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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 82

APRIL 1977

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (82)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 82

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 March 1977 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Special Bibliography* (NASA SP-7037) lists 311 reports, journal articles, and other documents originally announced in March 1977 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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

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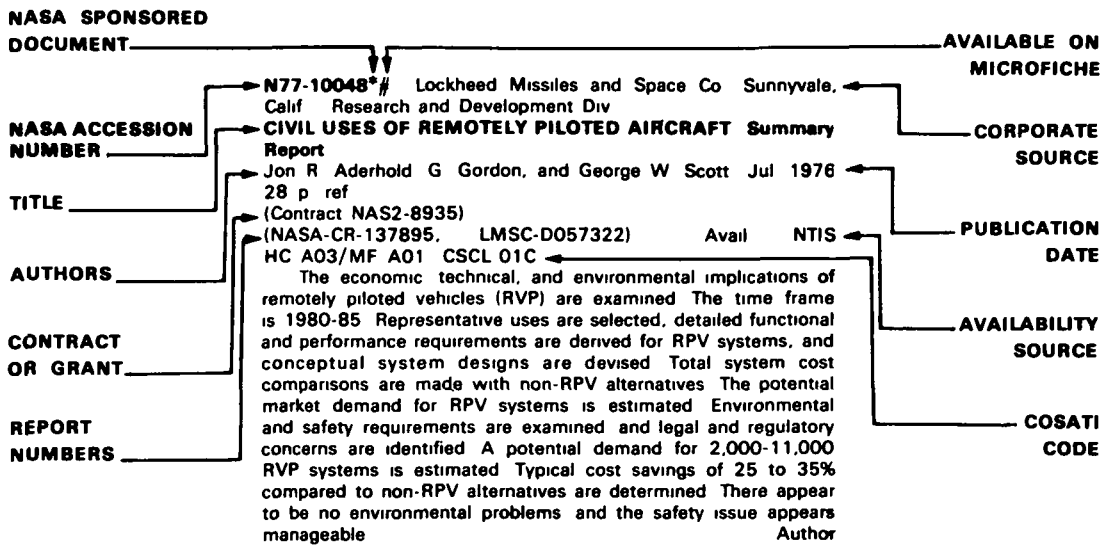


N77-10048*# Lockheed Missiles and Space Co Sunnyvale, Calif Research and Development Div

CIVIL USES OF REMOTELY PILOTED AIRCRAFT **Summary Report**

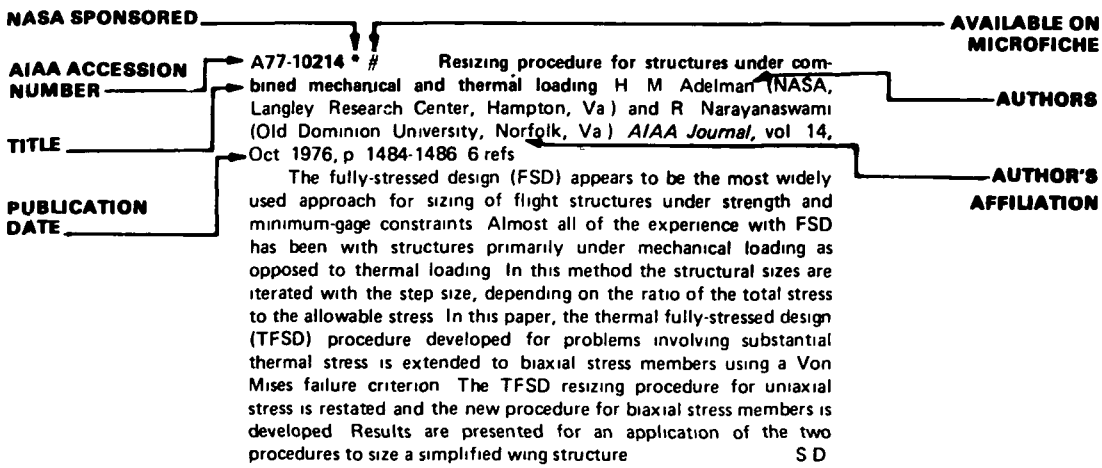
Jon R Aderhold G Gordon, and George W Scott Jul 1976 28 p ref

(Contract NAS2-8935)

(NASA-CR-137895, LMSC-D057322) Avail NTIS HC A03/MF A01 CSCL 01C

The economic technical, and environmental implications of remotely piloted vehicles (RVP) are examined The time frame is 1980-85 Representative uses are selected, detailed functional and performance requirements are derived for RPV systems, and conceptual system designs are devised Total system cost comparisons are made with non-RPV alternatives The potential market demand for RPV systems is estimated Environmental and safety requirements are examined and legal and regulatory concerns are identified A potential demand for 2,000-11,000 RVP systems is estimated Typical cost savings of 25 to 35% compared to non-RPV alternatives are determined There appear to be no environmental problems and the safety issue appears manageable Author

TYPICAL CITATION AND ABSTRACT FROM *IAA*



A77-10214 * # Resizing procedure for structures under combined mechanical and thermal loading H M Adelman (NASA, Langley Research Center, Hampton, Va) and R Narayanaswami (Old Dominion University, Norfolk, Va) *AIAA Journal*, vol 14, Oct 1976, p 1484-1486 6 refs

The fully-stressed design (FSD) appears to be the most widely used approach for sizing of flight structures under strength and minimum-gage constraints Almost all of the experience with FSD has been with structures primarily under mechanical loading as opposed to thermal loading In this method the structural sizes are iterated with the step size, depending on the ratio of the total stress to the allowable stress In this paper, the thermal fully-stressed design (TFSD) procedure developed for problems involving substantial thermal stress is extended to biaxial stress members using a Von Mises failure criterion The TFSD resizing procedure for uniaxial stress is restated and the new procedure for biaxial stress members is developed Results are presented for an application of the two procedures to size a simplified wing structure S D

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 82)

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IAA ENTRIES

A77 16175 # **Flight dynamics and controllability of large jet airplanes (Dinamika poleta i upravliaemost' tiazhelykh reaktivnykh samoletov)** F I Skliansku Moscow, Izdatel'stvo Mashinostroenie, 1976 208 p 42 refs In Russian

The book deals with the flight dynamics and the aerodynamic and design characteristics of modern passenger planes Attention is given to control system parameters which have a pronounced effect on controllability All possible flight conditions are examined, including hazardous conditions that may arise through atmospheric turbulence or pilot error Some aspects of airplane controllability at transonic speeds are studied The design and aerodynamic characteristics of control systems used on board modern airliners are discussed Simple mathematics are used to explain the physical nature of the phenomena encountered in airliner operation V P

A77-16195 **A transportable VFR air-traffic control system** J N Ostis (RCA, Automated Systems Div , Burlington, Mass) *RCA Engineer,* vol 22, Oct -Nov 1976, p 69 73

The article describes a prototype of a family of tactically deployable transportable visual flight rules (VFR) terminal air traffic control (ATC) systems, along with functional limitations, viable solutions, and support equipment The AN/TSW-7 deployable VFR terminal ATC system described can use any combination of 3500 UHF channels or 1360 VHF channels in simultaneous transmission/ reception Descriptions of a unique UHF/VHF colinear antenna and UHF/VHF transceiver coupler systems are presented These systems are designed for use in terminals where fixed facilities are not available or not adequate, and for use in austere contingencies (temporary replacement, repairs, or other downtime, support of disaster relief operations, training and mobility exercises for rapid deployment in military emergency situations) R D V

A77-16299 # **Fundamental studies of turbulent boundary layers with injection or suction through porous wall IV - Application of fundamental theoretical analysis to cascaded blades with injection or suction and cascade tests** T Maeda and K Shimura (Tokyo Metropolitan University, Tokyo, Japan) *JSME, Bulletin,* vol 19, Oct 1976, p 1149-1159 31 refs

Results obtained during tests on turbine blades in a cascade with injection or suction over their total surfaces are used to evaluate the applicability of an analytical method for studying a turbulent boundary layer with injection or suction to the boundary layer on a blade surface The velocity profile of the blade-surface boundary layer is compared with that of the boundary layer on a flat plate, and the validity of an analytical technique for estimating the separation point of the blade-surface boundary layer is considered The effect of injection or suction on cascade performance is investigated, the injection or suction ratio is determined, and the boundary-layer thickness on a blade surface is derived The total pressure loss coefficient of a blade is calculated theoretically and compared with experimental results A practical method is given for empirically computing the total pressure loss or wake momentum loss coefficient from the injection flow rate or injection ratio F G M

A77-16305 # **Electric analog modeling of temperature fields in gas turbine blades for transient modes of operation (Elektromodelirovanie temperaturnykh polei v lopatkakh gazovykh turbin na perekhodnykh rezhimakh ikh raboty)** A B Temnikov, A B Deviatkin, E L Mikheenkov, and V I Igonin In Mixed boundary value problems and problems of mathematical modeling Kiev, Institut Matematiki AN USSR, 1975, p 40-45 6 refs In Russian

A77-16311 # **A technique for reducing the differential wing-flutter equations to integral equations (Ob odnom metode svedeniia differentsial'nykh uravnenii flattera kryla k integral'nym uravneniiam)** K Ia Kukhta and V P Kravchenko In Mixed boundary value problems and problems of mathematical modeling Kiev, Institut Matematiki AN USSR, 1975, p 187 197 In Russian

A77-16325 **Efficiency of turbine-blade cooling by air injection through longitudinal slots** Ia I Bliumin *(Teplofizika i Teplotekhnika,* no 27, 1974, p 114 118) *Heat Transfer Soviet Research,* vol 8, Jan Feb 1976, p 155-160 7 refs Translation

A77-16372 **Empirical validation of turbine engine exhaust measurements** W G Alwang, N T Campbell, and R H Groth (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *Air Pollution Control Association, Journal,* vol 26, Dec 1976, p 1155 1157

A simple graphical method is developed for establishing the reliability of turbine engine exhaust data based on plotting correlations between the various constituents and fitting smooth curves to those plots If all points fall on the plotted curves to within experimental error, the data are considered to be reliable, indicating that the instrumentation is functioning properly and the sample handling system is satisfactory However, failure to follow a straight line CO2 O2 relationship when plotted, or a smooth relationship for other exhaust constituents, is indicative of a sampling problem, a method error, or a calculating error The correlations can be made available on a scope display to the test operator to help him judge the consistency of the data as the test progresses S D

A77 16373 **Standard reference gases and analytical procedures for use in gas turbine exhaust measurements** J H Elwood, D J Robertson, D G Gardner, and R H Groth (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *Air Pollution Control Association, Journal,* vol 26, Dec 1976, p 1158 1162 17 refs

The paper examines the specific problems encountered in the establishment of standard reference gases and in the development of attendant analytical procedures The present practice in establishing and using these standards is stressed, with particular reference to the development of standards for the measurement of NOx, CO, CO2, total hydrocarbons, and O2 A major conclusion is that hydrocarbon measurement standards should be changed, from a combined requirement for flame-ionization detector burner optimization and

allowable oxygen effect, to include just a prescription for oxygen effect, the required instrument response to oxygen should be limited to the range of actual use, i e , 15 to 20% The analysis of low concentrations of CO by methanation and subsequent detection using a flame ionization detector is a viable technique There is need for additional CO2 NBS standards in the range 0 5-5% and additional O2 NBS standards in the range 10 21% Participation in interlaboratory cross reference gas analysis programs would provide valuable insight into proficiency to make accurate and reliable analyses S D

A77-16375 **A new air transport policy for the North Atlantic** J J Friedman New York, Atheneum, 1976 151 p 97 refs $5 95

An investigation is conducted concerning the requisites of a sound regulatory policy with regard to the great North Atlantic air transport system A basic change in the regulatory policy under which the industry now operates is required to solve the deep-lying economic problems which have plagued the North Atlantic service for years Approaches for achieving improved efficiency are considered, taking into account the control of scheduled capacity, the integration of scheduled and charter capacity, and the control of charter capacity Questions related to an achievement of economic fares are also discussed, giving attention to fares for scheduled services, the relation of scheduled to charter fares, charter rates, and a standard of reasonableness of profits G R

A77-16401 **Max-Planck-Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut (Max-Planck-Institut fur Stromungsforschung Gottingen 1925-1975 Festschrift zum 50 jahrigen Bestehen des Instituts)** Gottingen, West Germany, Max Planck Institut fur Stromungsforschung, 1975 477 p In German and English

Attention is given to turbulent flow of compressible fluids, real and rarefied gas dynamics, molecular interactions in the framework of kinetic theory, and atomic and molecular collisions in rarefied gases Also considered are the interaction of elementary chemical processes with flow processes, turbulent wall flow, wall pressure fields in turbulent boundary layers, vortex rings, interactions of sound and flames, and aircraft noise Laser Doppler anemometry, and the investigation of vortex structures in the wake of a cylinder are also discussed

B J

A77-16413 **Self-excited oscillations in supersonic flow (Selbsterregte Schwingungen von Uberschallstromungen)** G E A Meier In Max Planck Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut Gottingen, West Germany, Max Planck-Institut fur Stromungsforschung, 1975, p 184-188 5 refs In German

Mach-Zehnder interferometry data on strongly unsteady gas flow in a Laval nozzle is used to explain the self-excitation of oscillations in transonic flow Attention was given to wall boundary layer separation in the divergent part of the nozzle where a pressure rise is observed The unsteady flow regime which results is conditioned by pressure gradients and the associated formation of compression shocks and resembles the flow regime associated with buffeting of wing profiles B J

A77-16414 **Sonic boom focusing (Uberschallknallfokussierung)** F Obermeier In Max-Planck-Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut Gottingen, West Germany, Max-Planck-Institut fur Stromungsforschung, 1975, p 189-193 5 refs In German

A shock-ray tracing method of caustics is applied to the problem of sonic boom focusing The method consists of three steps (1) determination of the time function of pressure distribution of the sonic boom, (2) determination of the Fourier component of the shock pressure in the neighborhood of the caustic formed by the boom, and (3) use of the inverse Fourier transformation to obtain the modified pressure distribution of the focused sonic boom The method is applied to a shock wave system with a shock duration of 0 1215 s and a shock rise time of 1 5 x 10 to the -3rd s B J

A77-16417 **Calculation of curves of constant equivalent levels of enduring sound for implementation of the aircraft noise protection law - Methods and preliminary results (Berechnung von Kurven konstanten aquivalenten Dauerschallpegels bei der Durchfuhrung des Gesetzes zum Schutz gegen Fluglarm - Methoden und erste Ergebnisse)** E Koppe, H Leinemann, and K Matschat In Max-Planck-Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut Gottingen, West Germany, Max-Planck-Institut fur Stromungsforschung, 1975, p 208 214 In German

A77-16421 **Wavelength in axisymmetric steady supersonic free jets (Uber die Wellenlange im rotationssymmetrischen stationaren Uberschallfreistrahl)** G Grabitz In Max-Planck-Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut Gottingen, West Germany, Max-Planck Institut fur Stromungsforschung, 1975, p 233-240 In German

The paper examines waves which form due to pressure variations in a supersonic free jet as it exits from an axisymmetric nozzle The wavelengths of the pressure waves are described for axisymmetric nozzles and jets by the expression 1 = k R square root of M squared - 1, where R is the nozzle radius, M is the Mach number of the undisturbed jet, and k is a constant equal to 2 61 (according to Prandtl) or 2 44 (according to Pack) The jet flow is assumed to be inviscid, uniform and parallel This paper examines the case where pressure waves distort the parallel nature of the free jet An analytical solution is obtained for the linear approximation of the wavelength equation B J

A77-16422 **The velocity field of small-Mach number Knudsen flow on the edge of a disturbed plate (Das Geschwindigkeitsfeld der Knudsenstromung kleiner Machzahl an der Kante einer anfahrenden Platte)** K Kraemer In Max Planck Institut fur Stromungsforschung Gottingen 1925-1975 Publication celebrating the 50th anniversary of the Institut Gottingen, West Germany, Max-Planck Institut fur Stromungsforschung, 1975, p 241 254 10 refs In German

When a plate that is in thermal equilibrium in a quiescent gas performs uniform translational motions, then a Knudsen flow is induced at the edges of the plate This paper uses the kinetic theory of gases to investigate the excitation of Knudsen flow for a thin flat infinite plate disturbed in a quiescent gas The Knudsen flow is considered to be subsonic and it is assumed that gas molecules are reflected diffusely from the plate The Maxwell distribution is used to obtain distribution functions for the collision-free Knudsen flow and to examine flow velocity distributions The problem is examined in a relative inertial reference system B J

A77-16528 **Parameter identification and study of properties within the scope of flight testing a high performance aircraft (Parameteridentifizierung und Eigenschaftsuntersuchungen im Rahmen der Flugerprobung eines Hochleistungsflugzeugs)** H Schaufele and H Eibl (Messerschmitt-Bolkow Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976 Paper 76-220* 53 p 7 refs In German (MBB UFE 1268)

The paper describes the method of subsystems for calculating stability and control derivatives from parameter identification tests of aircraft Differential equations for computing a number of derivatives of longitudinal and transverse motions are set up Measurement matrices that minimize the effects of angle of attack and sideslip angle measurement errors are introduced Calculations of poles and zeros of transfer functions are shown P T H

A77-16529 New technology for fighter aircraft (Neue Technologie fur Kampfflugzeuge) H Langfelder (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-147* 16 p In German (MBB-UFE-1263)

The paper discusses the interrelation between new technology, system integration, and economic feasibility with respect to a possible new generation of European fighter aircraft The desirability of an integrated prototype and European cooperation is stressed P T H

A77-16530 # Experiences concerning construction and testing in the case of a pressurized fuselage section with a sandwich-construction design (Erfahrungen aus Fertigung und Versuch an einer druckbelufteten Rumpfsektion in Sandwichbauweise). W Maurer (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76-197* 42 p 6 refs In German

