs Hearings on S 747 S 3064 and H R 8729 before the Subcomm on Aviation of the Comm on Commerce Sci and Transportation 95th Congr 2d Sess , 24-25 May 13-14 17 Jun 1978
(GPO-29-661) Avail Subcomm on Aviation

Aircraft and airport noise was investigated at a Congressional hearing to try to provide mechanisms through which air carriers could comply with FAA noise reduction regulations The possibility of guarantees was discussed as a mechanism Airport planning and land acquisition were also discussed RES

N79-25039*# Royal Aircraft Establishment Bedford (England) Structures Dept
SOME REMARKS ON THE DESIGN OF TRANSONIC TUNNELS WITH LOW LEVELS OF FLOW UNSTEADINESS
Dennis G Mabey Washington NASA Aug 1976 20 p refs (NASA Order L-32158-A)
(NASA-CR-2722) Avail NTIS HC A02/MF A01 CSCL 01E

The principal sources of flow unsteadiness in the circuit of a transonic wind tunnel are presented Care must be taken to avoid flow separations acoustic resonances and large scale turbulence Some problems discussed are the elimination of diffuser separations the aerodynamic design of coolers and the unsteadiness generated in ventilated working sections SES

N79-25040# Transportation Systems Center Cambridge Mass
THE AIRPORT PERFORMANCE MODEL VOLUME 1 EXTENSIONS, VALIDATIONS, AND APPLICATIONS Final Report, Jan 1975 - Jun 1976
J Bellantoni H Condell I Englander L Fuertes and J Schwenk Oct 1978 285 p refs
(AD-A062863 TSC-FAA-78-21-1) Avail NTIS HC A13/MF A01 CSCL 01/5

A comput4er simulation of airport delay and congestion was prepared to help evaluate the benefit of capacity-related investments in the nation s airports The model which has a data base comprising 31 high density airports estimates dollar benefits to passengers and aircraft operators or delay reduction in landing takeoff and gate docking and reduction in fuel consumed and pollutants emitted as well as required groundside facilities The delay estimate from the model showed reasonably good agreement with data taken at JFK LGA and EWR It was used to evaluate proposed investments for Honolulu Detroit and Charlotte N C GRA

N79-25041# Vought Corp Dallas Tex
AAES LABORATORY SIMULATOR REQUIREMENTS (A-7 AIRCRAFT) Final Report, 27 Sep 1977 - 27 Dec 1978
J R Perkins, D E Lautner J L Jones and A J Marek Sep 1978 126 p refs
(Contract N62269-77-C-0377)
(AD-A066393 Rept-2-54100/8R-3510 NADC-77277-30) Avail NTIS HC A07/MF A01 CSCL 01/3

This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator) The simulator system being developed is based on the Advanced Aircraft Electrical System (AAES) Prototype Design evolved by the Vought Corp under contract N62269-75-C-0391 The simulator system will ultimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment The evolved simulation design is formulated around the TA-7C aircraft electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections The designs developed under this contract were limited to electrical-avionic system definition and design Simulator structural system installation and wire harness designs will be developed under a follow-on contract The designs developed under this contract include the full application of the AAES technologies to the TA-7C electrical and avionic subsystem and systems The AAES technologies include HVDC (High Voltage DC) power generation SOSTEL (Solid State Electric Logic) power distribution and management and AMUX (Avionic Multiplexing) GRA

N79-25042# Naval Training Equipment Center Orlando Fla
MOTION IN FLIGHT SIMULATION AN ANNOTATED BIBLIOGRAPHY Final Report, 30 Sep 1977 - 30 Jun 1978
Joseph A Puig William T Harris and Gilbert L Ricard Jul 1978 753 p refs
(AD-A061687 NAVTRAEQUIPC-IH-298) Avail NTIS HC A99/MF A01 CSCL 05/9

In support of Project 7744 - Motion Drive Signals for Flight Simulators a review of the literature concerning motion simulation was conducted Abstracts were included for 682 references A primary objective of this review was to compare data from the various studies to identify general trends on the effects of motion on performance and training The publications were listed

alphabetically by author chronologically, and also grouped into eight major categories as follows reviews and bibliographies, equipment descriptions requirements algorithms and drive techniques effects of motion evaluation vertical motion and cost effectiveness Author (GRA)