A cylindrical aircraft fuselage section with a length and a diameter of about 3 m is considered The fuselage section consists of four component shells It contains six windows and a flap for freight loading applications A titanium sandwich design is used for a lateral shell and the upper shell An aluminum sandwich design is employed for the other structural components The design differences are used for a comparative study Attention is given to details of fuselage section construction, a comparison of the weights of the components, and the first results of a fatigue test G R

A77-16531 # Experimental cognition for qualification of voice warning systems in aircraft (Experimentelle Erkenntnisse zur Eignung von Stimmwarnsystemen in Flugzeugen) M Reinecke (Bundesministerium der Verteidigung, Flugmedizinisches Institut, Ingolstadt, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-211* 4 p In German

Pilots' responses to auditory (speaking voice) and visual warning and alarm annunciation systems are compared, with emphasis on response times Response times to auditory warnings are found to be demonstratively shorter than response times to visual warnings, although the gap is smaller with more experienced pilots Simulator and flight tests were carried out with UH-1D helicopter and with F104 A voice-transmitted 'check caution panel' warning in hedgehopping flight brought no faster response than the visual warning Pilots tend to respond most urgently to voiced warnings 'fire', 'rotor rpm too low', and 'exhaust temperature too high' Some average response times to different modes of warning are cited R D.V

A77-16532 # Calculation of pressure distribution on oscillating airfoils in supersonic flow (Berechnung der Druckverteilung an schwingenden Tragflugeln in Uberschallstromung) A Muller (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-156* 32 p In German

The integral equation for pressure distribution on an oscillating airfoil was solved by a stepwise procedure which divides the wing into rectangular cells whose diagonals are Mach lines The kernel function was formulated for the supersonic flow region Mean values and the first two moments were determined for selected cells and a three-term local approximation was calculated for the kernel functions The pressure integral thus determined was used to examine cells behind supersonic and subsonic leading edges Results of computations were compared with those obtained experimentally for rectangular wings with a steady pressure distribution B J

A77-16534 # Liquid hydrogen as propellant for commercial aircraft (Flussiger Wasserstoff als Treibstoff fur Verkehrsflugzeuge) A Quast (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Aerodynamik, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-188* 29 p 6 refs In German

An investigation is conducted concerning the feasibility to use liquid hydrogen as fuel for commercial aircraft Effects related to lower fuel weight and larger tank volume compensate each other The energy consumption in the case of an aircraft using hydrogen is, therefore, about the same as in the ccse of a corresponding conventional aircraft However, a considerable amount of electrical energy is required to transform gaseous hydrogen into the liquid state Liquid hydrogen is consequently significantly more expensive than synthetic hydrocarbons As much as 40% of the operational costs of commercial aircraft can be related to fuel costs It is concluded that a use of hydrogen in commercial aviation on the basis of the current status of technology is not economic G R

A77-16536 # Flight-characteristics requirements concerning static stability in supersonic flight (Zum problem der Flugeigenschaftsforderungen nach statischer Stabilitat im Uberschallflug) G Sachs (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76 199* 15 p 7 refs In German

It is shown that three important criteria of current flight-characteristics requirements concerning static stability are not suited for the range of the very high speeds of supersonic flight Relations between static and dynamic stability in supersonic flight are explored, taking into account the question of aperiodic instability It is found that the currently known criteria for the detection of aperiodic unstable forms of motion are not suited for the supersonic flight range G R

A77-16537 # Transonic cascade flow calculation using the relaxation method (Transsonische Gitterstromungs-Berechnung mit der Relaxations-Methode) M E Schmidt (Stuttgart, Universitat, Stuttgart, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76-186* 18 p 6 refs In German

The paper describes a numerical procedure for the calculation of two-dimensional inviscid transonic flow past a blade cascade A finite difference method is used to solve the full compressible potential flow equation in the potential stream function plane, and the relaxation method is used to solve the associated system of nonlinear hyperbolic differential equations The solution was obtained through integration in the flow velocity and direction fields Numerical results are compared to those of holographic interferometry on a transonic cascade flow B J

A77 16538 # **Amplification of jet noise through engine noise (Die Verstarkung von Strahllarm durch Schall aus dem Triebwerk)** D Bechert and E Pfizenmaier (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Tur bulenzforschung, Berlin, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-162* 29 p 10 refs In German

Common practice has been to consider the total noise output of an aircraft engine to be composed of several independent contribu tions The present investigation, however, shows that broadband jet noise can be amplified by a pure tone excitation as much as 6 to 7 dB This effect is found to occur at sound pressure levels which are present in real aircraft engines The experiments were carried out with a cold jet at high subsonic Mach numbers excited by sound waves coming from inside the nozzle Based on a simplified theoretical model an attenuator has been constructed which is able to reduce the jet noise amplification considerably (Author)

A77-16539 # **Investigation of airfoils near the ground with nonsymmetrical flow past them (Untersuchungen an unsymmetrisch angestromten Tragflugeln in Bodennahe)** G Binder (Braunschweig, Technische Universitat, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76 152* 34 p 24 refs In German

Airfoil theory is used to examine the aerodynamic coefficients of drifting and hanging wings near the ground with the ground effect accounted for by the mirror principle Kinematic flow conditions are considered giving particular attention to induced velocity distribu tions Results of line airfoil theory are compared with experimental data in terms of the influence of various flow and airfoil parameters on the aerodynamic characteristic lift, drag, rolling moment, and aerodynamic center Attention is given to rectangular, swept-back and delta wings B J

A77-16540 # **Mobile data radio (Mobiler Datenfunk)** R Bauerle (Elektronik System-Gesellschaft mbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-168* 28 p In German

An investigation is conducted concerning the parameters which affect the quality of communication in the case of mobile trans mitters and receivers Questions of data transmission by radio in the VHF range between a stationary transmitter and a receiver which is in motion are discussed, taking into account aspects of radio wave propagation, transmission error characteristics, and problems of data transmission to low-flying flight vehicles as, for instance, remotely piloted vehicles G R

A77-16541 # **The new microwave landing systems /MLS/ and their properties, giving particular attention to the German system DLS /DME-Derived Landing System/ (Die neuen Mikrowellen-Landesysteme /MLS/ und ihre Eigenschaften unter besonderer Berucksichtigung des deutschen Systems DLS /DME-Derived Landing System/)** A Becker (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugfuhrung, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-176* 40 p In German

An investigation is conducted concerning the requirements which have to be satisfied by the new microwave landing systems, taking into account certain disadvantages of the currently used instrument landing system The characteristics of air-derived and ground-derived systems are examined and a survey is provided regarding the various competitive landing systems Attention is given to the frequency bands for MLS, the time reference scanning beam systems of the U S and Australia, the Doppler scan system of Great Britain, and the DLS of West Germany Approaches are discussed for demonstrating the feasibility of DLS operation G R

A77-16542 # **Center-of-gravity problems in the system ejection seat-pilot (Schwerpunktprobleme im System Schleudersitz-Pilot)** H Bellmann (Bundesanstalt fur Wehrtechnik und Beschaffung, Manching, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-213* 18 p In German

Curves of pilot ejection with harmonic and stabilized characteristics are considered along with the details of the pilot ejection process The motions of the system pilot ejection seat are determined by the center of gravity of the system The location of the center of gravity of the system depends on the locations of the center of gravity of the ejection seat and that of the pilot A description is given of approaches which will ensure that the actual pilot ejection curves will be similar to the curves established for a pilot ejection process with ideal characteristics G R

A77-16543 # **Development of single-flight cycles for fatigue tests, based on operational stresses, in the case of large aircraft components (Erstellung von Einzelflugablaufen fur Ermudungsversuche an Flugzeuggrossbauteilen basierend auf Betriebsbelastungen)** K Wolthe (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-216* 22 p In German

A description is given of a flight by-flight program for an aircraft component test, taking into account a fatigue test involving the main landing gear of the F-104 G aircraft The fatigue test was carried out by a German company during the years 1974 and 1975 The test was conducted to determine the operational life of the landing gear components Attention is given to the determination of the stress cycles which correspond to the takeoff and landing operations Details are presented concerning the approaches which were used in the development of a test program that provides a suitable simulation of the operational stress cycles G R

A77-16544 # **Crack propagation in the reinforced structure of a transport aircraft, calculation-experiment comparison (Rissfortschritt in der versteiften Struktur eines Transportflugzeuges Vergleich Rechnung-Versuch)** H Wiese (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76 218* 21 p In German

The reported investigation is concerned with the determination of the damage tolerance of the structure of a transport aircraft, taking into account a study of a crack in the normal frame region of the fuselage The crack is located in the skin between the normal frame section and the stringers It extends in the flight direction The crack propagation was observed from an initial length of 200 mm to a length of 490 mm at constant stress amplitude Computational crack propagation data are compared with the experimental results The employed method of calculation is described G R

A77-16545 # **Methods and problems concerning the flight control of RPV's (Methoden und Probleme der Flugfuhrung von RPV's)** H Schmidtlein (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-204* 26 p 10 refs In German

One objective of the considered RPV's is related to a replacement of aircraft in the case of missions which are particularly

dangerous Another objective of RPV employment is a lowering of the hazards to which aircraft are exposed by using RPV's before the aircraft mission Both objectives involve a direct attack of hostile targets by RPV's General operational and technical conditions of RPV employment are examined It is recommended to develop low-cost RPV's for specific targets Attention is given to the degree of automatization, questions of a disturbance of RPV missions by enemy action, a definition of three stages for the development of RPV systems, approaches for precise navigation, procedures for the automatic recognition of ground targets, the onboard system, and methods for the transmission of information between RPV and ground control unit G R

A77-16546 # **Theoretical determination of the characteristic curves of airfoil profiles with flaps, flow separation and ground effect (Theoretische Bestimmung der Kennkurven von Tragflugelprofilen mit Klappen, Stromungsablosung und Bodeneinfluss)** J Jacob (Aerodynamische Versuchsanstalt, Gottingen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-206* 26 p 24 refs In German

The behavior of the characteristic curves (particularly the drag coefficient as a function of the lift coefficient and the lift coefficient as a function of angle of attack) depends on Reynolds and Mach numbers, and especially on airfoil geometry The paper considers the following flow situation a dead-water region outside boundary layer separation from the airfoil, a region of constant pressure distribution inside the dead-water region, and a potential outer flow outside the separated boundary layer A two-step procedure is applied (1) the use of a singularity method to calculate the potential flow using a dead water simulation, and (2) the use of boundary layer calculations and iteration to calculate the separation region The case of a high-lift wing system is considered and attention is given to ground effect, displacement effects, and the effects of wind tunnel walls B J

A77-16550 # **Application and effect of the results of stability and structural component studies on current and future aircraft (Anwendung und Auswirkung der Ergebnisse von Festigkeits- und Bauteiluntersuchungen auf gegenwartige und zukunftige Fluggerate)** P Garnatz (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-167* 70 p 43 refs In German

Technological developments related to the materials used for aircraft components are examined, taking into account activities concerning the use of fiber reinforced composites in the U S and in Europe, the employment of titanium alloys, the development of improved aluminum and beryllium alloys, and the use of steel Certain problems concerning the use and the manufacture of the new materials are considered along with the approaches which, in West Germany, can be used to overcome these difficulties The gradual utilization of the new technological developments in the production of military and civil aircraft components is discussed, giving attention to the time from now to 1990 G R

A77-16554 Airfoil design for a variable-geometry aircraft (Tragflugelentwicklung fur ein Flugzeug mit variabler Geometrie). E Klinke (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-153* 42 p 7 refs In German (MBB-UFE-1266)

The design of a variable-geometry wing for STOL military aircraft applications is examined giving attention to geometrical characteristics of the wing, mission spectra, and wing-stability optimization Two-dimensional optimal wing design is considered for an assigned pressure distribution and three-dimensional wing design is considered for conditions of vortex flow, separated flow, and flow with shocks The design of an augmented lift system (and a three-dimensional one in particular) is examined giving attention to structural considerations and optimal control flap conditions B J

A77-16558 # **Reducing secondary losses by blowing cold air in a turbine (Verminderung der Sekundarverluste durch Kuhlluftausblasung in einer Turbine)** W Koschel (Rheinisch Westfalische Technische Hochschule, Aachen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76 164* 23 p 6 refs In German

Experimental investigations are described, the purpose of which is to determine whether local blowing on the profile suction side of the turbine guide wheel blades can be effective in preventing the propagation of secondary flows, that is, casing and hub boundary layers being transported by pressure gradients Some preliminary results on how the blowing should be accomplished in order to influence the secondary flows in the desired manner are given The effectiveness of blowing is demonstrated by comparing to performance without blowing Blowing is also seen to be more effective than using boundary layer slots as far as diminishing losses in the rim zones is concerned P T H

A77-16560 # **Aerodynamic design and flight testing of the VFW 614 (Aerodynamische Auslegung und Flugerprobung der VFW 614)** G Krenz (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-208* 42 p 5 refs In German

Aerodynamic design of the VFW 614 aircraft is considered with attention given to the interference interaction of engine and airfoils under stall conditions The effects of engine wing interactions at high Mach number (about 0 68) are examined taking account of the behavior of the lift coefficient and the aerodynamic moments Flight testing has involved the examination of a number of different aerodynamic engine-wing configurations, with particular attention given to engine over-the-wing configurations B J

A77-16561 Gasdynamic investigations of explosive decompression of one of the cargo holds of the Airbus A 300 (Gasdynamische Untersuchungen zur explosiven Dekompression einer der Frachtraume im Airbus A 300) U Haux (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-209* 31 p 10 refs In German (MBB-UFE-1269)

The paper describes a procedure for making gasdynamic calculations of explosive decompression in a cargo hold of the Airbus A 300 aircraft, which could result from collision, an explosion, or the loss of a door or window, for example General ideas on flow processes within the aircraft were obtained by model tests, with which a calculation procedure was calibrated Additional through-flow surfaces for reducing the pressure load on the passenger deck are optimized with respect to location, size, and inlet and outlet pressure differences P T H

A77-16562 # **A wall interference problem in a hybrid tunnel at transonic speeds (Wandinterferenzprobleme im Hybridkanal bei transsonischen Geschwindigkeiten)** T Hottner (Stuttgart, Universitat, Stuttgart, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-169* 28 p 11 refs In German

The paper proposes a procedure for compensating for the aerodynamic interference caused by boundary layers formed on the

walls of a hybrid transonic wind tunnel The wall interference problem is considered as one of power transmission and the following processes in the hybrid wind tunnel are examined restriction of the core of the potential flow to the corridor through the boundary layer, the effects of the wall boundary layer on wind tunnel corrections in the supersonic region, and shock wave attenuation in the supersonic region The following wall configurations were examined to find the optimal one in terms of interference (1) a freely stretched foil, (2) a foil on an elastic backing, and (3) an elastic foam B J

A77-16564 # **Self-adaptive difference method for the effective solution of computationally complex problems of boundary layer theory (Selbststeuernde Differenzenverfahren zur effektiven Losung von stark rechenintensiven Problemen der Grenzschichttheorie).** W Schonauer, H -G Daubler, G Glotz, and J Gruning (Karlsruhe, Universitat, Karlsruhe, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-185* 20 p 7 refs In German

An implicit difference procedure for the solution of equations for a chemically reacting hypersonic boundary layer is described Difference forms of arbitrary error order in the x and y coordinate plane were used to derive estimates for discretization error Computational complexity and time were minimized by the use of this difference method and the iteration of the nonlinear boundary layer equations was regulated by discretization error B J

A77-16566 # **Calculation of three-dimensional boundary layers on sweptback wings (Berechnung dreidimensionaler Grenzschichten an Pfeilflugeln)** E H Hirschel, V Jawtusch, and R Grundmann (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur angewandte Gasdynamik, Cologne, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-187* 35 p 38 refs In German Research supported by the Deutsche Forschungsgemeinschaft

The finite difference method is used to examine the three-dimensional laminar boundary layer on a sweptback wing and the laminar-to-turbulent boundary layer transition on the wing Boundary layer equations are formulated in a nonorthogonal coordinate system on the curved wing, taking account of the effects of curvature The calculations are performed in the infinite drifting wing approximation and attention is given to initial and boundary conditions, and the dependence and influence regions of the solution to the boundary layer equations obtained through numerical integration using the finite difference method B J

A77-16567 # **High-speed tests with the helicopter BO 105 HGH (Hochgeschwindigkeitserprobung des Hubschraubers BO 105 HGH)** H Huber, C Schick, and A Teleki (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-222* 32 p 7 refs In German (MBB-UD-178-76)

A description is presented of a research and test program which has been conducted by a German aerospace company in connection with the development of high-speed helicopters Objectives of the test program include the testing of a hingeless rotor with respect to an extended flight regime, the study of advanced blade designs for future high performance helicopters, and a determination of the effect of a rotor-lift relief provided by wings on flight performance and maneuverability G R

A77-16568 # **Contribution of materials technology to progress in propulsion system construction (Beitrag der Werkstofftechnik zum Fortschritt im Triebwerkbau)** H Huff *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16 1976, Paper 76-150* 13 o In German

The basic goals of progress in gas turbine engine design are higher gas temperature, higher specific strength, and higher material utilization, which are attained by lighter construction Progress in these areas over the past twenty-five years achieved by the development and use of new materials is summarized P T H

A77-16569 # **Theoretical and experimental investigation of the departure characteristics of external stores which are dropped from an aircraft (Theoretische und experimentelle Untersuchung des Abgangsverhaltens einer Aussenlast von einem Tragerflugzeug)** H Barth (Messerschmitt Bolkow-Blohm GmbH, Ottobrum, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76 202* 40 p 6 refs In German

Approaches for the determination of the behavior of external stores which are dropped from an aircraft are discussed, taking into account a theoretical model for store trajectory calculations, the equations of motion for the stores, and experimental investigations in the wind tunnel A description is given of the results obtained in the study of the departure characteristics for an external store in the vicinity of the Phantom F4F The study included an investigation of the effect of differences in store weight G R

A77-16571 # **Development of a carbon fiber-reinforced plastic elevator unit for the Alpha Jet (Entwicklung eines KFK-Hohenleitwerks fur den Alpha-Jet)** H Conen, S Roth, and W Seuster (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14 16, 1976, Paper 76 194* 31 p 9 refs In German

It is expected that in the future a large part of the aircraft structure will consist of fiber-reinforced composite materials Of these materials, carbon fiber-reinforced plastic has the greatest potential for a replacement of the light metal currently used in aircraft manufacture A description is given of the employment of carbon fiber reinforced plastic for an elevator unit by a German aerospace company An important development objective, in addition to the reduction of the component weight, is the avoidance of a cost increase in comparison to the design which utilizes metal G R

A77-16572 # **The development of a carbon fiber-reinforced plastic rudder for the Alpha Jet (Entwicklung eines KFK-Seitenruders fur den Alpha-Jet)** H Schneider, H Frick, and E Henze (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-193* 50 p 9 refs In German

Sandwich construction is employed in the design of the rudder Outer sheets of carbon fiber reinforced plastic cover a layer of aluminum Component design calculations have been performed with the aid of the finite element method Modifications in the initial design were introduced to lower production costs in connection with a use of quantity-production techniques Certain difficulties experienced in the construction of the first rudder could be eliminated by design changes G R

A77-16573 **Sound shielding on an engine model and comparison with theory (Schallabschirmung an einem Triebwerksmodell und Vergleich zur Theorie)** G Wolfer (Messerschmitt-Bolkow-Blohm GmbH, Hamburg, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-163* 27 p 5 refs In German (MBB-UH 16-76)

Although numerous data exist on noise shielding values of lifting surfaces for point sources of noise, the noise generated by aircraft is hardly from a point source This paper describes experiments in an acoustic sound chamber, the purpose of which was to verify the prediction capacity of such data for real aircraft designs An aircraft half-model was placed in a reflection free acoustic chamber, while the noise source was a fan model The experiments were specifically to determine the shieldability of the noise from the fan moving from back to front Harmonic components of the fan revolution noise were measured with and without the aircraft model A numerical model was constructed that enables calculating with reasonable accuracy the noise emission of noise shielding configurations P T H

A77-16574 Adaptation of the lateral controls for the VFW 614 during the flight tests (Anpassung der Quersteuerung fur die VFW 614 wahrend der Flugerprobung) K Bottcher (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76 221* 31 p In German

The VFW 614 is a commercial aircraft which is equipped with two engines It was developed for short-haul traffic and a use of small airports The design criteria for the lateral controls are described The first flight test showed that the flight characteristics of the aircraft at low speeds were unacceptable Certain modifications of the design of the lateral controls were required to eliminate difficulties concerning the control of the aircraft The design modifications are discussed in detail together with the effect of the modifications on the flight characteristics of the aircraft G R

A77-16575 # Layout and flight performance of a hypersonic transport /HST/ (Auslegung und Flugleistungen eines Hyperschall-Transport-Flugzeugs /HST/) G Bruning, M Kloster, and H Krammer (Munchen, Technische Universitat, Munich, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-198* 44 p 31 refs In German

General considerations for planning and reference designs for a hypersonic transport aircraft (HST) are laid out Selection criteria for airfoils are discussed, including a conventional wing fuselage combination, wedge airfoils, and surfboard type airfoils Projections for flight range, propulsion plant organization, and drag value assignments in computer models are discussed High Mach diagrams are plotted for performance in throttling, maneuvering, acceleration, and under loading Literature data for thrust, fuel consumption, and drag are found to be realistic Flight noise is considered moderate, and hydrogen fuel with water vapor as exhaust gas is environmentally safe R D V

A77-16577 # Multidimensional solutions for supersonic flow fields in turbomachines (Mehrdimensionale Lösungen fur Uberschall-Stromungsfelder in Turbomaschinen) H.-H. Fruhauf (Stuttgart, Universitat, Stuttgart, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-165* 10 p 9 refs In German

A nonlinear model for three-dimensional supersonic flow through an axial ring cascade is compared with a simplified nonlinear model Next, an axisymmetric flow model and a model for a two-dimensional cascade are compared Three-dimensional corrections introduced into the flow models are examined along with a number of three-dimensional flow effects including warping of the flow surfaces, and cross flow The example of supersonic flow through a ring cascade with complex geometry is treated with application to a supersonic momentum impeller The results obtained are examined in the light of supersonic turbine development B J

A77-16578 # Numerical procedures for the calculation of unsteady air forces on oscillating wings and fuselages (Numerische Verfahren zur Berechnung instationarer Luftkrafte an schwingenden Tragflachen und Rumpfen) W Geissler (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Aeroelastik, Gottingen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-155* 24 p 9 refs In German

Accurate information regarding the unsteady air forces on oscillating aircraft components is vital for a detailed flutter analysis A description is given of numerical panel procedures which can be used for the calculation of unsteady pressure distributions and the resulting air forces in the case of oscillating aircraft components in subsonic flow The procedures are based on the velocity potential The employment of the velocity potential in place of the acceleration potential, used in current approaches, has a number of advantages related to certain simplifications and additional possibilities The results obtained with the aid of the new procedures are compared with the results of other theories and with experimental data G R

A77-16579 # The relationship between the mean depression in a vortex and its rotational kinetic energy A Stewart (Rolls-Royce /1971/ Ltd , Derby, England) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-184* 18 p

A relationship is derived between the mean depression within a vortex and its rotational kinetic energy, which applies to any vortex which goes 'solid' at the center With this proviso, the relationship is independent of the type of vortex As an illustration of the use of the relationship, the loss due to swirl in a propulsion nozzle is derived (Author)

A77-16581 # Experience related to the development of high-stress carbon fiber-reinforced plastic structures, taking into account the example of a subsonic inlet ramp (Entwicklungserfahrungen fur hochbelastete KFK-Strukturen am Beispiel einer Unterschall-Einlauframpe) H D Berg (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-195* 41 p In German

A number of development problems are connected with the employment of carbon fiber reinforced materials with plastic matrices in components which have to satisfy exacting stiffness and strength requirements over a wide operational temperature range These problems are quite different from those involved in the use of metallic materials The development of a mobile inlet ramp for a Mach 2 military aircraft is discussed Attention is given to the technical requirements for the ramp, a weight cost analysis of various design and material combinations, questions of ramp design, problems of material selection, mechanical tests, and aspects of ramp manufacture G R

A77-16582 # Experiments on supersonic lee-side flow past delta wings (Experimente zur Leeseiten-Stromung bei Deltaflugeln im Uberschall) J Szodruch (Berlin, Technische Universitat, Berlin, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-154* 23 p In German

Experiments were performed on three sweptback delta wing models in two different wind tunnels, one at a Mach number of 3 5 and a Reynolds number of 5 x 10 to the 6th, the other at a Mach number of 2 5 and a Reynolds number of 1 x 10 to the 6th Static pressure measurements on the lee sides of the models, all with different cross sections, were performed using Hg manometers Schlieren and oil-film images of the pressure distributions were obtained Primary attention was given to the effects of Mach number and angle of attack on leading edge conditions with angle of attack selected between 0 and 30 degrees B J

A77-16585 # **Time-optimal ascent trajectories (Zeitoptimale Aufstiegsbahnen)** P Hahn (Munchen, Technische Universitat, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76 200* 39 p 7 refs In German

An investigation is conducted concerning the optimal flight trajectories for a fictive aircraft studied by Hahn (1975) The results are used to derive a number of relationships which make it possible to carry out a rapid quasi-time minimal trajectory calculation The maximum deviation of the results of these trajectory calculations from the data obtained by the accurate method appears to be about 3% Attention is also given to the trajectories for the Concorde and the F-104 The operational characteristics of the three considered aircraft types are compared G R

A77-16586 # **Theoretical and experimental results of the investigation of two different supersonic compressor stages (Theoretische und experimentelle Ergebnisse der Untersuchungen an zwei unterschiedlichen Uberschallverdichterstufen)** H E Gallus, D Bohn, and K -D Broichhausen (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-166* 25 p 12 refs In German

One-dimensional calculations were performed on two supersonic turbocompressor stages a stage with a momentum impeller and a stage with a shock impeller, to determine optimal flow conditions for the compressor Theoretical results are checked by pressure probe measurements performed on a supersonic compressor using a Freon-air mixture as the working fluid, and by schlieren photographic flow-visualization data The results are relevant to the determination and control of the pressure distribution and thrust-weight ratios of supersonic compressors, with possible application to engines of remotely piloted vehicles B J

A77-16587 # **Holographic determination of thermal and mechanical deformations in the case of structural components and structures of aeronautical and astronautical technology (Holographische Bestimmung thermischer und mechanischer Deformationen an Bauteilen und Strukturen aus der Luft und Raumfahrttechnik)** K Grunewald (Dornier System GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-180* 9 p In German

A77-16588 # **Testing procedures for carbon fiber reinforced plastic components (Prufverfahren fur KFK-Bauteile)** H J Gosse, M Kaitatzidis, and S Roth (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-215* 77 p 14 refs In German

Tests for studying the basic material are considered and quality control investigations involving preimpregnated materials (prepreg) are discussed Attention is given to the prepreg area weight, the fiber area weight of prepregs, the resin content, volatile components, the effective thickness, resin flow, the resistance to bending strain, tensile strength, and shear strength A description of tests conducted during the manufacturing process is also presented, taking into account X-ray methods, approaches of neutron-radiography, ultrasonic procedures, resonance methods, and impedance studies G R

A77-16590 # **Hingeless rotor for the larger helicopters (Gelenkloser Rotor fur grossere Hubschrauber)** F L Von Doblhoff (Boeing International Corp , Munich, West Germany) and E Weiland (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 9th, Munich, West Germany, Sept 14-16, 1976, Paper 76-223* 33 p 20 refs In German

Regularities encountered in the scale-up of hingeless rotors are discussed and comparisons are drawn between rotors manufactured by several firms (Boeing-Vertol YUH-61A rotor and the BO 105 rotor of MBB) Rotor parameters independent of the rotor system are studied tip speed, rotor disk loading, rotor blade thickness, blade width, the rotating mass of the rotor (of interest for helicopter autorotation performance), and operating conditions The ratio of the first impact bending eigenform to the rotor rotating frequency is studied as the major parameter dependent upon the rotor system Geometric similitude problems and recent trends in design are examined, and the two rotor designs are compared systematically R D V

A77-16597 , **Longitudinal stability in supersonic and hypersonic flight (Langsstabilitat im Uberschall und Hyperschallflug)** G Sachs (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Nov Dec 1976, p 301 329 66 refs In German

The paper deals with conditions specific for static and dynamic stability of supersonic and hypersonic flight In particular, it is shown that height dependent forces and moments have a decisive influence on stability Contrary to this, speed dependent forces and moments are unimportant or even negligible It is shown which consequences exist with regard to the effect of thrust characteristics on stability The influence of speed and height dependent pitching moments on stability is described The study includes the effects resulting from elastic deformations Further, it is shown that the current concept of static stability is not applicable to supersonic and hypersonic flight A new concept generally valid is introduced which is adequate for supersonic and hypersonic flight as well as for subsonic flight In addition, it is shown that the well known relation between static stability and the variation of elevator angle with speeds does not exist in supersonic and hypersonic flight Here, too, a new concept is introduced (Author)

A77-16598 # **The effect of inclined trailing edges and membrane weight on the supersonic flow past conical paragliders with small camber (Einfluss schrager Hinterkanten und Einfluss des Eigengewichts der Bespannung auf die Umstromung konischer Paragleiter mit schwacher Wolbung im Uberschall)** B Wagner (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Nov -Dec 1976, p 329 340 8 refs In German

Lifting wing theory is used to analyze the supersonic flow past a conical paraglider of small camber for the case of inclined trailing edges The integral equation of the problem is solved in the elliptical and hyperbolic regions of supersonic flow and the effect of glider membrane weight on aerodynamic characteristics is considered The effect of trailing edge inclination and of membrane weight on the eigenvalues of the problem is studied with particular attention given to flutter boundaries B J

A77-16599 # **Design of airfoils in transonic flow by the integral method (Entwurf von Tragflugelprofilen fur schallnahe Anstromung nach der Intregalmethode)** H Hansen (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Aerodynamik, Braunschweig, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Nov -Dec 1976, p 340-349 43 refs In German

In the present paper a method for the design of lifting airfoils for a prescribed sub- or supercritical contour velocity distribution is developed From Oswatitsch's integral method for the prediction of the velocity distribution on a given airfoil in transonic flow a corresponding design procedure is deduced A reduced gasdynamic equation is derived for transonic speeds assuming small perturbations which is also valid for the stagnation region In contrast to the prediction method after Oswatitsch which requires the solution of an integral equation, the present design problem works by solving simple integrations For this new method a computer program has

been developed and tested by comparison with exact solutions For prescribed sub- and supercritical velocity distributions on airfoils with convex curvatures, good agreement is obtained with corresponding exact solutions (Author)

A77-16600 # A simplified method in flight test techniques for the determination of the range performance of jet aircraft (Ein vereinfachtes flugversuchstechnisches Verfahren zur Ermittlung der Horizontalflugleistungen von Strahlflugzeugen) R Rosenberg (Bundesamt fur Wehrtechnik und Beschaffung, Manching, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Nov Dec 1976, p 350-356 In German

From the physical fundamentals of the known W/delta method, a simplified method is derived to determine the range performance of jet aircraft The theoretical background is provided The flight test parameters which are to be measured result from the developed equations The simplicity of the method, which under certain conditions is also applicable to aircraft with multishaft engines, results from a special plotting of the data (Author)

A77-16666 * Computation of wave drag for transonic flow P R Garabedian (New York University, New York, N Y) *Journal d'Analyse Mathematique,* vol 30, 1976, p 164-171 10 refs Contract No E(11-1) 3077, Grants No NGR 33 016 167, No NGR-33-016-201

The paper develops a method for calculating wave drag for two dimensional transonic flow, with particular application to the prediction of the drag rise Mach number of a supercritical wing section The method is based on a transonic similarity model which is defined by a normalized small perturbation equation and represents shock waves by the addition of an artificial viscosity term in the region of supersonic flow to the partial differential equation The drag formula obtained allows the computer simulation of transonic wind tunnel data taking account of boundary layer and wall effects B J

A77 16732 Sneak circuit analysis of military systems E J Hill and L J Bose (Boeing Aerospace Co , Seattle, Wash) In International System Safety Conference, 2nd, San Diego, Calif , July 21-25, 1975, Proceedings Newport Beach, Calif , System Safety Society, 1976, p 351-372 16 refs

The purpose of sneak circuit analysis is to detect latent (sneak) circuits and conditions that inhibit desired functions or cause undesired functions to occur without a component having failed The technique consists of the recognition of basic topological patterns inherent in all circuitry (straight line, power dome, ground dome, combination dome, and H pattern), with the circuitry to be analyzed reconstructed in node topograph form Attention is given to com puter aided sneak circuit analysis, data encoding and processing, and network tree analysis Some military applications of sneak circuit analysis are considered including the AQM-34M, AWACS, the Boeing Compass Cope, the F4C autopilot, the Titan II coded switch system, and the Pershing missile B J

A77-16734 # Safety concepts and innovations on the B-1 Bomber H Wilkerson (Rockwell International Corp , El Segundo, Calif) In International System Safety Conference, 2nd, San Diego, Calif , July 21-25, 1975, Proceedings Newport Beach, Calif , System Safety Society, 1976, p 411-448

The B-1 System Safety Program is modeled after the guidelines in MIL-STD-882 This paper describes the B-1 System Safety Program with particular emphasis on several analytical and management innovations to integrate hazard analyses, classify potential hazard impact, and track and resolve potential hazards The innovative safety concepts developed during the B-1 program were implemented in two advanced electronic systems (1) the electrical multiplexing (EMUX) subsystem guided by fail operational/fail safe design philosophy, and (2) the central integrated test subsystem (CITS) governed by lockout guidelines B J

A77 16735 # System safety and the Utility Tactical Transport Aircraft System J C Henderson (U S Army, Agency for Aviation Safety, Fort Rucker, Ala) In International System Safety Conference, 2nd, San Diego, Calif , July 21-25, 1975, Proceedings Newport Beach, Calif , System Safety Society, 1976, p 455 460

After a general description of the UTTAS (Utility Tactical Transport Aircraft System) helicopter, attention is directed to integration of system safety during concept formulation and specific system safety tasks which included hazard analyses, the establishment of positive system safety evaluation procedures for proposed system modifications, and the identification of qualitative and quantitative safety requirements for the system and all subsystems System safety criteria, hazard identification and control (including preliminary hazard analysis, and operating and maintenance hazard analyses), reliability, vulnerability and crashworthiness are examined B J

A77-16736 # System safety in the Advanced Attack Helicopter D W Logan and M V Stratton (U S Army, Agency for Aviation Safety, Fort Rucker, Ala) In International System Safety Conference, 2nd, San Diego, Calif , July 21 25, 1975, Proceedings Newport Beach, Calif , System Safety Society, 1976, p 506-510

The safety features of the Advanced Attack Helicopter (AAH) include twin engines with OEI capability, a redundant hydraulic system, a redundant flight control path, a crashworthy structure, a crashworthy fuel system, tail rotor protection, self retaining bolts, and damage tolerant main and tail rotor blades The principal objective of the AAH System Safety Program is to provide for the identification and correction of hazards Once a decision is made to apply a specific correction to a hazard, the correction must be submitted to analysis to assure that other problems are not introduced B J