N79-25043# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics
OPTIMAL PLACEMENT OF REGIONAL FLIGHT SIMULATORS M S Thesis
David R VanDenburg and Jon D Veith Sep 1978 98 p refs
(AD-A060450 AFIT-LSSR-18-78B) Avail NTIS
HC A05/MF A01 CSCL 05/9

Due to the depletion of petroleum resources and increasing aircraft operating costs inflight simulators are assuming a larger role in aircrew training Simultaneously increased simulator acquisition and support costs have resulted in fewer simulator systems Consequently a regional simulator deployment plan is often used This plan involves the placement of simulator systems at a number of central locations and transporting students to these locations to accomplish their required training This research attempted to develop a mathematical model to assist in the placement decision The model was developed however, a suitable computer algorithm could not be found to solve the resulting equations Consequently a model was developed and used to provide suggested student allocation schedules for predetermined simulator location plans It was concluded that mathematical techniques could be employed to assist in the placement decisions In addition it is believed that future improvements in computer software could produce an algorithm capable of solving the model originally developed Author (GRA)

N79-25044# Naval Air Development Center Warminster Pa Systems Directorate
DESIGN OF AN OFF-AXIS WIDE FIELD-OF-VIEW VISUAL DISPLAY SYSTEM FOR FLIGHT SIMULATORS Final Report
G Terry Thomas and Robert L Jones 1 Jan 1979 126 p refs
(AD-A066530, NADC-79023-20) Avail NTIS
HC A07/MF A01 CSCL 01/4

This report describes the analysis and design of an off-axis wide field-of-view visual display system including component specifications and structural drawings A fabrication cost and schedule estimate is also presented Author (GRA)

N79-25046# Bunker-Ramo Corp Wright-Patterson AFB Ohio
MULTIFUNCTION KEYBOARD IMPLEMENTATION STUDY Final Report, 1 Apr 1976 - 11 Feb 1977
Robert P Bateman John M Reising Emmett L Herron and Gloria L Calhoun Dec 1978 193 p refs
(Contract F33615-76-C-0013 AF Proj 6190 AF Proj 2049)
(AD-A066140 AFFDL-TR-78-197) Avail NTIS
HC A09/MF A01 CSCL 05/9

An aircraft which utilizes digital computers will require the use of multifunction controls and displays Four different multifunction keyboard configurations were examined by pilots flying a simulated mission Two of the configurations were located on the left side of the front instrument panel while the remaining two were located on the right side console and/or the right side of the front instrument panel The pilots performed communications navigation and stores tasks using each configuration The configurations also utilized two different types of hardware projection switches and cathode ray tubes GRA

N79-25236# Systems Research Labs Inc Dayton Ohio Research Applications Div
DYNAMIC EVALUATION OF EXPERIMENTAL INTEGRAL FUEL-TANK SEALANTS, PART 2 Final Technical Report, Jul 1977 - Jun 1978
William R Mallory Wright-Patterson AFB Ohio AFML Nov 1978 41 p
(Contract F33615-76-C-5253 AF Proj 2421 AF Proj 7340)
(AD-A066592 SRL-6901-Pt-2 AFML-TR-77-152-Pt-2) Avail NTIS HC A03/MF A01 CSCL 11/1

An exploratory development program has been performed to investigate and evaluate experimental integral fuel-tank sealant materials under laboratory conditions which closely simulate those of actual aircraft integral fuel tanks during flight As part of this effort a unique facility has been designed and fabricated for the evaluation of a variety of joint configurations The facility consists primarily of a biaxial stress machine in which temperature pressure, and vibrational strain can be programmed for automatic operation Specimens can be strained longitudinally and torsionally to simulate actual flight conditions Frequency and amplitude of the strains can be independently set and recorded Simulated fuel-tank and environmental pressure can also be adjusted independently Early difficulties with sealant-failure detection and with undesirable thermal strains have been largely resolved and partial evaluation of continuous-fillet specimens utilizing one sealant material has been performed A second evaluation apparatus is now under construction Author (GRA)

N79-25244# Rockwell International Corp Los Angeles, Calif
THE IMPACT OF ALTERNATE FUELS ON AIRCRAFT CONFIGURATION CHARACTERISTICS Final Report, Dec 1977 - Oct 1978
Douglas A Robinson Oct 1978 139 p refs
(Contract F33615-77-C-3155 AF Proj 2404)
(AD-A066983, AFFDL-TR-78-152) Avail NTIS
HC A07/MF A01 CSCL 21/4