A77-16737 # The hidden passenger J A Eckols (Air Line Pilots Association, Washington, D C) In International System Safety Conference, 2nd, San Diego, Calif , July 21-25, 1975, Proceedings Newport Beach, Calif , System Safety Society, 1976, p 547-563

Aircraft safety is considered from the point of view of dangerous cargo materials particularly toxic chemicals and corrosive substances The emergency which arose on a United Airlines 2875 flight from Chicago to San Francisco is described in detail with quotations from the report written by the flight engineer The emergency described was related to the spread of fumes from the cargo compartment where thirty different organic chemicals were being stored A number of recommendations are made concerning chemically dangerous cargo handling of chemicals by ground personnel, packing containers, flammable cargo-flash point determination, the inflammability limits of flammable cargo, onboard detection systems, fire extinguisher systems, crew oxygen masks and smoke goggles, and emergency procedures B J

A77-16739 # Experience with the VOR-navigation system in the German Democratic Republic I (Erfahrungen mit dem VOR-Navigationssystem in der DDR I) H Richter and W Trempler (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 12, no 4, 1976, p 201-212, 219 5 refs In German

Error sources related to an employment of the VOR navigation system are considered, taking into account the connecting line between two VOR positions, the local declination, the ground error,

and the onboard error The results of flight tests concerning VOR installations in the airspace of the German Democratic Republic are discussed Attention is given to the results of flight tests conducted during the time from 1967 to 1973 and proposals regarding the establishment of additional VOR installations G R

A77-16740 # **The technical concept of the IL-62M I (Die technische Konzeption der IL-62M I)** S W Iliushin and G V Novozhilov *Technisch-okonomische Information der zivilen Luftfahrt,* vol 12, no 4, 1976, p 213, 214 In German

The IL-62M airliner is currently used for long-distance flights Differences between the IL-62M and the IL-62 are mainly related to a greater flight range and the enhancement of the payload for the IL-62M The increase in payload is on flights from Moscow to Tokyo about 50%, on flights from Moscow to New York about 80%. The improvements were obtained as a result of design changes Attention is given to improvements regarding the aerodynamic properties of the aircraft, the new fuel system, changes in engine location, and the design of the landing gear G R

A77-16741 # **Maintenance basis for the aircraft Tu-134 (Wartungsbasis fur das Flugzeug Tu-134)** D Kausch (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 12, no 4, 1976, p 217-219 In German

An increase in maintenance operations in connection with the enlarged volume of flight operations and the growing number of aircraft produced certain problems concerning the provision of a suitable place for the conduction of the maintenance operations in the case of the Tu-134 Approaches used for overcoming these difficulties are discussed and a description is given of the selected dock installation design which makes it possible to perform the required maintenance operations for the Tu-134 G R

A77-16742 # **Electric power supply in the case of airports I (Elektroenergieversorgung von Flughafen I)** H Krause (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 12, no 4, 1976, p 222, 223 In German

The requirements concerning the power supply systems for airports are examined Airport installations and devices which have to be supplied, in the event of power failure, with electric power from an emergency power supply include selected installations and areas of the air traffic control system, selected navigational devices, selected obstacle lights, selected meteorological equipment and installations, and selected parts of the airport lighting system. G R

A77-16744 # **Experience with the flight simulator (Erfahrungen mit dem Flugsimulator)** J Gorlich (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 12, no 4, 1976, p 229, 230 In German

A general analysis is conducted regarding the advantages of simulator training and an evaluation of the experience obtained in the use of Soviet flight simulators is provided In a comparison of new flight crews with and without simulator training it was found that the proficiency of crews with simulator training was significantly higher The use of flight simulators in the training of INTERFLUG crews is briefly discussed G R

A77-16749 **Concorde has designed-in reliability** L J Schefer (British Aircraft Corp /U S A /, Inc , Arlington, Va) *Hydraulics and Pneumatics,* vol 29, Dec 1976, p 51 55

The paper outlines the design capabilities of the Concorde's hydraulic system based on advanced planned-in safety and reliability considerations Hydraulic power is essentially used for operating those services in the flight control, landing gear, wheel brakes, and fuel systems which require relatively large forces instantaneously The discussion covers the hydraulic system design elements, including three independent hydraulic systems, hydraulic reservoirs, titanium alloy tubing lines with brazed couplings, and pump depressurization Also discussed are emergency power unit, hydraulic fuel-to-fuel exchanges, and maintainability The hydraulic layout is so planned that if any one engine or any one main pump becomes inoperative, flight can be continued without recourse to the standby system Hydraulic system design paid attention to surge control, fluid filtration and emulsification with a view toward reducing risk of fire, fatigue failure of fittings and lines, systems simplicity, accessibility, and maintainability S D

A77-16786 # **The effect of twist on the aerodynamic investigation of axial compressor blades (Influenza dello svergolamento sullo studio aerodinamico delle pale dei compressori assiali)** M Albin and P Miraglino (Napoli, Universita, Naples, Italy) *Ingegneria,* Sept Oct 1976, p 257 264 In Italian

Axial compressor blade twist, associated with tangential velocity free vortex distributions on the blades and with axial-velocity variations along blade radii is studied in the framework of aerodynamic theory Expressions are presented for tangential-velocity free vortex distribution, and the optimization of compressor rotor efficiency is considered B J

A77-16947 # **Spin entry of aircraft** S B Spangler (Nielsen Engineering and Research, Inc , Mountain View, Calif) *Naval Research Reviews,* vol 29, Aug 1976, p 24-32 13 refs

The paper describes the general features of theoretical work which has been advanced recently on the basic flow characteristics and force distributions acting on modern fighter bomber aircraft at incipient spin entry The central phenomenon is the asymmetric separation of vortex sheets on the nose, and the problem is to define position and strengths of the vortices and calculate the loads induced on the components Two principal models being investigated are discussed the Thompson model is based on extensive experimental data on long cone-cylinders in which many vortices are formed and torn from the feeding sheet at the separation line to move aft in a direction close to the free stream direction, the Wardlaw method is based on slender-body analysis where three dimensional flow is analyzed as unsteady, two dimensional flow in a plane normal to the body axis Some predicted and measured loads in four aircraft regions for 40 deg angle of attack and zero sideslip are given as examples P T H

A77-16959 **MLS - A practical application of microwave technology** R M Cox and J R Sebring (Bendix Corp , Baltimore, Md) *(Microwave Theory and Techniques Society, International Microwave Symposium, Cherry Hill, N J , June 14-16, 1976) IEEE Transactions on Microwave Theory and Techniques,* vol MTT 24, Dec 1976, p 964-970 U S Department of Transportation Contract No FA72WA-2801

The microwave landing system (MLS) discussed has emerged from the FAA development program as the U S candidate system to ICAO This scanning beam system uses a signal format with time division multiplexing of all functions using a common carrier frequency at C band The most comprehensive MLS configuration (known as the expanded configuration) provides proportional azimuth angle distance up to + or 60 deg relative to runway center line with vertical coverage at least to +20 deg, with a 13 33 Hz update rate, proportional elevation guidance from 0 to 20 deg with a 40-Hz update rate, proportional flare elevation guidance from -2 to +8 deg with a 40-Hz update rate, range to GPIP (touchdown) and range to end of runway after strut switch actuation is provided by an

independent DME subsystem, basic data prior to each angle function, auxiliary data in blocks of 5, 10, or 15 ms which will transmit fixed siting data and growth capacity for variable data transmitted every 75 ms at a 15-kbit rate, and capability of serving runways up to 14,000 ft long V P

A77-17021 * # **LTA - Recent developments** N J Mayer (NASA, Office of Aeronautics and Space Technology, Materials and Structures Div , Washington, D C) *Astronautics and Aeronautics,* vol 15, Jan 1977, p 58 64

NASA-sponsored studies of existing and new LTA missions showed that airships looked very promising for some two dozen civil and military applications These include surveillance of rural and urban areas, in the form of forest and police patrols, transport of very heavy large-volume maritime, industrial, and military payloads, coastal patrol and sea control, seismographic surveys, air pollution monitoring, and moving goods to remote areas, along with a number of less important but still attractive missions A figure of merit of productivity (payload weight, ton moles per hour) was used to compare airships of various type and size In each case, this criterion established an index of efficiency for evaluating not only conceptual approaches but also modes of flight Some, in part unexpected, results of these studies are described V P

A77-17026 **Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17-20, 1976** London, Kalerghi Publications, 1976 394 p. $52 60

Over half the articles deal with the design, operation, testing, and use of hydrofoil hovercraft, with some emphasis on military uses, and about a quarter of the articles deal with advanced transit systems Air cushion vehicles also receive attention, and one article reconsiders wind-driven sail craft as a minimum-energy maritime transit system Particular hovercraft and geographical areas serviced by hovercraft, new designs, hovercraft use in counterinsurgency and protection of offshore rigs against commando attacks, and linear multivariable control of hydrofoil motion are discussed Articles on transit systems cover magnetic levitation, linear induction motors, transverse-flux motors, air bearing systems, mechanical suspension systems, and high-speed trains R D V

A77-17028 # **Studies of the drag of air cushion vehicles overland** H S Fowler (National Research Council, Div of Mechanical Engineering, Ottawa, Canada) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17-20, 1976 London, Kalerghi Publications, 1976, p 11 19 11 refs

The paper presents an account of the studies arising from the National Research Council of Canada's 'CASPAR' programme to date Studies of the drag of ACVs over water are well advanced, and clearly summarized by Trillo and others The drag of an ACV overland is a much more complex problem, and was not well understood when this programme started The experimental difficulties in measuring it are severe, and the data available were poor and fragmentary The accepted theory of overwater drag is examined and extended to attempt to cover the overland case The connection between lift airflow and drag is examined, and a fully non dimensional lift air coefficient developed, to match a tow coefficient for drag measurement The experimental measurement of these quantities is discussed in detail, and theoretical rationalization is foreshadowed Experimental data are shown and discussed, and towing drag measurement methods are evaluated (Author)

A77-17030 # **Astroglide - The advanced automatic guideway transit system** G P Scelzo (PRT Systems Corp , Chicago Heights, Ill.) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17-20, 1976 London, Kalerghi Publications, 1976, p 29-35

The technical and economic aspects of a people-moving overhead monorail system powered by linear induction motors or advanced transverse flux motors, of the type used at Braniff International, Dallas to move airline passengers between the terminal and the parking area, are discussed The advantages such a transportation system would offer to people using mass transit systems are noted A demand-responsive fully automatic transportation system, called Astroglide, is described and is shown to be far superior to the monorail installation used at Braniff International V P

A77-17032 # **Hovercraft ground contact directional control devices** G Abele (U S Army, Cold Regions Research and Engineering Laboratory, Hanover, N H) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17-20, 1976 London, Kalerghi Publications, 1976, p 51-59 6 refs

The maneuverability of a hovercraft where the craft's travel route is restricted by obstacles or requires close-quarter turns, and during travel on slopes and in crosswind conditions, and the use of ground contact devices for positive directional control is discussed Wheels are analyzed in more detail because of their obvious application on a variety of land terrains Brake rods and harrows are more suitable on water, ice and snow The saucer would cause the least ecological impact on fragile organic terrains such as tundra The use of controlled ground contact with skirt sections having retractable rollers or special wearing surfaces may represent the least significant change to the basic design of the craft or its components The relative directional stability is evaluated in terms of the total yawing moments produced by a variety of wheel arrangements (single, dual, tandem), location on the craft, and operational modes (free-rolling, braked, or a combination of the two) The available moments are plotted against the yaw angle of the craft to determine the most effective operational mode with a particular wheel arrangement for any yaw condition The analysis is limited to retractable devices which act as moment-producing brakes or rollers and do not serve as either propulsion or load support aids (Author)

A77-17037 # **VT 2 100 ton amphibious hovercraft** A E Bingham (Vosper Thornycroft, Ltd , Portsmouth, England) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17 20, 1976 London, Kalerghi Publications, 1976, p 119-128

The prototype VT 2 hovercraft (100 tons normal maximum weight) features a non-compartmented cushion/skirt system with softer suspension than existing skirt arrangements and a marked improvement in maintenance downtime Propulsion is provided by large diameter ducted axial fans Compared with an open aircraft-type propeller, the ducted propulsor results in a more compact installation, reduced noise and increased safety to personnel working around the craft deck The VT 2 may be adapted for several military roles Various mixes of weapon systems, guns and missiles can be accommodated, in a logistic role up to 32 tons weight of vehicles and personnel can be carried VT 2 is almost identical in size to the US AALC (JEFF) craft due to be launched in 1976 The Royal Navy recognizes the particular advantages offered by amphibious hovercraft in mine countermeasures operations (Author)

A77-17038 # **The design and operating features of Vosper Thornycroft skirts** R Dyke (Vosper Thornycroft, Ltd , Portsmouth, England) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17 20, 1976 London, Kalerghi Publications, 1976, p 129 147

The Vosper skirt/cushion design discussed consists essentially of an outer loop of flexible material around the periphery of the craft, attached to the upper edge of the hull Numerous segments are attached to the lower edge of the outer loop and also to the lower edge of an inner loop and segment attachment cables The skirt configuration is designed to accept a skirt shift system in both pitch and roll This allows the craft trim to be altered to suit prevailing conditions and to move the center of pressure relative to the center of gravity A two dimensional theory on which the design and dimensions of the Vosper skirt are based is outlined V P

A77-17044 # **Hovercraft operation in the Torres Strait between Australia and Papua New Guinea** R L Trillo (Robert Trillo, Ltd , Brockenhurst, Hants , England) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17 20, 1976 London, Kalerghi Publications, 1976, p 252-273

A77-17050 # **General survey of the studies and testing techniques that led to the definition of N500 performance** G Herrouin and Y Boccadoro (Societe d'Etudes et de Developpement des Aeroglisseurs Marins, Bayonne, Pyrenees Atlantiques, France) In Hovering craft, hydrofoil and advanced transit systems, Proceedings of the Second International Conference, Amsterdam, Netherlands, May 17-20, 1976 London, Kalerghi Publications, 1976, p 325-340 8 refs

The performance, reliability and economy of a new means of transportation must be such as to enable it to compete with the existing facilities Although the N 500 will be the largest operating hovercraft in the world, it is not derived from a smaller similar craft Therefore, a tremendous effort in research and development was necessary in all the techniques involved This research and the testing facilities used by SEDAM are described here with particular emphasis on external and internal aerodynamics, air distribution and skirt systems, maneurability and sea keeping qualities (Author)

A77-17066 * # **A theoretical study of the acoustic impedance of orifices in the presence of a steady grazing flow** E J Rice (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Annual Meeting, 91st, Washington, D C , Apr 5-9, 1976, Paper* 22 p 18 refs

Oscillatory fluid flow in the vicinity of a circular orifice with a steady grazing flow is analyzed A simplified system of partial differential equations is obtained by starting with the momentum and continuity equations and by assuming that the flow can be represented as an oscillatory motion superimposed on the (known) steady flow It is found that the equations are linear in the region where grazing-flow effects dominate, a solution and the resultant orifice impedance are given for this region It is tentatively concluded that orifice resistance is directly proportional to grazing-flow velocity and that the orifice inductive end correction is not a function of grazing flow F G M

A77-17067 * # **Sources and characteristics of interior noise in general aviation aircraft** J J Catherines and S K Jha (Cranfield Institute of Technology, Cranfield, England) *Acoustical Society of America, Annual Meeting, 91st, Washington, D C , Apr 5 9, 1976, Paper* 23 p NASA-sponsored research

A field study has been conducted to examine the interior noise characteristics of a general aviation aircraft The purposes of the study were to identify the major noise sources and their relative contribution and to establish the noise transmission paths and their relative importance Tests were performed on an aircraft operating under stationary conditions on the ground The results show that the interior noise level of light aircraft is dominated by broadband, low frequencies (below 1,000 Hz) Both the propeller and the engine are dominant sources, however, the contribution from the propeller is significantly more than the engine at its fundamental blade passage frequency The data suggests that the airborne path is more dominant than the structure-borne path in the transmission of broadband, low frequency noise which apparently results from the exhaust (Author)

A77-17069 * # **Prediction of light aircraft interior noise** J T Howlett and D A Morales (NASA, Langley Research Center, Hampton, Va) *Acoustical Society of America, Annual Meeting, 91st, Washington, D C , Apr 5 9, 1976, Paper* 20 p NASA-sponsored research

At the present time, predictions of aircraft interior noise depend heavily on empirical correction factors derived from previous flight measurements However, to design for acceptable interior noise levels and to optimize acoustic treatments, analytical techniques which do not depend on empirical data are needed This paper describes a computerized interior noise prediction method for light aircraft An existing analytical program (developed for commercial jets by Cockburn and Jolly in 1968) forms the basis of some modal analysis work which is described The accuracy of this modal analysis technique for predicting low frequency coupled acoustic structural natural frequencies is discussed along with trends indicating the effects of varying parameters such as fuselage length and diameter, structural stiffness, and interior acoustic absorption (Author)

A77-17080 **Exoelectrons** E Rabinowicz (MIT, Cambridge, Mass) *Scientific American,* vol 236, Jan 1977, p 74 82

Electrons emitted by a fresh metal surface (made by machining, crack growth, or wear) are exploited for visualization, quantification, and monitoring of dynamics of surfaces experiencing wear, cracks, or fatigue, and illuminated by a focused UV beam (Einstein photoelectric effect) The author's use of exoelectrons emitted by metallic surfaces of rolling-contact devices (ball bearings) experiencing surface fatigue wear is discussed at length, and other uses of exoelectrons are also illustrated (ball milling, sliding pairs and friction loads, radiation damage, crack growth and fatigue, distinguishing between arrested microcracks and rapidly propagating microcracks, studying direction of crack growth and fatigue mode in process) Novel uses of exoelectrons are suggested (NDT of an entire aircraft wing structure, incipient-flaw detection in wheels and rails, cracks in subsurface rock for earthquake prediction) R D V