The study dealt with the effect of alternate fuel usage for three classifications of advanced technology vehicles for a post-2000 time period Alternate fuel design vehicles were configured to optimum thrust loading and wing loading based on hydrocarbon JP-4 fuel and found to offer 35 to 45 percent weight reduction Life-cycle cost savings were estimated as a function of fuel cost and showed fuels 10 to 15 times the basepoint resulted in breakeven LCC with the more exotic fuels Author (GRA)

N79-25245# Mobil Research and Development Corp Paulsboro, N J
FACTORS AFFECTING ELECTROSTATIC HAZARDS Final Technical Report, 15 Apr 1977 - 15 Jul 1978
P W Kirklin and D L Rhynard Dec 1978 91 p
(Contract F33615-77-C-2047 AF Proj 3048)
(AD-A066927, AFAPL-TR-78-89) Avail NTIS
HC A05/MF A01 CSCL 21/4

Conductivity additives ASA-3 and Stadis 450 have been found to significantly reduce static electricity in JP-4 containing approved additives when fuel conductivity is at least 100 CU at use temperatures In the absence of conductivity additives some additives caused increased charge accumulation which may have contributed to previous static ignited aircraft fires Tests were performed in a Mobil Research small-scale electrification unit modified to simulate USAF fueling velocities and aircraft fuel tank configurations Author (GRA)

N79-25247# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
A FILTERABILITY STUDY OF CORROSION INHIBITED JP-4 Summary Report, Aug 1974 - Jun 1976
Paul C Hayes, Jr Jun 1978 68 p refs
(AF Proj 3048)
(AD-A066887 AFAPL-TR-78-44) Avail NTIS
HC A04/MF A01 CSCL 21/4

The filterability of JP-4 fuel indicates the extent of contamination with solid particulate matter refinery carry-overs and/or reaction products generated from the mixing of inhibited fuel and water bottoms This report examines the creation of filter-plugging precipitants via the interaction of a fuel corrosion inhibitor with entrained water Further work revealed methods to prevent the formation of the reaction product and steps to reclaim such a synthetically created high filtration time JP-4 Author (GRA)

N79-25251# Civil and Environmental Engineering Development Office Tyndall AFB Fla
EVALUATION OF MATERIALS FOR POST-ATTACK PAVEMENT REPAIR Final Report, Sep 1976 - Dec 1977
C L Rone and A L Sullivan III Sep 1978 107 p refs
(AF Proj 2104)
(AD-A066516 CEEDO-TR-78-16) Avail NTIS HC A06/MF A01 CSCL 01/3

This study was conducted to evaluate the performance of candidate materials used to repair small damaged areas in pavement when subjected to traffic by an F4C aircraft loading The study consisted of preparing simulated damaged areas in portland cement concrete pavement and flexible pavement and repairing the areas with selected materials The evaluation was based on the performance of the repaired areas when subjected to accelerated traffic with a loading equivalent to one main gear of the F4C aircraft Author (GRA)

N79-25278# Army Materiel Systems Analysis Activity Aberdeen Proving Ground, Md
A COMPUTER PROGRAM FOR DOUBLE SWEEP OPTIMAL SMOOTHING
Robert A Scheder Jan 1979 74 p refs
(DA Proj 1R7-65706-M-541)
(AD-A066512 AMSAA-TR-246) Avail NTIS HC A04/MF A01 CSCL 17/9

This report documents the double sweep smoothing program used at AMSAA to determine an aircraft s position velocity and acceleration from radar tracking data It includes a tutorial guide to the underlying mathematics A quadratic programming problem with linear constraints is formulated reduced to a system of difference equations with initial and endpoint boundary conditions and solved using Bryson s double sweep method The iterative solution is programmed in simple machine independent FORTRAN with top down structured programming A listing is supplied and card decks are available GRA

N79-25310*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex
ANALYTICAL MODELING OF THE DYNAMICS OF BRUSHLESS dc MOTORS FOR AEROSPACE APPLICATIONS A CONCEPTUAL FRAMEWORK
Nabeel A O Demerdash 18 Aug 1976 102 p refs
(NASA-TM-80445 IN-76-EG-18 JSC-11552) Avail NTIS HC A06/MF A01 CSCL 09A