A77-17167 **Experiments on vortex stability** P I Singh and M S Uberoi (Colorado, University, Boulder, Colo) *Physics of Fluids,* vol 19, Dec 1976, p 1858-1863 7 refs Contract No Nonr-4965(48) Project SQUID

The tip vortex of a laminar-flow wing was studied at a sectional lift-to-drag ratio of 60 The vortex Reynolds number was 78,000 At and near the wing, the vortex core was turbulent with an axial jet Downstream of the wing, the jet rapidly dissipated, a wake developed in the core, and the intensity of turbulent velocities decreased From 13 to 40 chord length, periodic oscillations dominated the velocity fluctuations with little background turbulence These instabilities had a symmetric and a helical mode with wavelength of the same order as the core diameter In this range of distances along the vortex core, the maximum axial, swirl, and fluctuating velocities vary

slowly At 40 chord lengths behind the wing, there is a rapid change in these velocities This change of state of the vortex core is accompanied by change of velocity fluctuations from periodic to turbulent The core showed spatial excursions Measurements up to 80 chord lengths downstream showed no self similar decay (Author)

A77 17226 International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Symposium sponsored by the U S Army, U S Air Force, U S Navy, Bundesministerium der Verteidigung, DFVLR, et al Edited by D K Hennecke and G Winterfeld Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt (DGLR-Fachbuch Volume 6), 1976 964 p S41 25

The present collection of papers is concerned with economics and operational aspects, progress in engine and component design and assessment, and advanced powerplant concepts for air breathing flight propulsion systems Papers presented in the field of combustor development promise new knowledge derived from theoretical and experimental studies which should help lead the way to a better combustion chamber flow analysis and improved fuel injection systems Featured topics include matching problems and SST engines, variable geometry for high-performance aircraft engines, high-temperature turbine problems, and the hypermixing-ejector concept applied to greatly shortened mixing chambers for rocket ejector ramjet composite engines A review of supersonic combustion ramjet (scramjet) engine development in the United States is included

S D

A77-17227 Life cycle cost impact on design considerations for civil transport aircraft propulsion systems W C Swan, D W Bouwer, and F F Tolle (Boeing Co , Seattle, Wash) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 11-26

This paper reviews recent history on both narrow and wide body transport aircraft with respect to cost of ownership of the propulsion systems A careful analysis of design decisions made and the resulting cost impact in service are reviewed in an effort to define certain lessons learned Suggestions for design consideration for future long and short-haul transport and cargo aircraft are outlined to support low life cycle cost at a minimum penalty in propulsion performance (Author)

A77-17228 A new development concept for gas turbine engine optimize life cycle costs W D Cowie, E E Abell, and E W Horn (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 27-38 12 refs

The life cycle development and management process for turbine engines is being revised to provide more durable, reliable, and lower life cycle cost engines to the military services Greater attention is being given earlier in the life cycle to the cost trades between performance, producibility, and operability/supportability, i e , during the technology, conceptual and validation phases of the development process The full-scale development phase has been restructured to emphasize structural durability and to provide formal demonstrations of useful engine life limits, operational and logistic characteristics, and validation of the engine life management process to provide economic management rationale for the production hardware acquisition, operational usage, and logistic support phases (Author)

A77-17229 The development and utilisation of an engine usage monitoring system with particular reference to low cycle fatigue recording R Holl and R S Wilkins (Ministry of Defence /Procurement Executive/, London, England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 39-58

The paper discusses the development and application of an elementary electronic digitally-compatible airborne continuous recording data acquisition and recording system to be incorporated in in service aircraft to provide factual, accurate and quantitative LCF data The airborne system along with the ground replay system and the data processing procedures are described The system - referred to as engine usage monitoring system - consists of a digital airborne data acquisition unit and a quick access recorder which sequentially monitors engine and aircraft parameters, converting each discrete parameter into a digital number and recording this digital output on tape The ground computing equipment analyzes the airborne data and provides processed data related to each aircraft sortie and also provides a historical record of the data related to each engine System reliability and data integrity are also examined S D.

A77-17230 Operational experience on engine health monitoring G Ottensmann (Deutsche Lufthansa AG, Hamburg, West Germany) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings (A77-17226 05-07) Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 59-75

Engine condition monitoring is discussed with particular reference to routine measurements for trend monitoring which contains inflight data recording The inflight data may be recorded either manually by the flight crew or automatically by onboard systems commonly known as AIDS (Aircraft Integrated Data System) Experience derived from routine application of the engine condition monitoring system is outlined, and guidelines for development of future advanced systems are presented S D

A77-17231 Operational behaviour of a turboprop engine K Sridhara and P A Paranjpe (National Aeronautical Laboratory, Bangalore, India) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 79-91

Problems are encountered in the determination of in-flight power of turboprop engines which are not fitted with a direct torque measuring device Elaborate investigations were carried out on such an engine to estimate its performance during its service with fleet The present paper describes the special tests and their results to determine the effectiveness of water methanol injection, nature of installed loss and torque shift Based on the above information a procedure is presented for the estimation of in-flight engine power The contents of this paper would be of great interest to the operators of such engines and to the designers and manufacturers in the assessment of the overall flight performance of the aircraft fitted with such engines (Author)

A77-17232 Some experience with small engines E H Warne and R A Farrell (Lucas Aerospace, Ltd , Birmingham, England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 93-111

A general review is presented of the difficulties and problems associated with the design and product realization of small engines in the region of 45 to 200 kW with air flows up to 1 kg/sec The small scale of these engines adversely affects various factors such as the,

efficiency of the aerodynamic machinery, the weight and cost per unit power, etc On the converse side, the response time of small engines is lower than that of the larger counterparts and the surge and stall margins are generally more tolerant for a number of reasons A small onboard combined starter and auxiliary power engine is described which is unique in permitting the pilot to select a start mode without stopping the engine when it is operating in the auxiliary generating mode The unit has now been in operational service for sometime and a description is undertaken of some of the problems arising and their investigation (Author)

A77-17233 Operational experience with lift plus lift/cruise R Smyth (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen, West Germany) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 113-137

Operational experience with the L + L/C propulsion system of the VAK 191B V/STOL Strike and Reconnaissance aircraft is the subject of this paper This is based on a large number of flights done in jetborne and aerodynamic flight Special attention is paid to the handling of the lift engine system for minimum work load and optimum performance This includes vertical take-off procedures, shutting down of lift engines and relight in transition flights Flight experience has shown that this type of L + L/C concept has proven its feasibility within the whole range of flight operation from vertical lift-off to aerodynamic flight in the high subsonic region (Author)

A77-17234 Fuel consumption of civil jet transport aircraft J P K Vleghert (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 139-148 7 refs

Fuel consumption under steady cruise conditions is analyzed using aircraft flight data logged by hand and further processed by computer A large problem with the interpretation of the observed data is the limited reliability of the instrumentation chain, which requires extensive cross-checking, filtering and fault-eliminating, with the attendant risk that short-term deterioration passes unnoticed Examples of possible cross-checks are given Only part of the excess fuel consumption could be traced to the engine via test bed results Some considerations are given with regard to the applicability of static test bed results to cruise conditions Further flight tests with tufted nacelles showed the boundary layer aft of the fan exhaust to be unsteady in some cases, which could be related to in-service deterioration of the fan exhaust ducts (Author)

A77-17235 The impact of despatchability and civil airworthiness requirements on reliability and engine control system design E S Eccles (Smiths Industries, Ltd , London, England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 149-170

The paper analyzes the impact of civil airworthiness requirements on the reliability of engine control systems, on the partitioning of response to failure, and on the efficiency of monitors which control the partitioning The whole of the certification process for aircraft and engines assumes that there will be an extremely low probability of multiple shut-down from a common cause The first impact of the airworthiness requirements is to make an independent overspeed limiter mandatory because this is the simplest way of achieving the triplex protection against catastrophic overspeed which is imposed by the requirements applied to state-of-the-art technology. The discussion of dispatch in the presence of failure has some important repercussions on the way a system is built S D.

A77-17236 Self-correcting control for a turbofan engine S H Ellis (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 171-186 5 refs

A failure-tolerant turbofan engine control concept is presented that can maintain operational capability after a sensor failure while minimizing the number of additional sensors. This has been accomplished by multivariable logic in which key engine parameters are synthesized by a process that utilizes all sensed information for estimating each parameter Sensor signals are cross checked using the coupling between signals given by knowledge of the engine cycle Sensors which lie outside editing boundaries are disconnected from synthesis circuits The fail-operational capabilities of the control are demonstrated by simulating sensor failures in a mathematical model of a turbofan engine Editing demonstrations are presented showing the ability to detect small magnitude failures and failure tolerance during transients (Author)

A77-17237 A comparison of two transonic compressors designed for a pressure ratio of 1 88 R K Oldham (National Gas Turbine Establishment, Farnborough, Hants , England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 189-216 11 refs

Overall and interblade row measurements were made in two two-stage compressors of small and large size which were designed by the same method and designated for the same target performance. There were three major geometric differences between the two compressors the small compressor is about one-third the size of the large compressor, has lower aspect ratio blades instead of a clappered first stage rotor, and a parallel outer wall compared with the constant mean radius annulus of the large compressor A comparison is drawn between the two compressors from the viewpoints of validity of traverse readings and the effect of the different geometric features on their measured overall characteristics The detailed flow measurements in the two compressors revealed the advantages of having a large unit for interblade row traversing S D

A77-17239 Three-dimensional turbomachine flow equations expressed with respect to non-orthogonal curvilinear coordinates and methods of solution C -H Wu (Academia Sinica, Peking, Communist China) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 233-252 26 refs

The basic aerothermodynamic equations governing the flow of a viscous fluid in a turbomachine are reviewed, and the equations governing a three dimensional flow along relative surfaces of revolution are expressed in terms of general nonorthogonal coordinates Two groups of general methods for solving these equations are outlined, one based on the 'mean streamline circumferential extension' technique and one that combines matrix and iterative methods previously used to solve the flow equations expressed in terms of orthogonal cylindrical coordinates Some special forms of the flow equations are discussed, and a procedure is presented for computing the F term F G M

A77-17240 **Analytical and experimental studies of an axial compressor with co-rotating stators** M S Chappell (National Research Council, Ottawa, Canada) and D A J Millar (Carleton University, Ottawa, Canada) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1976, p 253-278

This paper discusses the testing of an axial flow compressor in which the 'stator' casing corotates with the rotor and extracts power from the air stream This concept originated as a means for driving a fan in a turbofan engine The rotor speed, relative to the casing, is similar to that of a conventional compressor, so that the driving turbine speed is high, while the casing speed is kept at a level compatible with the fan The arrangement, in effect, provides an aerodynamic gearbox to permit a better matching of the speed requirements of the turbine and the fan A co operative project was undertaken to examine this concept of compressor spooling Analytical and experimental results showed that the concept was both mechanically and aerodynamically feasible The paper compares the performance of the rotating-stator compressor with the conventional compressor, and some possible applications of this type of compressor scheme are presented (Author)

A77-17241 **Engine compression system surge line evaluation techniques** K. Kovach and P R Griffiths (General Electric Co., Aircraft Engine Group, Cincinnati, Ohio) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 279-305

Test and measurement techniques are described for evaluating surge margin in an actual engine Emphasis is placed on the fuel step technique for high pressure compressor surge testing, which is a relatively simple method that eliminates some of the limitations imposed by other engine testing techniques The fuel step is simply a rapid acceleration of the engine by induction of fuel flow at a rate well above that of the normal engine acceleration fuel schedule The transient is called a step because fuel flow is jumped rapidly to a predetermined level, with an attendant acceleration of the engine up to the speed at which the stepped fuel flow level holds the engine steady state. An analysis procedure is described for estimating the path of the transient on the compressor map S D

A77-17242 **Some experimental investigations on the improvement of the off-design performance of a single stage axial flow fan** N Venkatrayulu, D Prithvi Raj, and R G Narayanamurthi (Indian Institute of Technology, Madras, India) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 307-331 8 refs

Results are presented for experimental investigations of the performance of a six-bladed free vortex axial-flow fan impeller with a hub/tip ratio of 0 4 and a tip diameter of 250 mm The experiments were performed to determine whether the performance of an axial-flow fan at low flow coefficients with stalling and back flow can be improved by installing inlet guide blades which may rotate freely and may also brake the flow Effects on performance of axial distance between inlet-guide-blade row and impeller, inlet-guide blade shape and setting angle, and the partial omission of guide blades at hub and tip regions are analyzed, the most favorable axial distance and setting angle are determined It is found that the installation of freely rotating inlet guide blades appreciably increases the useful operating range of the fan, reduces the power coefficient, and gives higher efficiency for corresponding volumes in comparison with a fan without guide blades It is concluded that essential improvement in the stalled working range of the fan may be obtained by the combined use of freely rotating and braked guide blades F G M

A77-17243 **Supersonic compressors with subsonic and supersonic axial inlet component** F A E Breugelmans (Institut von Karman de Dynamique des Fluides, Rhode-Saint Genèse, Belgium) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 333-349 8 refs USAF-supported research

Two supersonic prototype wheels have been designed in order to explore the Mach-2 domain and the supersonic axial inlet component The Mach-2 compressor stage has been investigated in terms of an inlet blockage ring, a bleed system, the rotor, inlet-guide vane-rotor performance, and the modified rotor The second prototype has been designed to study the supersonic axial inlet component up to an axial Mach number of 1 50 Information about some aspects of the dynamic behavior, supersonic inlet component, and incidence-angle variations has been obtained (Author)

A77-17244 **One-dimensional analysis of the properties of the elementary supersonic axial-flow compressor cascade** K Celikovsky (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7 12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1976, p 351 368 15 refs

The paper deals with a theoretical investigation of the characteristics of the supersonic compressor cascade, which is treated as an elementary cascade of the supersonic or transonic stage of an axial flow compressor The loss coefficient and diffusion factor are derived as functions of inlet conditions, contraction ratio of stream surfaces, and back pressure Equations of one-dimensional compressible flow are applied for the derivations The derived relations may be of use for three dimensional stage design The flow angles are correlated with the stream contraction ratio (Author)

A77 17245 **Shock wave boundary layer interaction control by means of wall suction in a supersonic cascade** H Miton and A Agnes (Aix Marseille II, Universite, Marseille, France) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 369-380 Research supported by the Direction des Recherches et Moyens d'Essais

An experimental study of a control device for the boundary layer in the region of interaction with the shock-wave due to back pressure has been realized in a plane supersonic cascade Such a device allows control of the flow in the region of interaction by suction through the lateral walls (limiting the blade span) as well as through the blades walls A number of tests have been performed for an upstream Mach number of 2 under conditions corresponding to the maximum pressure ratio (required for initiating the cascade) Measurements and probings realized under such circumstances have revealed a noticeable increase in the static pressure ratio across the cascade (from 2 4 to 4) (Author)

A77-17246 * ***Status review of NASA programs for reducing aircraft gas turbine engine emissions*** R A. Rudey (NASA, Lewis Research Center, Cleveland, Ohio) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 383-407 19 refs

The paper describes and discusses the results from some of the research and development programs for reducing aircraft gas turbine engine emissions Although the paper concentrates on NASA programs only, work supported by other U S government agencies and industry has provided considerable data on low emission advanced technology for aircraft gas turbine engine combustors The results from the two major NASA technology development pro-

grams, the ECCP (Experimental Clean Combustor Program) and the PRTP (Pollution Reduction Technology Program), are presented and compared with the requirements of the 1979 U S EPA standards Emission reduction techniques currently being evaluated in these programs are described along with the results and a qualitative assessment of development difficulty S D

A77-17247 Results of further investigations of a new concept of fuel prevaporization G Kirschey, A Fehler, G Koppler, and W Krockow (Motoren- und Turbinen Union Munchen GmbH, Munich, West Germany) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 409-428 17 refs

A new fuel injection system for aircraft engines is developed to suppress droplet combustion and avoid burning at stoichiometric air fuel ratios Based on a suitable fuel vaporization model, a computer program is used to determine the lifetime of fuel droplets along a recirculating stream path inside the combustor The additional pressure loss implicated by the attachment of the fuel injection system to conventional combustors is measured using a full-scale air flow model Full-scale combustor tests are carried out at chamber pressures up to 10 bar and air entry temperatures up to 825 K The measured temperature distribution at the combustor outlet and the recorded pollutant and smoke emission values are reported S D

A77-17248 A premixed, variable area combustor for a small gas turbine engine J Odgers, H Gerardin, and D Kretschmer (Universite Laval, Quebec, Canada) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 429 445 18 refs Research supported by the National Research Council of Canada

A design study has been made of a combustor which combines both premix and variable geometry, for application to a small gas turbine The variable geometry is achieved by moving a baffle within a conical section at the entry to the chamber, the movement of the baffle being accomplished by the fuel pressure The rate of the baffle movement is such that there is adequate response to changes occasioned within the fuel system Additionally a fail-safe mechanism is incorporated so that flame extinction cannot occur inadvertently The performance of the combustor is estimated using existing correlations, carbon monoxide, hydrocarbons and oxides of nitrogen are all predicted for a range of operating conditions The results indicate that this type of combustor has the potential of a near-to-optimum performance at all operating conditions Some confirmation of the predictions has been suggested by results obtained using a premixed combustor having a similar, but fixed geometry (Author)

A77-17249 Unsteady combustion of fuel spray in jet-engine after-burners S Elghobashi, D B Spalding, S K Srivatsa (Concentration, Heat and Momentum, Ltd , New Malden, England), and D T Pratt (Washington State University, Pullman, Wash) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 447-471 8 refs