The modes of operation of the brushless d c machine and its corresponding characteristics (current flow torque-position etc) are presented The foundations and basic principles on which the preliminary numerical model is based are discussed M M M

N79-25408# General Research Corp Santa Barbara Calif
LIFE CYCLE COST ANALYSIS CONCEPTS AND PROCEDURES
Edward N Dodson *In* AGARD Methodology for Control of Life Cycle Costs for Avionics Systems Apr 1979 28 p refs

Avail NTIS HC A07/MF A01

The principles and procedures of parametric cost analysis based upon aggregate relationships between cost and the physical/performance characteristics of high technology equipment are presented M M M

N79-25410# Rome Air Development Center Griffiss AFB N Y
RECENT EXPERIENCE IN THE DEVELOPMENT AND APPLICATION OF LCC MODELS
Jerome Klion and Anthony Coppola *In* AGARD Methodology for Control of Life Cycle Costs for Avionics Systems Apr 1979 150 p refs
Avail NTIS HC A07/MF A01

A description of various models which incorporate acquisition costs and operation support costs as they apply to avionics procurements are presented The methods by which the models are developed along with their shortcomings and sensitivities are reported M M M

N79-25412# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)
NON-DESTRUCTIVE INSPECTION METHODS FOR PROPULSION SYSTEMS AND COMPONENTS
Apr 1979 70153 p refs In ENGLISH and partly in FRENCH Lecture series held at London 23-24 Apr 1979 and Milan 26-27 Apr 1979
(AGARD-LS-103 ISBN-92-835-0237-X) Avail NTIS HC A08/MF A01

The state-of-the-art and the foreseeable or hoped progress of the nondestructive inspection methods applied to the turbine and pistons engine are examined and discussed The following topics are discussed (1) nondestructive inspection of aircraft engines (2) high resolution radiography in the aero-engine industry (3) wear debris analysis (4) high resolution ultrasonic nondestructive testing of complex geometry components (5) nondestructive methods for the early detection of fatigue damage in aircraft components (6) in situ inspection of electron beam weld by acoustic emission and (7) broadband ultrasonic transducers for nondestructive inspection of aeronautical components

N79-25413# General Electric Co Cincinnati Ohio
STATE-OF-THE-ART OF NONDESTRUCTIVE INSPECTION OF AIRCRAFT ENGINES
D M Comassar *In* AGARD Non-destructive Inspection Methods for Propulsion Systems and Components Apr 1979 12 p refs
Avail NTIS HC A08/MF A01

There are five basic nondestructive inspection disciplines which are more commonly applied to engine components namely ultrasonic, eddy current fluorescent penetration radiographic and magnetic particle inspection There are a number of recent advancements in the ultrasonic and eddy current processes as well as improvements in the fluorescent penetration process These are discussed These advancements are primarily in the *equipment area and in the automation of the inspection process* The discussion focuses on improvements in the ultrasonic eddy current and fluorescent penetration processes Several nonconventional techniques used for inspection of development hardware are also discussed G Y

N79-25414# Atomic Energy Research Establishment Harwell (England) Material Physics Div
HIGH RESOLUTION RADIOGRAPHY IN THE AERO-ENGINE INDUSTRY
R W Parish *In* AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 38 p refs
Avail NTIS HC A08/MF A01

Microfocal X-ray equipment which in certain circumstances can achieve considerably enhanced resolution is discussed and emphasis is placed on the application of these small X-ray sources to aero-engine components These techniques allow small defects to be resolved which hitherto were undetectable when using conventional X-ray techniques G Y

N79-25417# Johns Hopkins Univ Baltimore Md Dept of Mechanics and Materials Science
NON-DESTRUCTIVE METHODS FOR THE EARLY DETECTION OF FATIGUE DAMAGE IN AIRCRAFT COMPONENTS
Robert E Green Jr *In* AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 31 p refs
Avail NTIS HC A08/MF A01

The various nondestructive techniques which are used or which are potentially useful for detection of fatigue damage in aircraft components are described and discussed Included among the nondestructive techniques which are considered are radiography penetrant inspection eddy current ultrasonics acoustic emission magnetic particle and Barkhausen noise analysis and more exotic techniques such as exoelectron emission positron annihilation and other atomic nuclear or solid state physics reactions G Y

N79-25419# Office National d Etudes et de Recherches Aerospatiales, Paris (France)
BROAD-BAND TRANSDUCERS FOR NONDESTRUCTIVE INSPECTION OF AERONAUTICAL COMPONENTS
Jean-Francois deBelleval *In* AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 10 p refs In FRENCH ENGLISH summary

Avail NTIS HC A08/MF A01

For ultrasonic nondestructive inspection of aeronautical components it is mandatory to detect defects both smaller and smaller and nearer and nearer the surface of these components The quantitative evaluation of these defects allowing a definition of their mechanical consequences must also be improved This requires the use of more sensitive ultrasonic transducers, with a larger bandwidth The main method used at present to increase the bandwidth of piezoelectric transducers entails an important decrease of their sensitivity it is based on the damping of the piezoelectric wafer on its rear face Suggested to use instead damping by a multilayer front face which allows a simultaneous increase of both sensitivity and bandwidth In order to study the feasibility of this process a computing program was developed to calculate the propagation of a wave through several layers of different thicknesses This program makes it possible to optimize the characteristics (impedance and thickness) of the various layers making up the transducer Comparisons with actual transducers allowed the validation of this theoretical model G Y

N79-25426*# Rockwell International Corp Los Angeles Calif Aircraft Div
DETERMINATION OF SUBCRITICAL FREQUENCY AND DAMPING FROM B-1 FLIGHT FLUTTER TEST DATA Final Report
S K Dobbs and C H Hodson Jun 1979 87 p refs
(Contract NAS4-2278)
(NASA-CR-3152) Avail NTIS HC A05/MF A01 CSCL 01C

The application of the time-lag products correlation/frequency analysis procedure to determine subcritical frequency and damping from structural response measurements made during flight flutter test of the B-1 prototype airplane is described The analysis procedure the test airplane and flight test procedures are discussed Summary frequency and damping results are presented for six transonic flight conditions Illustrative results obtained by applying various options and variations of the analysis method are included for one flight condition A R H

N79-25428# Army Engineer Waterways Experiment Station Vicksburg Miss
USER'S GUIDE COMPUTER PROGRAM WITH INTERACTIVE GRAPHICS FOR ANALYSIS OF PLANE FRAME STRUCTURES (CFRAME) Final Report
Joseph P Hartman and John J Jobst Mar 1979 60 p
(AD-A067349 WES-INSTRUCTION-0-79-2) Avail NTIS HC A04/MF A01 CSCL 13/13

This report documents the usage of the general purpose computer program CFRAME for the analysis of plane frame structures The intent was to develop an easy-to-use program incorporating the best features of many similar programs and to provide the many additional capabilities required by a diverse group of users CFRAME utilizes the stiffness methods of structural analysis The Cholesky decomposition method is used to solve the resulting matrix equation Automatic generation routines are available to simplify the data input Graphical display of this input data is also available The output may be printed or displayed with graphics Author (GRA)

N79-25433# Boeing Co Wichita Kans
THE INFLUENCE OF FLEET VARIABILITY ON CRACK GROWTH TRACKING PROCEDURES FOR TRANSPORT/BOMBER AIRCRAFT Final Technical Report, 1 Nov 1976 - 1 Jun 1978
David F Bryan and Gordon E Lambert Nov 1978 208 p refs
(Contract F33615-76-C-3130)
(AD-A066596 AFFDL-TR-78-158) Avail NTIS HC A10/MF A01 CSCL 01/3

The purpose of this program is to provide generalized crack growth tracking procedures for transport/bomber aircraft The study was composed of three major tasks (1) an evaluation of the effects of usage parameters on crack growth (2) the development of generalized tracking procedures and (3) an evaluation of the techniques for implementing the individual aircraft tracking program The KC-135A tanker was selected as the baseline aircraft for this study Approximately thirty tests were conducted to experimentally verify predictions made from analyses and to determine the crack growth rate characteristics of the specimen material The results of the parametric and variability studies were used to develop analysis schemes for predicting the effects of usage variations on crack growth Four tracking procedures were evaluated (1) pilot logs with the use of parametric crack growth rate data (2) pilot logs with the use of parametric stress exceedance data (3) the Mechanical Strain Recorder (MSR) and (4) the crack growth gauge The implementation of each tracking procedure was evaluated by developing a cost model to study relative life cycle costs Author (GRA)