Predictions of the hydrodynamic and thermodynamic properties of a flow under the conditions of a jet-engine after-burner are presented The flow is two-dimensional, axisymmetric, unsteady, compressible, turbulent and chemically-reacting The predictions are obtained by the numerical solution of the transport equations for the components of the mean velocity, the pressure, the kinetic energy of turbulence and its dissipation rate, the stagnation enthalpy, the concentrations of fuel droplets in ten size ranges and the concentrations of the gaseous fuel before and after the occurrence of chemical reaction In the analysis of fuel spray, account is taken of the vaporization-plus-combustion processes around the droplets The present numerical solution-procedure provides a useful tool for investigating the 'buzz' phenomenon in engine after burners (Author)

A77-17250 Numerical methods for calculating the performance of air-breathing combustion chambers Y Manheimer-Timnat (Technion - Israel Institute of Technology, Tel Aviv, Israel) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 473-488 35 refs

After reviewing briefly numerical methods developed recently for predicting the performance of air-breathing combustion chambers, two numerical codes are described The first allows to calculate the performance and to carry out parametric studies, taking into account the finite rate of chemical reactions and the effect of unmixedness of the different chemical components The governing equations and the method of solving them, overcoming stiffness problems, are described for a flow field governed by elliptical partial differential equations Examples of the results obtained and a comparison with experimental data are presented The second code allows to consider two-phase flow phenomena, the way this is achieved, as developed for a flow governed by boundary-layer type equations (parabolic in character), is described The concluding section discusses possible directions of future research, such as integration of the above methods and inclusion of further physical effects in the calculations. (Author)

A77-17251 Prediction of the flow and combustion processes in a three-dimensional combustion chamber M A Seraq Eldin and D B Spalding (Imperial College of Science and Technology, London, England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 489-514 16 refs Research supported by the Science Research Council Grant No B/RG/1095

A finite difference procedure is used to predict quantitatively the local flow, heat-transfer, and combustion processes inside a three-dimensional Can Combustor for the case of swirling and recirculating flow The procedure involves the solution of 12 simultaneous differential equations with three velocity components, pressure, stagnation enthalpy, fuel-air ratio, mass fraction of unburned fuel, the kinetic energy of turbulence, and three radiation fluxes as dependent variables The following example is considered gaseous fuel and air enter separately, additional air is injected both for dilution and film cooling, and the flame tube wall is cooled externally B J

A77-17252 The application of advanced turbine cooling technology in the XT701 Engine W H Thomas In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings. Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 517-534

The focus of this paper is upon the developments which lead to the turbine cooling features found in the 501-M62B and XT701-AD-700 Engine developed for use in the U.S Army Heavy Lift Helicopter Program (HLH) Specific design features of the XT engine turbine section, as well as the features of the prototype are described (Author)

A77-17253 Compressible flow, temperature and life calculations with turbine blades U Hall and U Olsson In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings
Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p. 535-561 10 refs

Computer programs have been developed to analyze the external and internal flow and heat transfer, temperatures, mechanical and thermal stresses, creep and fatigue lives of cooled turbine blades The programs involved comprise a finite element iteration scheme for solving the steady, compressible cascade flow problem and a finite-difference solution of the two-dimensional compressible boundary layer A finite element method is used for steady or transient temperature calculations in an arbitrary cross section and an iterative matrix method for solving the stationary, three-dimensional temperature distribution in a cooled turbine blade The elastic and plastic stresses and the creep life are calculated for prescribed centrifugal, aerodynamic and thermal loads and the combined creep and fatigue life is found using a weighting method. (Author)

A77-17254 A statistical method for the prediction of component low cycle fatigue life D C White and A W M Greig (National Gas Turbine Establishment, Farnborough, Hants., England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 563-584 22 refs

Existing methods of assessing the low cycle fatigue life of gas turbine components such as disks are based on testing a wide range of specimens, cyclic spinning of actual disks, and service experience This paper proposes an approach to the estimation of life based on fatigue testing a number of identical simple specimens The results are analyzed statistically to produce a general description of the LCF behavior of the material This information is then used as material data in a modified finite element stress analysis program to compute the cumulative probability of failure of any specific component design The specimen and the fatigue testing machine are described and the results of a preliminary investigation using a titanium alloy are presented and discussed It is concluded that although further research is required, the proposed method offers considerable promise (Author)

A77-17255 Boundary layer calculation of an effusion cooled turbine blade H Kruse (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Luftstrahlantriebe, Cologne, West Germany) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 585-603 5 refs

Results are presented for an investigation of discrete hole cooling of turbine blades, whereby air is effused through small holes distributed either all over the blade surface or over parts of it Particular attention is given to the influence of pitch to diameter ratio on boundary layer development A modified mixing-length model is used for calculating the boundary layer, which takes into account the specific condition of discrete hole injection Introducing an analytical expression with two additional constants as a turbulence model, it is possible to give an overall description of measured boundary layer phenomena with discrete hole injection by a two-dimensional calculation procedure Blowing of the coolant through distributed discrete holes appears to be more realistic than blowing through porous materials for engine application S D

A77-17256 Simple complex method of selection of the main design parameters of turbine stages for turbine-engines. A Malek (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 605-626 10 refs

The paper shows that the preliminary step in the design of high-load aircraft turbine stages must be based on mutual conditions for selection of the basic design parameters of the turbine and the corresponding compressor Construction of blade rows by means of optimized groups of elementary stages allows effective application of aerodynamically valuable blade cascades which meet strength requirements with proper assumptions for the desired dynamic properties of blades Necessary information for systematic improvement of design materials can be obtained through optimization of elementary turbine stage groups S D

A77 17257 Turbine engine cycle selection procedures J Frederick (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio), R Sutton (Boeing Aerospace Co, Seattle, Wash), and R Martens (McDonnell Aircraft Co, St Louis, Mo) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 629-663

A multivariable design method is described whereby subsystems can be properly selected, advanced engine cycles can be examined adequately as they evolve, and insight as to technology leverages and direction for developments can be provided in a timely and cost-effective manner A systematic procedure for fighter engine and airframe design selection is developed and demonstrated Three aircraft roles, encompassing sixteen missions, are defined Tradeoff studies regarding the size and design characteristics of both the engine and the airframe can be successfully achieved S D

A77-17258 Pressure ratio optimization criteria in aircraft turbojet-engines design V Quaggiotti (Padova, Università, Padua, Italy) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 665-683

Optimization criteria are obtained for the pressure ratio in an aircraft turbojet-engine of rectilinear configuration in which the propelling nozzle, the exhaust duct, the turbomachines, the intake duct, and the diffuser are aligned The symmetric configuration and the essentially rectilinear geometry of the stream suggest a one-dimensional representation as a good approximation The propulsive efficiency and the thermal efficiency are expressed as functions of the total pressure ratio considered as the most important design parameter Suitable charts can be plotted as useful tools in guiding the preliminary choice between requirement of low displacement and low weight and requirement of low specific fuel consumption as an ever impelling factor due to oil crisis S D

A77-17259 Aircraft considerations for advanced S S T propulsion systems H A Goldsmith and C S Leyman (British Aircraft Corp, Ltd, Weybridge, Surrey, England) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1976, p 685 702 6 refs

Experience gained in the design of first generation supersonic transport aircraft is reviewed to infer the desirable features of advanced supersonic transport (AST) aircraft The discussion covers engine cycle, intake, nozzle, and control system AST aircraft mission will be more severe with greater emphasis on environmental considerations A summary of AST features which will differ from those of the first generation aircraft is given The intake should give lower cowl drag The engine is expected to be a bypass engine with duct burning, or a variable cycle engine Good nozzle design will be even more critical to the project than at present, and the subsonic/supersonic compromise will be slightly altered S D

A77-17260 Investigation of the flow pattern at the engine face and methods of the flow pattern simulation at supersonic flight speed D A Ogorodnikov and V A Ianchuk. In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 703-721

Steady-state disturtions and fluctuations of a nonuniform time-dependent fluctuating flowfield at an aircraft engine face at supersonic flight speed affect significantly the engine operational stability The principal characteristics of this distortion flow and the possibilities of its simulation are examined for a normal shock wave in a model of slightly divergent diffuser duct The model is provided with transducers for measurement of steady-state distortion flow and total pressure fluctuations in different sections downstream of the terminal shock wave A similar distortion flow study is performed for a cylindrical duct with a smooth inlet and a spoiler of varying height Regions are identified where the flow pattern corresponding to the flow downstream of the terminal shock wave may be simulated by means of spoilers with good approximation S D

A77-17262 Ejectors for supersonic transport aircraft - Analytical method J M Hardy (SNECMA, Paris, France) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 741-755 7 refs

An account is given of basic principles for the calculation of three-dimensional axisymmetric flows in choked or nonchoked ejectors with internal venting By means of a correlation between theory and experience, it will be shown that the calculation method requires incorporation of an accurate theoretical determination of the transonic field together with an appropriate thermodynamic formulation of the primary flow (Cp varying continuously) Adaptation of the proposed mathematical model to ejector design is discussed, including analysis of the optimum pattern and geometric dimensioning Soundness of the calculation method is substantiated by comparisons between theory and experience The feasibility is considered of investigating the compromise between aerodynamics and mechanical design by means of numerical tests in order to reduce wind-tunnel testing (Author)

A77-17264 Variable geometry for high performance aircraft engines J Hourmouziadis (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 781-801 10 refs Research supported by the Bundesministerium der Verteidigung

An investigation was carried out to assess the feasibility of variable geometry as an active means of influencing bypass ratio, aiming at improving the adaptability of engine performance characteristics to aircraft requirements Addition of variable geometry to existing engines and development of new optimized designs were considered Since some variable components can also have significant effects on spillage and afterbody drag, installed performance was chosen as a basis for comparison It is shown that active variable geometry offers a significant potential for improving turbofan performance flexibility and component handling by means of rather conventional technologies Improvement from variable geometry in existing engines is restricted by speed limits and maximum permissible pressure levels in the core engine S D

A77-17265 Crossflow performance of lift-fans in tandem R A Tyler and R G Williamson (National Research Council, Gas Dynamics Laboratory, Ottawa, Canada) In International Symposium on Air Breathing Engines, 3rd, Munich, West Germany, March 7-12, 1976, Proceedings Cologne, Deutsche Gesellschaft fur Luft- und Raumfahrt, 1976, p 803-832 15 refs

Earlier work on the thrust behavior of isolated fans equipped with cowled intakes in crossflow is extended here to multiple lift-fans in tandem, as in recent designs of V/STOL transport aircraft incorporating wing pods or fuselage-mounted sponsons The cowled fans are usually gimbal-mounted to allow limited thrust vectoring or inflow distortion control by fan tilting A V/STOL propulsion tunnel designed for testing the models is described A sponson model containing three cowled and tiltable lift-fans in tandem array was operated in crossflow Tunnel flow breakdown and wall interference effects, shielding effects on inflow distortion from fans operating upstream, and inflow interaction effects were taken into account The leading fan operates in the manner of an isolated fan, while trailing fans benefit from favorable interaction effects on inflow distortion R D V

A77-17349 Application of the method of causality to the study of noise from a subsonic jet (Application de la méthode de causalité à l'étude du bruit d'un jet subsonique) D Juve, M Sunyach, and J Bataille (Lyon, Ecole Centrale, Ecully, Rhône, France) *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol 283, no 10, Oct 27, 1976, p 269 272 7 refs In French

Experimental data obtained on aerodynamic noise emitted by a cold subsonic jet is evaluated using the so-called method of causality The experiments consisted of hot-wire measurements performed in an anechoic chamber on a jet with a diameter of 20 mm and a velocity of 105 m/s The measured correlation between far field sound pressure and velocity fluctuations is used to analyze sound source distribution in the Lighthill sense Attention is given to the behavior of self-noise and shear noise B J

A77-17406 Research in multicyclic and active conol of rotary wings M Kretz (Giravions Dorand, Suresnes, Hauts-de-Seine, France) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22 24, 1975) Vertica,* vol 1, no 2, 1976, p 95-105 9 refs

Studies of active control of rotary wings, using an experimental 40-ft diam jet-flap rotor capable of introducing multicyclic effects to improve the performance and dynamic response of the lifting rotors, are reported This research was undertaken to find a way to replace the conventional swashplate by using to advantage gains achieved in fly by-wire and control configurated-vehicle developments Each rotor blade is governed independently by a feedback system with an electrohydraulic actuator Generalized feedback control of the blades is tested with encouraging results The design and tested performance of jet-flap rotors and feedback-configured rotors are described R D V

A77-17407 Optimizing the cyclic control response of helicopter rotors M I Young (Delaware, University, Newark, Del) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22-24, 1975) Vertica,* vol 1, no 2, 1976, p 107-112 Grant No DA ARO(D)-31-124-71-G112

The response of a helicopter rotor to cyclic pitch control inputs is examined from the point of view of error analysis and system optimization The transient deviations of individual blade flapping response from the desired steady state are used as the bases of calculations of a variety of performance indices These are integral square error (ISE), integral time square error (ITSE), integral absolute error (IAE) and integral time absolute error (ITAE) It is

shown in the case of conventional articulated rotors that Lock number and its influence on the blade aerodynamic flap damping ratio is the decisive parameter in minimizing and hence optimizing the various performance indices The ideal Lock number is shown to vary between 8 and 12, depending on the performance index selected The influence of real or virtual offset of the blade flapping hinges in the case of hingeless rotors is then examined for the case of integral square error, and the ideal trade offs between blade flapping frequency ratio and flap damping ratio are determined It is found that the optimum flap damping ratio increases only slightly with increasing flapping frequency ratio thus making the optimum Lock number vary directly with flapping frequency ratio (Author)

A77-17408 **A synthesis of unsteady aerodynamic effects including stall hysteresis** T S Beddoes (Westland Helicopters, Ltd , Yeovil, Somerset, England) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22-24, 1975) Vertica,* vol 1, no 2, 1976, p 113-123 7 refs

A relatively simple computational model for synthesizing unsteady section aerodynamic effects in theoretical analyses of rotor aerodynamics is constructed on the basis of a physical model for dynamic stall having sufficient generality to be applicable to all airfoils and excitation modes The model's validity is substantiated by applying it to the case of harmonically oscillating airfoils, using a stepwise solution The theoretical results are compared with test data in terms of the resulting amplitude and phase relations in which the Mach number effect is included for pitch in forward and reverse flow as well as for pure plunging motion The correlation is found to be good except for the case of reverse flow at high reduced frequency It is noted that this computational model may be used to predict airfoil behavior under conditions that have not been simulated in tests, to predict changes in dynamic behavior resulting from design or operational modifications of the airfoil profile, and particularly to investigate rotor airloads and flight boundaries F G M

A77-17409 **Handling qualities evaluation of helicopters with different stability and control characteristics** H -J Pausder (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) and D Jordan (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22-24, 1975) Vertica,* vol 1, no 2, 1976, p 125 134 7 refs

The intention of this paper is to present a discussion of and contribution to the evaluation of handling qualities criteria of helicopters, especially for IFR-flight For a critical examination of helicopter flight dynamics it is necessary to consider the combination of stability and controllability Therefore, pilot-in-the-loop methods are used The existing stability boundaries are considered and compared with results of closed loop analysis Root locus-curves and Bode plots in the frequency domain are applied For a special case, a time history for a gust disturbance is plotted showing the influence of the pilot model (Author)

A77-17410 **Investigation of helicopter airframe normal modes** R W White (Westland Helicopters, Ltd , Yeovil, Somerset, England) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22-24, 1975) Vertica,* vol 1, no 2, 1976, p 135 147 Research supported by the Ministry of Defence (Procurement Executive)

Dynamic characteristics of helicopter airframes and evaluation of general methods for analyzing helicopter vibration, particularly in relation to the use of normal modes to calculate the forced response of the airframe, are studied Normal modes of a Wessex helicopter were isolated (using multipoint excitation), quantified, and compared to modes calculated by finite-element analysis The airframe was suspended in a normal forward-flight attitude, with backlash minimized, with pitch (nose-down) simulated by ballast, and with lumped masses replacing rotors, crew, and standard equipment A maximum of three exciters was needed for modal purity in all five normal modes up to 21 Hz Coarse branched-beam analysis adequately represented the first three normal modes R D V

A77-17411 **Ground vibration test - A tool for rotorcraft dynamic and aeroelastic investigations** F Kiessling (Deutsche Forschungs- und Versuchsanstalt fur Luft - und Raumfahrt, Institut fur Aeroelastik, Gottingen, West Germany) *(European Rotorcraft and Powered Lift Aircraft Forum, University of Southampton, Southampton, England, Sept 22 24, 1975) Vertica,* vol 1, no 2, 1976, p 149-163 8 refs

The present paper deals with the applicability of ground vibration tests to rotorcraft Especially new VTOL-concepts require the investigation of rotor whirl-flutter or ground/air-resonance The design of efficient vibration isolation systems demands a thorough knowledge of natural vibration behavior, supported by proper ground vibration tests The possible test configurations based on different subsystems are discussed Experiments on non rotating subsystems are most attractive A theory based on such tests takes into account effects of rotor rotation and uses 'modal synthesis' to assemble the elastomechanical model If a whole rotor is used as a subsystem, the classical 'phase resonance' procedure can be modified to obtain 'multi-blade' modes in the test (Author)

A77-17413 **Heat diffusion as a source of aerodynamic sound** A J Kempton (Cambridge University, Cambridge, England) *Journal of Fluid Mechanics,* vol 78, Nov 5, 1976, p 1 31 35 refs

The paper examines the role of heat diffusion as an internal noise source in aeroengines and as a source of noise in the mixing of hot jets A number of model problems are considered, and it is found that the sound induced by unsteady heat transfer can show an unusually weak dependence on the mean flow velocity At low enough velocities, diffusion effects will overwhelm other noise sources, but a significant practical situation cannot be found in which it can be proved that sound generated by diffusion clearly dominates over that excited by unsteady aerodynamic forces, they are sometimes comparable The possibility that diffusive monopole sources feature in the noise of hot jets is examined using model problems in the linear case and dimensional analysis in the nonlinear case It is concluded that no significant monopole exists when the specific heats are constant But the specific heats are not constant at low frequencies when, for example, heat flows into and out of vibrational energy modes, then an important monopole source is present This source shows an unusually complicated scale effect (Author)