N79-25496*# Arizona Public Service Co Phoenix
PHOTOVOLTAICS AND ENVIRONMENTAL IMPACT CONSIDERATIONS Airport Solar Photovoltaic Concentrator Project
Eric R Weber *In* OAO Corp Proc of the US DOE Photovoltaics Technol Develop and Appl Program Rev 1978 p 1-225 - 1-267
Avail NTIS HC A15/MF A01 CSCL 10A

An analysis and description is presented for the proposed Airport Solar Photovoltaic Concentrator Project The environmental effects and potential impacts of the test facilities are discussed S E S

N79-25544# National Aviation Facilities Experimental Center Atlantic City N J
EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT-AIRCRAFT AVCO LYCOMING 10-360-A1B6D PISTON ENGINE Final Report
Eric E Becker Feb 1979 94 p refs
(FAA Proj 201-521-100)
(AD-A066556 FAA-NA-78-49 FAA-RD-78-142) Avail NTIS HC A05/MF A01 CSCL 13/2

A steady state exhaust emissions data base was developed This data base consisted of current production baseline emissions characteristics lean-out emissions data effects of leaning-out the fuel schedule on cylinder head temperatures and data showing ambient effects on exhaust emissions and cylinder head temperatures The engine operating with its current full-rich production fuel schedule did not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) under sea level standard-day conditions The engine did however meet the proposed EPA standards for unburned hydrocarbons (HC) and oxides of nitrogen (NOx) under the same sea level test conditions The results of testing the engine under different ambient conditions (hot day) were also presented and these results showed a trend toward higher levels of emissions output for CO and HC while producing slightly lower levels of NOx Author

N79-25545# National Aviation Facilities Experimental Center Atlantic City N J
EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT-AIRCRAFT AVCO-LYCOMING 10-360-B1BD PISTON ENGINE Final Report
Eric E Becker Feb 1979 91 p refs
(FAA Proj 201-521-100)
(AD-A066589 FAA-NA-78-28 FAA-RD-78-129) Avail NTIS HC A05/MF A01 CSCL 13/2

A steady state exhaust emissions data base was developed This data base consisted of current production baseline emissions characteristics lean-out emissions data effects of leaning-out

the fuel schedule on cylinder head temperatures and data showing ambient effects on exhaust emissions and cylinder head temperatures The engine operating with its current full-rich production fuel schedule did not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) and unburned hydrocarbons (HC) under sea level standard-day conditions The engine did however meet the proposed EPA standards for oxides of nitrogen (NOx) under the same sea level conditions The results of engine testing under different ambient conditions were also presented and these results showed a trend toward higher levels of emissions output for CO and HC while producing slightly lower levels of NOx R E S

N79-25550# Civil and Environmental Engineering Development Office Tyndall AFB Fla Detachment 1 ADTC
AIRCRAFT AIR POLLUTION EMISSION ESTIMATION TECHNIQUES, ACEE Final Report, Aug 1977 - Aug 1978
Harold A Scott, Jr and Dennis F Naugle 1 Sep 1978 12 p refs
(AF Proj 2103)
(AD-A067262 CEEDO-TR-78-33) Avail NTIS HC A02/MF A01 CSCL 13/2

A five-step analytical methodology is presented that can be adapted to nearly any aircraft related air quality assessment problem The methodology is for use by base level environmental personnel to calculate (1) annual aircraft emissions and (2) downfield pollutant concentrations The latest individual engine emission factors and other information required for the methodology are contained in this report Author (GRA)

N79-25567# Lockheed Missiles and Space Co Huntsville, Ala Research and Engineering Center
AIR POLLUTANT EMISSION FACTORS FOR MILITARY AND CIVIL AIRCRAFT Final Report, Aug 1977 - Apr 1978
D Richard Sears Oct 1978 91 p refs
(Contract EPA-68-02-2614)
(PB-292520/4 LMSC-HREC-TR-D568208
EPA-450/3-78-117) Avail NTIS HC A05/MF A01 CSCL 13B

Tables of military aircraft fuel characteristics aircraft classifications, military and civil times in mode, engine modal emission rates and aircraft emission factors per landing-takeoff cycle are calculated and compiled The data encompass 59 engines and 89 aircraft Information related to benzo(a)pyrene emissions and to hydrocarbon emissions (volatile organic) with potential to produce photochemical oxidant is discussed GRA

N79-25662*# National Aeronautics and Space Administration John F Kennedy Space Center Cocoa Beach Fla
GROUND WINDS FOR KENNEDY SPACE CENTER, FLORIDA, 1979 REVISION
D L Johnson and S C Brown Jun 1979 192 p refs Revised
(NASA-TM-78229) Avail NTIS HC A09/MF A01 CSCL 04B

Revised ground-level runway wind statistics for the Kennedy Space Center Florida area are presented Crosswind headwind tailwind, and headwind reversal percentage frequencies are given with respect to month and hour for the Kennedy Space Center Space Shuttle runway G Y

N79-25840*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
TONE NOISE OF THREE SUPERSONIC HELICAL TIP SPEED PROPELLERS IN A WIND TUNNEL
James H Dittmar Robert J Jeracki and Bernard J Blaha 1979 66 p refs Presented at 97th Meeting of the Acoustical Soc of Am , Cambridge Mass 11-15 Jun 1979
(NASA-TM-79167 E-030) Avail NTIS HC A04/MF A01 CSCL 20A

Three supersonic helical tip speed propellers were tested in the NASA Lewis 8- by 6-foot wind tunnel This is a perforated-wall wind tunnel but it does not have acoustic damping material on its walls The propellers were tested at tunnel through flow Mach numbers of 0 6 0 7 0 75 0 8 and 0 85 with different rotational speeds and blade setting angles The three propellers which had approximately the same aerodynamic performance incorporated different plan forms and different amounts of sweep and yielded different near field noise levels The acoustically designed propeller had 45 deg of tip sweep and was significantly quieter at M = 0 8 cruise than the straight bladed propeller The intermediate 30 deg tip sweep propeller which was swept for aerodynamic purposes, exhibited noise that was between the other two propellers Noise trends with varying helical tip Mach number and blade loading were also observed Author

N79-25841*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
ASSESSMENT AT FULL SCALE OF NOZZLE/WING GEOMETRY EFFECTS ON OTW AERO-ACOUSTIC CHARACTERISTICS
D Groesbeck and U vonGlahn 1979 31 p refs
(NASA-TM-79168 E-031) Avail NTIS HC A03/MF A01 CSCL 20A

The effects on acoustic characteristics of nozzle type and location on a wing for STOL engine over-the-wing configurations are assessed at full scale on the basis of model-scale data Three types of nozzle configurations are evaluated a circular nozzle with external deflector mounted above the wing a slot nozzle with external deflector mounted on the wing and a slot nozzle mounted on the wing Nozzle exhaust plane locations with respect to the wing leading edge are varied from 10 to 46 percent chord (flaps retracted) with flap angles of 20 (takeoff altitude) and 60 (approach attitude) Perceived noise levels (PNL) are calculated as a function of flyover distance at 152 m altitude From these plots static EPNL values defined as flyover relative noise levels are calculated and plotted as a function of lift and thrust ratios From such plots the acoustic benefits attributable to variations in nozzle/deflector/wing geometry at full scale are assessed for equal aerodynamic performance Author

N79-25843*# Douglas Aircraft Co Inc Long Beach Calif
VALIDATION OF AIRCRAFT NOISE PREDICTION PROGRAM Final Report, 21 Jun 1978 - 21 Jan 1979
C Y Kapper Jun 1979 84 p refs
(Contract NAS1-15471)
(NASA-CR-159047) Avail NTIS HC A05/MF A01 CSCL 20A

Predictions made with NASA s aircraft noise prediction program (ANOPP) were compared with flyover noise data A data base of six flyover noise runs for the DC-10-40/JT9D-59A configuration was used For all power settings, ANOPP consistently underpredicted the low frequency spectral levels overpredicted high frequency spectral levels and consequently overpredicted the inlet and aft PNLT time histories A R H

N79-25844*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF ROTOR TIP SHAPE ON HELICOPTER BLADE-SLAP NOISE
Danny R Hoad May 1979 464 p refs Prepared in cooperation with Army Res and Technol Labs Hampton Va
(NASA-TM-80066) Avail NTIS HC A20/MF A01 CSCL 20A