A77-17424 **Oblique slot blowing into a supersonic laminar boundary layer** N Riley (East Anglia, University, Norwich, England) *Cambridge Philosophical Society, Mathematical Proceedings,* vol 80, Nov 1976, p 541 554 10 refs

The behavior of a two dimensional laminar boundary layer in a supersonic flow is considered in the case where air is blown obliquely into the layer from a narrow slot in the boundary Blowing-velocity and slot-width scales are adopted which permit exploitation of Stewartson's (1969) triple deck theory An analytical solution is derived by assuming small blowing rates on the triple deck scale and linearizing about the profile of the oncoming stream The solution is completed numerically by relaxing the assumption of small blowing rates and exercising particular care at the slot edges The calculated pressure distributions and shear stresses indicate that either a compressive or an expansive interaction can occur between the boundary layer and the free stream upstream from the slot, depending on blowing angle F G M

A77-17479 * Ames T-3 fire test facility - Aircraft crash fire simulation R H Fish (NASA, Ames Research Center, Moffett Field, Calif) *Journal of Fire and Flammability,* vol 7, Oct 1976, p 470-481 7 refs

There is a need to characterize the thermal response of materials exposed to aircraft fuel fires Large scale open fire tests are costly and pollute the local environment This paper describes the construction and operation of a subscale fire test that simulates the heat flux levels and thermochemistry of typical open pool fires It has been termed the Ames T 3 Test and has been used extensively by NASA since 1969 to observe the behavior of materials exposed to JP-4 fuel fires (Author)

A77-17482 Smoke emission of aircraft seat materials G Borsini and C Cardinali (Avionteriors S p A , Rome, Italy) *Journal of Fire and Flammability,* vol 7, Oct 1976, p 530-538 13 refs

Measurements of the density of smoke emission from various nonmetallic materials present in a conventional aircraft passenger seat are reported The following materials were tested in a sealed smoke chamber wool fabric, flexible and rigid polyurethane foam, integral-skin polyurethane foam, rigid PVC foam, and conventional plastic material used for panels, dishes, thermoformed shrouds, and other components The results show that (1) all the materials except flexible polyurethane foam will not comply with proposed FAA smoke density standards, (2) advanced materials which comply with a low-smoke-density standard, such as polycarbonate, should be substituted for wool upholstery fabric, and conventional plastic material, and (3) the smoke density of integral skin foams should be lowered by adding a smoke-density suppressant F G M

A77-17483 ATC automation with minicomputers R E Busch and K R Schwerdt (Raytheon Co , Lexington, Mass) *Journal of Air Traffic Control,* vol 18, Oct -Dec 1976, p 20-23

Particular cases of minicomputers incorporated into ATC systems are cited with an overview of ATC applications for minicomputers Relative advantages of minicomputers in ATC systems are compared briefly to advantages offered by large computers or by microcomputers The RAYDARC (Raytheon direct access radar channel) system is described briefly, with its data processing and display functions, and the JCS-1 system derived from RAYDARC and delivered to South Africa is characterized briefly In addition to their use as key components in broader systems, minicomputers are now used in the development of some novel systems aviation weather and automated weather observations, discrete address beacon (DABS), meteorological and aeronautical presentation (MAPS), computer display channel test equipment, oceanic ATC testbed, and wake vortex avoidance (WVAS) Promotion of worldwide air safety by bringing ATC automation to a wider range of users is highlighted R D V

A77-17484 The metering system concept J E McNamara *Journal of Air Traffic Control,* vol 18, Oct -Dec 1976, p 24-28

The metering concept developed for smoother handling of arrivals at airports with congested facilities or with arrivals bunched up at certain times (on the hour or half-hour) is explained, with an illustrative example worked out in detail for a fictitious airport The desired runway/airport capacity, desired average time or ground speed between the outer fix and the runway threshold, and the desired optimum flight track(s) are three major considerations entertained in the metering approach from the outset The approach is designed to improve system efficiency via input of dynamic data to flow and sector controllers, recording and supply of data for analysis of delays, reduction of unnecessary delay stemming from ad-hoc flow control or speed restrictions, equalization of delay potential among all arrivals Unreported delays (less than, say, 30 min) and fuel wastage not accountable under present concepts are discussed R D V

A77-17494 # Attitude instability in steady rolling and roll resonance T Hacker (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania) *Journal of Aircraft,* vol 14, Jan 1977, p 23-31 6 refs

It has been pointed out in an earlier paper that unsatisfactory response characteristics in steady-rolling maneuvers are not necessarily related to divergence in linear approximation, and it is the aircraft's angular position that experiences large deviations in the early stages of the maneuver Two complementary causes of this phenomenon are now considered It is shown that steady rolling results in unstable angular positions of the aircraft without regard to the value of the rolling velocity The instability, however, is gentle and not critical by itself, it may nevertheless provide a propicious ground for perturbing actions, particularly the resonance effect This effect, though apparent only in second-order approximation, induces large deviations of the response in pitch angle in the first 5-10 sec, and is essential in determining unsatisfactory response characteristics It is shown that the main parameters that control attitude instability are the lift curve and particularly the side-force curve slopes low values promote the occurrence of a rough resonance affecting the pitch angle at certain rolling velocities which would not develop for some higher values of these parameters Resonance values of the roll rate mainly depend on the longitudinal and the directional static stability and are higher the greater the static stability (Author)

A77-17496 * # Experimental investigation of subsonic turbulent separated boundary layers on an airfoil H C Seetharam and W H Wentz, Jr (Wichita State University, Wichita, Kan) *Journal of Aircraft,* vol 14, Jan 1977, p 51-55 14 refs Grant No NGR 17 003-021

Detailed measurements of flow fields associated with low-speed turbulent boundary layers have been made for the 17% thick GA(W) 1 airfoil section at nominal angles of attack of 10, 14, and 18 deg, Reynolds number 2 2 million, and Mach number 0 13 The data include extensive pressure and velocity surveys of the pre- and post-separated regions on the airfoil and the associated wake Integrated boundary-layer characteristics, including regions of separation on the airfoil, are also presented The results indicate steep gradients of displacement thickness, momentum thickness, shape factor, and the separation streamline from the point of separation to the trailing edge of the airfoil The present tests reveal that the region of flow reversal terminates within a suprisingly short distance of less than 20% chord downstream from the trailing edge for the test range of angle of attack (Author)

A77-17497 # Characteristic wake data for local blade propeller stalling J Rebont, C Maresca, and D Favier (Aix Marseille I, Universite, Marseille, France) *Journal of Aircraft,* vol 14, Jan 1977, p 56 59 9 refs

The aim of this experimental program is to show some effects of local blade stalling on wake structure Measurement of all mean velocity components was carried out in the near wake of a four-bladed propeller by use of a hot-film anemometric probe In order to observe evolution of the wake structure, four values of the advance ratio are investigated The two lower values of this ratio correspond to the stalled working conditions of the propeller, and the two upper values are in the vicinity of the maximum propeller efficiency Some quantitative information about the stall characteristics was obtained from the velocity measurements The flow separation in the stalled region of the blade decreases both the axial and radial velocity components and increases the rotational speed of the wake It is found that the stalled region first affected the blade

tip and then grew from the tip towards the hub with decreasing values of the advance ratio (Author)

A77-17498 # **Random vibration peaks in rotorcraft and the effects of nonuniform gusts** G H Gaonkar (Southern Illinois University, Edwardsville, Ill.) *Journal of Aircraft*, vol 14, Jan 1977, p 68-76 22 refs Research supported by the Southern Illinois University

The analysis of random blade vibrations is extended (1) to include the average number of peaks above arbitrary thresholds, and (2) to the case of both longitudinally and laterally nonuniform or completely nonuniform vertical turbulence over the rotor disk This extended analysis provides a means of assessing the validity of uniform and partially nonuniform (nonuniform only in the longitudinal direction) approximate turbulence models and exactly identifies threshold ranges above which peak distribution functions (PDF) over one rotor revolution can be approximated by the statistics of threshold upcrossings This PDF over one revolution directly gives the probability that any maxima or peaks in one revolution are less than or equal to the required thresholds The selected problem refers to random flap bending at high advance ratios The general turbulence theory includes cross correlation between inputs from different blade stations Numerical results demonstrate that the average number of threshold upcrossings and peaks per unit time differ significantly for all values of response levels and azimuth positions Consequently, the approximation of PDF conditional on the occurrence of a peak at any instant by threshold upcrossing expectations is not satisfactory Two other important findings are (1) the effects of nonuniform turbulence are negligible, and (2) the formulation of approximating the PDF over one rotor revolution by corresponding threshold crossing statistics is satisfactory for rotor applications (Author)

A77-17499 * # **Measurement of post-separated flowfields on airfoils** H C Seetharam, W H Wentz, Jr., and J K Walker (Wichita State University, Wichita, Kan.) *Journal of Aircraft*, vol 14, Jan 1977, p 95, 96 5 refs Grant No NGR-17-003-021

A small combination pitch-yaw probe designed to facilitate measurement of post separated flow fields on airfoils is described, along with its calibration A five tube probe is found 'ideally suited' to separated-flow measurements because of the pitch and yaw angle information provided in addition to static and total pressures Wall proximity effects (in a low-speed tunnel) are described Procedures for measurements in flows with small inclinations in pitch and yaw, for large flow angles, and for scanning flows with large inclinations are indicated R D V

A77-17503 # **Electrostatics in aviation fuel systems sessions** J B Godwin, Jr *Institute of Electrical and Electronics Engineers, Electromagnetic Compatibility Symposium, San Antonio, Tex., Oct 7-9, 1975, Paper* 15 p

An analysis is presented of the electrostatic charging characteristic of flowing hydrocarbon jet aircraft emphasizing means and materials for the retardation of these charges and the elimination of the dangerous situation which might arise The clothing study of the National Bureau of Standards concerning electrostatic charge buildup on clothing materials to be worn by fuel handlers is reviewed indicating that a 50% cotton 50% polyester blend is the safest material In addition, an EXXON AF fuel system study has found that special precautions must be taken following the installation of new filter separator elements or inspections of existing elements to prevent ignition of fuel air vapors during initial filling of the vessel Attention is also given to new grounding criteria for RR tank cars and truck fillstand assembly B J

A77-17510 # **Stainless steels and alloys in air and spacecraft** L Sanderson *Aircraft Engineering*, vol 48, Dec 1976, p 24-27

Modern classes of stainless steels used in the aircraft and aerospace industries are described, and characteristics and applications of special stainless materials are summarized Techniques for producing high strength corrosion-resistant steels are discussed, including vacuum induction melting and arc refining, electroslag resmelting, and argon-oxygen steel decarburization Age hardened and austenitic alloys for naval aircraft, various fasteners and liners, space shuttle engines, and high-temperature service are evaluated Cost factors involved in choosing the correct steel for a specific purpose are noted, and various tests are suggested for finished products F G M

A77-17532 # **The application of microprocessors to the control of small /helicopter/ gas turbines** A Sharpe (Hawker Siddeley Dynamics Engineering, Ltd., Hatfield, Herts., England) In Electronic micromechanical interactions, Workshop on Electronics and Microtechnology, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, October 19-21, 1976, Proceedings (Interactions electronique micromecanique, Journees d'Electronique et de Microtechnique, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, October 19-21, 1976, Comptes Rendus) Workshop sponsored by the Association Suisse des Electriciens, Association Suisse de Microtechnique, Ecole Polytechnique Federale de Lausanne, Groupement de l'Electronique de Suisse Occidentale, and IEEE Lausanne, Ecole Polytechnique Federale de Lausanne, 1976, p 177-188

Development and testing of a microprocessor based fuel control system for a specific small gas turbine designed as power and propulsion unit for helicopters are described Modifications of the control system for the application, hardware added to the system, dedicated software, and propulsion plant functions responding to analog and digital control inputs are discussed Real-time program timing, and techniques for improving the dynamic range and resolution of signals for internal variables, are discussed (speed of power turbine and engine, error accumulation and lag) Test bed trials are sketched Since gas turbine control tasks take up little more than half the microprocessor capacity, additional tasks are proposed for the available spare capacity R D V

A77-17534 **A combined cycle with a partial-oxidation reactor (Cycle combine avec reacteur a oxydation partielle du combustible)** J Ribesse, A Jaumotte (Bruxelles, Universite, Brussels, Belgium), and A De Goeyse *Entropie*, vol 12, no 70, 1976, p 15-18 In French

A combination of power generator and lean fuel gas generator is realized by replacing the combustion chamber of a gas turbine with a reactor featuring partial oxidation of the fuel The lean fuel gas lends itself to use in the boiler of a conventional steam cycle The combined cycle makes it possible to raise the output of a conventional steam power plant with some boiler redesign The cost of installation per kW generated is low The catalytic oxidation gas turbine system is recommended for judicious combination with other industrial facilities, furnaces in particular Extension of the method to other fuels is also recommended R D V

A77-17536 **Functional representation of the kinematic properties of two-dimensional blade cascades (Représentation fonctionnelle des propriétés cinématiques des grilles d'aubes planes)** R Rey (Ecole Nationale Superieure d'Arts et Metiers, Paris, France) *Entropie,* vol 12, no 70, 1976, p 25-30 9 refs In French

Ruden has superimposed two flows in an ideal fluid and shown that the tangent lines to the exit angle and the entry angle of a two-dimensional blade cascade are associated by a linear relation whose two parameters are dependent on the keying angle of the profiles and the tightening and shape of the profiles This paper demonstrates on the basis of experiments conducted on NACA airfoils that a universal law can be formulated for one of the two parameters in question, namely that it is not dependent on the profile shape, but only on tightening It is also shown that two tests are sufficient for giving a more exact value of the second parameter as a function of the keying angle B J

A77-17548 **Foundations of aerodynamics Bases of aerodynamic design /3rd edition/** A M Kuethe (Michigan, University, Ann Arbor, Mich) and C-Y Chow (Colorado, University, Boulder, Colo) New York, John Wiley and Sons, 1976 539 p 192 refs $21 95

This textbook deals with fundamental concepts of aerodynamic design applicable to both aircraft and fluid machinery in general First principles of hydrostatics and aerostatics are reviewed along with the kinematics and dynamics of incompressible, compressible, and viscous fluid flows The method of source, vortex, and doublet panels for analyzing incompressible flows about bodies of arbitrary shape is outlined, analyses of flow about a circular cylinder and an airfoil (including NASA's supercritical airfoil) are described in detail, and it is shown how the panel method can be applied to design a wing-fuselage configuration Other topics include the formation and characteristics of shock waves in two and three dimensions, the Prandtl-Glauert method for determining characteristics of subsonic and supersonic flows, wave drag, laminar boundary layers in compressible and incompressible flows, conditions governing stability and the transition to turbulent flow, separation of laminar and turbulent boundary layers, and boundary-layer control for low drag and high lift F G M

A77-17554 **Superplastic forming of titanium alloys (Superplastische Verformung von Titanlegierungen)** C A J Gay and J Payne *Metall,* vol 30, Dec 1976, p 1203-1205 In German

The forming of metals in the superplastic condition can be compared with glassblowing The advantages of superplastic forming techniques for design and manufacturing are examined, taking into account possibilities concerning the use of the new technology for the forming of titanium alloy components for civil and military aviation It is shown that superplastic forming is competitive with conventional procedures Attention is given to development problems and applications of superplastic forming in the production of components for current and future aircraft G R

A77-17725 # **Technology of manufacturing aircraft honeycomb structures /2nd revised and enlarged edition/ (Tekhnologiia izgotovleniia sotovykh aviatsionnykh konstruktsii /2nd revised and enlarged edition/)** V E Bersudskii, V N Krysin, and S I Lesnykh Moscow, Izdatel'stvo Mashinostroenie, 1975 296 p 51 refs In Russian

Some aspects of designing and manufacturing glued, soldered, and welded aircraft components with honeycomb fillers are discussed Design, stability, and weight data are given for components with honeycomb fillers made of nonmetallic materials, stainless steel, and aluminum and titanium alloys The production methods described are extended to include latest foreign and domestic progress in this field Means of automating the production of honeycomb fillers are examined V P

A77-17751 # **Instability phenomena in the flow passages of a gas turbine engine compressor (Iavlenie neustoichivosti v protochnykh polostiakh kompressora GTD)** A I Belousov, I P Tokarev, and D E Chegodaev *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 4-10 5 refs In Russian

Loss of stability of the dynamic system comprising the rotor disk and the flow passages of a compressor stage is pinpointed as a likely reason for the generation of dangerous vibrations and resonances leading to fractures and flaws in protruding rotor parts Introduction of split rings often proves ineffective, but redesign of labyrinth seal passages and axial clearance can eliminate some self-sustained vibrations The compressor stage can be treated as a gas thrust bearing Coping with vibrations by altering the clearances in the labyrinths or in the shaft-end area is examined The range of measurements of dimensions of labyrinth seal passages and axial clearances of the stage, available for conforming to unstable rotor disk positions, is ascertained R D V

A77-17754 # **Contribution to the investigation of heat transfer in turbine blade cascades in effusion cooling (K issledovaniiu teploobmena v reshetkakh turbinnykh lopatok pri effuzionnom okhlazhdenii)** C G Dezider'ev, A G Karimova, B I Lokai, and A V Shchukin *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 28 31 In Russian

Experiments designed to find the coefficient of heat transfer from the gas to the turbine blade surface in effusion cooling are described A U-tube of rectangular cross section for static blowdown of a planar turbine cascade was devised for the tests Hot air served as working fluid and purified air as the heat-transfer medium Porous effusion cooling brings the temperature of the gas-turbine blades down effectively Data acquired from experiments run on different cascades using different materials will be analyzed in order to arrive at inferences on cooling methods needed R D V