The effect of tip-shape modification on blade-vortex interaction-induced helicopter blade-slap noise was investigated The general rotor model system (GRMS) with a 3 148 m (10 33 ft) diameter four-bladed fully articulated rotor was installed in the Langley V/STOL wind tunnel The tunnel was operated in the open-throat configuration with treatment to improve the semi-anechoic characteristics of the test chamber Based on previous investigation four promising tips (ogee sub-wing 60 deg swept-tapered and end-plate) were used along with a standard square tip as a baseline configuration Aerodynamic and acoustical

data concerning the relative applicability of the various tip configurations for blade-slap noise reduction are presented without analysis or discussion A R H

N79-25855# Naval Research Lab Washington D C
THERMOSPHERIC PROPAGATION OF SONIC BOOMS FROM THE CONCORDE SUPERSONIC TRANSPORT Final Report
John H Gardner and Peter H Rogers 14 Feb 1979 83 p refs
(AD-A067201 NRL-MR-3904) Avail NTIS HC A05/MF A01 CSCL 20/1

A nonlinear theory for the long-range propagation of sonic booms through the thermosphere has been developed A realistic atmosphere is employed and consideration is given to such factors as nonlinear stretching and decay of the wave the effects of the caustic the linear acoustic attenuation and the increase in Mach number due to the decreasing density at high altitudes Detailed results are presented for the case of the I Concorde SST in straight level and steady flight at 17 5 km and a velocity of Mach 2 We predict maximum ground level pressures of 0 3 Pa with an N-wave period of about 10 seconds The sound level is a minimum along the flight track with the maximum signal strength occurring about 300 km off the flight track The strongest received signal travels initially downward and reflects off the surface of the ocean to thermosphere The wave turns around at an altitude of 160 km and is returned back to the ground at a horizontal distance of 320 km from the launch point The acoustic Mach number of the wave never exceeds 0 2 Ninety percent of the wave s energy is attenuated below 100 km with 99% attenuated by the time the wave reaches the turning point GRA

N79-25979# Naval Air Systems Command Washington, D C
AVIONICS TECHNOLOGY FOR TACTICAL DATA HANDLING
E B Beggs *In* AGARD Tech for Data Handling in Tactical Systems 2 Apr 1979 8 p

Avail NTIS HC A16/MF A01

Trends emerging in Naval Aviation are discussed along with their impact on avionics community New avionics concepts are discussed with emphasis on the technical and managerial challenges which must be met to assure their successful implementation These challenges include the software implementation of distributed network control and fault tolerance NATO interoperability and standards and logistic support J A M

N79-25991# Naval Air Development Center, Warminster Pa
THE APPLICATION OF STRUCTURED DESIGN AND DISTRIBUTED TECHNIQUES TO AVIONICS INFORMATION PROCESSING ARCHITECTURES
Louis A Naglak and William M Norr *In* AGARD Tech for Data Handling in Tactical Systems, 2 Apr 1979 17 p refs

Avail NTIS HC A16/MF A01

Structured design principles were used in the formulation of a methodology for systems design and applied to the definition of avionics processing architectures The task was an effort to take advantage of technology advances in the computer field and structured support in software to reduce life cycle costs of avionics A core avionics was defined and the design constraint imposed upon it discussed The structured procedure and the way in which it was meant to take advantage of technology was explained Impact of standard is presented and also a specified scheme for implementation Alternatives for development and acquisition methods and contracting for a generic avionics score are presented J A M

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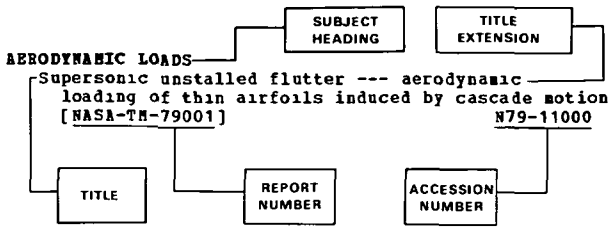

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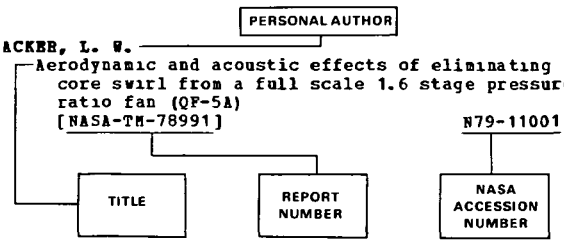

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