A77-17760 # **Comparison of energy performance of different types of heat exchangers (Sopostavlenie energeticheskoi effektivnosti teploobmennikov razlichnykh tipov)** N V Lokai *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 60-65 In Russian

Thermal losses, hydraulic losses, and leakage of working fluid in recuperators, regenerative heat exchangers (rotating or nonrotating), and other types of heat exchangers are examined in a comparison of the efficiency of these exchanger types The energy efficiency of the heat exchanger is viewed as a parameter similar to efficiencies for other gas turbine engine subsystems such as turbine or compressor Formulas for calculating heat exchanger energy efficiency are derived, and the usefulness of the method is assessed in optimization of heat exchanger design or selection R D V

A77-17761 # **Optimum distribution of material in rotating disks found from strength conditions (Optimal'noe raspredelenie materiala vo vrashchaiushchikhsia diskakh iz uslovii prochnosti)** V P Malkov and E A Salganskaia *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 66-71 8 refs In Russian

A procedure for finding the optimum distribution of material in rotating disks of gas turbine engine rotors in the sense of meeting strength requirements and coping with stresses generated by centrifugal forces associated with the mass of the rotor disk and the blades fastened to it, and thermal stresses, is worked out The characteristics of the rotor disk material are assumed to vary with temperature and disk radius in nonlinear fashion, and a stationary temperature field is assumed An iterative method is developed for discrete elements of equal strength constituting the disk Breaking up the disk into discrete annuli and the method of forces are employed in the direct computations R D V

A77-17762 # **Theoretical aspects of optimization of aviation gas turbine engine design variables (Teoreticheskie voprosy optimi-**

zatsii proektnykh parametrov aviatsionnykh GTD) V G Maslov *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 72-79 7 refs In Russian

Typical aircraft systems optimization criteria are presented with emphasis on their use in finding regions of optimum gas turbine engine (GTE) performance in early design stages Attention is centered on comparative evaluations of two salient criteria the effective specific weight of the GTE in the aircraft design system and losses incurred per ton kilometer Analytic formulas minimizing specific weight and specific fuel consumption are derived, along with the boundaries of those optimum performance variables in the neighborhood of minima Optimization results for a helicopter GTE and a fixed-wing GTE with respect to the two criteria are compared numerically R D V

A77-17765 # **Analysis of parameters and characteristics of a bypass turbojet engine operating in a cycle with stepwise heat removal (Analiz parametrov i kharakteristik DTRD, rabotaiushchikh po tsiklu so stupenchatym otvodom tepla)** B Kh Perel'shtein *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 94-100 8 refs In Russian

A feasibility analysis is carried out for a bypass turbojet engine (BPTJ) with design complicated by addition of a self-contained vacuum module whose function is to effect heat removal in a stepwise pattern The vacuum module comprises a re-expansion turbine, a contact type freezer (in aerothermocompressor format), and a booster compressor The first heat removal stage involves cooling of the working fluid in the freezer and venting to atmosphere Positioning of the vacuum module aft of the main engine brings the pressure downstream of the power turbine down, with increased available pressure head, while specific fuel consumption is diminished by a factor of 1 21 and specific thrust is increased by a factor of 1 33 R D V

A77-17770 # **Features of the concept of the efficiency coefficient of a turbine with open air cooling operating in a gas turbine engine system (Ob osobennostiakh poniatiia koeffitsienta poleznogo deistviia turbiny s otkrytym vozdushnym okhlazhdeniem, rabotaiushchei v sisteme gazoturbinnogo dvigatelia)** E N Bogomolov *Aviatsionnaia Tekhnika,* vol 19, no 3, 1976, p 119-123 5 refs In Russian

The efficiency coefficient of a turbine is understood here to mean the ratio of useful mechanical energy produced by the turbine to the energy of the working fluid Different forms of this energy conversion coefficient are studied for a gas turbine engine with air cooling Specific attention is given to the conversion efficiency of a turbojet engine B J

A77-17952 **Development of method for modification of thin-wall fuselage-type reinforced shells and construction of a practical calculation algorithm** Z I Burman and V I Lukashenko *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 9-14) *Soviet Aeronautics,* vol 19, no 2, 1976, p 5 9 8 refs Translation

A generalized method is developed for stiffness modification of fuselage structural elements which is based on using the principle of superposing initial deformations on the modified elements of a precalculated regularized system, the method permits successive modification (specifically, sequential formation of cutouts) of the structures We present the required proofs, calculation algorithm, fuselage calculation results and comparison with the results of a careful laboratory experiment (Author)

A77-17953 **Theory of small aspect ratio wing analysis using discrete-continuous calculation scheme - Numerical integration of resolving equations** M B Vakhitov and N G Larionov *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 15-20) *Soviet Aeronautics,* vol 19, no 2, 1976, p 10-14 Translation

The paper is devoted to numerical solution of the closed system of matrix differential equations obtained in Vakhitov and Larionov (1974 and 1975) for small-aspect ratio wing analysis using a discrete continuous calculation scheme The solution is obtained with the aid of integrating matrices after the differential equations are transformed into integrodifferential form The solution is in the form of matrix equations in the sought for unknowns at the design sections P T H

A77-17955 **Stability of rotating body in a gas stream** P I Zheludev *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 28-32) *Soviet Aeronautics,* vol 19, no 2, 1976, p 21-24 6 refs Translation

The paper investigates the effect of angular velocity of rotation about the longitudinal axis on dynamic stability of a slender elastic body with an elastic hinge in the middle, situated in a supersonic flow of an ideal gas On the regular motions of the body are superimposed small unsteady motions The system of differential equations of motion is written with account for the elastic, Coriolis, inertial, and aerodynamic forces, and for section rotary inertia and gyroscopic moments Slender body theory is invoked, and the equations are solved approximately by the Bubnov method For a body of constant cross section performing steady harmonic oscilla tions, it is found that the critical flutter velocity decreases with increasing angular velocity of rotation P T H

A77-17956 **Dynamics of elastic curvilinear rod with free ends** R L Iskhakov *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 33-39) *Soviet Aeronautics,* vol 19, no 2, 1976, p 25-30 Translation

The motion of a curvilinear unrestrained elastic rod is studied The posed boundary value problem is solved by the Fourier method A technique is given for determining the eigenmodes and eigenvalues Analytic relations for a specific example are obtained which make it possible to determine the motion of the subject rod (Author)

A77-17957 **Optimizing GTE tests on the basis of sequential Bayesian procedures** Iu V Kozhevnikov, Iu V Meluzov, R I Adgamov, and S K Shamil *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 40-47) *Soviet Aeronautics,* vol 19, no 2, 1976, p 31-36 Translation

We examine the question of optimizing gas turbine engine stand tests In the control stage we use all the information accumulated in the process of sequential corrections of the object states Trimming of the engine characteristics is accomplished by linear programming under the assumption of linear connection between small parameter deviations and regulating element displacements The described technique was used in conducting gas turbine engine tests, and the results are presented graphically (Author)

A77-17958 **Estimation of automated GTE test system characteristics** Iu V Kozhevnikov and A Kh Khairullin *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 48-54) *Soviet Aeronautics,* vol 19, no 2, 1976, p 37-42 Translation

We examine the problem of analyzing and evaluating the effectiveness of the automated gas turbine engine test system (ATS) Joint solution of the systems of equations obtained previously by the present authors (1975) for describing the ATS state probabilities makes it possible to obtain the basic ATS characteristics A numerical example is used to illustrate the problem of optimizing the number of engines simultaneously serviced by a given ATS (Author)

A77-17961 **Hypersonic gas flow around slender blunt body of revolution** N M Monakhov *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 68-73) *Soviet Aeronautics,* vol 19, no 2, 1976, p 54-58 Translation

Ideal gas flow around slender blunt bodies of revolution with shock waves similar to the parabolic shock waves of strong blast theory are described by power-law polynomials The coordinate deformation method is used in solving the basic gasdynamic equation and determining the uniformly-exact values of the flow parameters at the body surface (Author)

A77-17968 On the mechanism of vortex breakdown point stabilization for low subsonic flow around a delta wing E A Truneva *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 106 110) *Soviet Aeronautics,* vol 19, no 2, 1976, p 87 90 Translation

Results are presented of an experimental study of the mechanism of stabilization of the position of the 'breakdown point' of the vortices which form at the leading edge of a delta wing, beginning from breakdown initiation The experiments were made on three delta wing models of different sweep The results can be used in analyzing the unsteady phenomena which develop on delta wings in the takeoff and landing regimes (Author)

A77-17970 Analysis of multicontour thin-wall structures by the cell method V G Shataev *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 117 123) *Soviet Aeronautics,* vol 19, no 2, 1976, p 96-101 13 refs Translation

The paper examines the problem of determining the stress-strain state of thin wall stiffened wing type structures on the basis of Odinokov's theory The structure is assumed to be broken down into cells Cell coupling equations are obtained which have quasi tridiagonal structure and can be easily solved by the matrix pivoting method Simple matrix formulas are presented for the coefficients of the governing system of equations The multiply connected cross section is considered a linear directed graph (Author)

A77-17971 Hypersonic flow in converging conical channel V V Duganov and V V Poliakov *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 124 128) *Soviet Aeronautics,* vol 19, no 2, 1976, p 102-105 Translation

Calculations are made of flow of an ideal gas with adiabatic exponent 1 67 in a converging conical channel with sharp leading edge by the through the-shock calculation method for approaching flow (free-stream) Mach numbers M = 5, 10, 15, 20, 25, 35 for three fixed values of a hypersonic similarity criterion It is shown that hypersonic similarity theory is valid for internal gas flow in such a channel with a system of oblique shocks present in the flow The error of similarity law satisfaction does not exceed 5% if the local Mach numbers in the channel are larger than four (Author)

A77 17975 Determining minimal drag of nonslender body R S Tereshchenko *(Aviatsionnaia Tekhnika,* vol 19, no 2, 1976, p 139-141) *Soviet Aeronautics,* vol 19, no 2, 1976, p 118-120 Translation

In the present article an attempt is made to broaden analytically the region of application of the results of the Miele-Saaris problem on the transverse contour of minimal resistance to thicker bodies by introducing a new quadratic term into the functional being minimized This term accounts for the weak nonlinearity of the problem New quantitative relations are obtained for the drag coefficients, and the numerical bounds for the minimal drag body cross section radii are broadened (Author)

A77-18134 # Shock wave diffraction by a thin wedge moving at supersonic speed in the case of irregular wave interaction (Difraktsiia udarnoi volny na tonkom kline, dvizhushchemsia so sverkhzvukovoi skorost'iu, pri nereguliarnom vzaimodeistvii voln) L E Pekurovskii *Prikladnaia Matematika i Mekhanika,* vol 40, Sept -Oct 1976, p 857 864 6 refs In Russian

A supersonic wedge-shaped airfoil moving in an ideal gas at rest is examined, assuming that a supersonic shock front of arbitrary intensity impinges on the edge of the airfoil and that the angle formed by the plane of the shock and the symmetry plane of the airfoil is close to a right angle The wedge half-angle is a small parameter of the problem The diffraction of the shock is complicated by irregular interaction of the shock with a plane pressure jump generated by the flow about the wedge The disturbance of the pressure along the front exhibits a singularity, which leads to a boundary value problem The solution of this problem yields the pressure disturbances at the wall and along the front, as well as the shape of the front (expressed in elementary functions) V P

A77-18201 # Overview A look into the future of U S air transport - Keynote remarks J J Casey (Braniff International, Dallas, Tex) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77 251* 3 p

The present state of American commercial aviation technology is critically examined, taking into account the Anglo French development of the Concorde It is concluded that the U S leadership in this field has been lost It is pointed out that the next five years, or perhaps only two years, will determine what kind of air transport system the U S will have for the next 25 years A number of specific recommendations are made Attention is given to the development of a second generation of supersonic transport which will meet noise and air pollution objectives, the design of subsonic aircraft that will satisfy noise regulations, and the development of aircraft which can replace the 127, DC-8, DC-10, and 747 Approaches for overcoming financing difficulties are also considered G R

A77-18210 # Computers in flight - An historical perspective of computation in aviation and aerospace C D Perkins (National Academy of Engineering, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-271* 7 p

The origin of modern computer technology can be traced to the analytical engine concept evolved by Babbage A revolutionary development occured in the 1930s with the development of electromechanical digital machines using binary arithmetic Further advances came with the replacement of relays by vacuum tubes and finally with the use of transistors and integrated circuits in computer technology Applications of the computing devices in the field of aerospace are considered, taking into account devices for aircraft simulation and pilot training, the solution of air-defense problems, and an employment in air traffic control operations It is pointed out that modern, light weight, reliable computer capabilities are now integral to nearly all modern high performance aircraft systems and essential to space systems G R

A77-18212 # Future impact of computers on military aviation J J Martin (USAF, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77 273* 5 p

Relative advantages of digital and analog techniques and equipment are compared and the importance of IC and microprocessors in on-board systems is emphasized, as well as programmability even in highly dedicated systems because of the inherent fast and inexpensive redesign capability Further advances are anticipated in digitalized simplification of on-board switchgear and interconnections of aircraft systems Software problems are considered broadly, with attention given to software-compatible computer architecture, software management difficulties, structured programming, and advantages of higher-level programming languages R D V

A77 18213 # Expanded use of computers in air transportation A P Albrecht (FAA, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-274* 6 p

The role of computers in holding rising costs down, while

improving efficiency, productivity, and safety, in civilian aviation is explored Uses of computers in ATC, on board flight operations, airline and airport services, and weather forecasting are sketched, and the satellite-based CONUS ATC now under study is mentioned ATC systems discussed include UG3RD, MSAWS (minimum safe altitude warning system), BUEC (backup emergency communication), DARC (direct access radar channel), DABS (discrete address beacon), and IPC (intermittent position control) On-board navigation and flight operations data processing and display systems of several types are mentioned CADC (central air data computer), RNAV area navigation, CHWS (cockpit hazard warning), ACT (active control technology), and CAS (collision avoidance) R D V

A77-18229 # **Advanced composite landing gear leg** D Maass *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10 13, 1977, Paper 77 304* 6 p 6 refs

Spring landing gear legs offer simplicity, durability, low cost, and low drag However, those constructed of solid spring steel are structurally inefficient and thus excessively heavy By means of selective reinforcement with advanced composites a large weight saving can be realized with the application of a small amount of material A computer program was developed to analyzed a landing gear leg consisting of an aluminum core stiffened with graphite/epoxy A half scale model for an existing aircraft was designed and fabricated Tests were performed to determine spring constant, deflections, and stresses A significant savings in weight was achieved (Author)

A77-18232 # **Wind tunnel investigation of devices to reduce bus aerodynamic drag** D P Raymer (Purdue University, West Lafayette, Ind) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-307* 6 p 6 refs U S Department of Transportation Contract No TSC-989

Aerodynamic drag on long haul passenger buses (specifically the common MC 7 coach) at flowspeeds scalable to typical highway cruising speeds are investigated, using 15 front end configuration models in a wind tunnel Reduction of fuel consumption via reduction of drag and turbulence with the aid of aerodynamic add on devices (inflicting no penalties in costs or added total bus length) is studied Turbulence under the bus was a persistent problem Rear-end modifications and turning vanes failed to reduce drag Three front-end modifications show promise and are being tested further ('top bonnet', 'full mask', and 'lip removed' configurations) Fuel savings of $834 per bus annually are anticipated if drag can be cut 21% (resulting in 10% reduction in fuel consumption at 55 mph) R D V

A77-18233 # **Flutter analysis of a cascade of rotor blades** G P White (Texas A & M University, College Station, Tex) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-308* 8 p 10 refs Grant No AF-AFOSR-74-2700B

A classical two-dimensional, bending-torsion flutter analysis of a reference airfoil in a cascade of infinite blades is performed The unsteady airloads on the reference airfoil are predicted using a numerical lifting surface theory Several cascade and flow parameters such as interblade spacing, stagger angle, phase angle between blades, Mach number, and frequency are investigated The bending torsion flutter speed of the cascaded reference airfoil is studied as a function of the cascade and flow parameters and the results are compared with that of an isolated airfoil (Author)

A77-18242 # **Incompressible flow over delta wings** J K Nathman (Texas A & M University, College Station, Tex) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77 320* 13 p 26 refs Navy supported research

The analysis of delta wings in incompressible flow is treated by a numerical lifting-surface theory based upon a velocity potential formulation This theory has been expanded to include spanwise velocity effects and the leading-edge separation associated with delta wings The numerical technique has made use of both fixed and free wakes In the fixed wake model, the analytical results of Brown and Michael (1955) have been used to position the leading-edge vortex In the more refined free wake model, the leading-edge separation was modeled as a discrete number of vortices attached to the leading-edge, which are allowed to align themselves with streamlines The iteratively determined position of these vortices resembles the experimentally observed spiral form, while computed lift coefficients reflect the added vortex lift (Author)

A77 18246 # **Flight simulators for air warfare of the future** J H Venner (Singer Co , Link Div , Binghamton, N Y) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-327* 5 p

Use of sophisticated simulator systems for real-time interactive training of flight crews in projected combat environments is envisaged, beyond the traditional use of simulators as a cheap substitute for training aircraft and to cut costs (in fuel, training, aircraft use) Simulator training of crews in flight control, sensor and ECM operation and interpretation, air combat maneuvering, and tactical decision making is discussed at length The short time available for 'on the-job training' in a common mission environment in future war scenarios is pointed out, and advances in simulation technology and representation of sensory and visceral cues are noted Current and future simulator technology brings simulation fidelity to the point where the main constraints are imposed by accuracy of knowledge about hostile capabilities and about the mission environment R D V

A77-18247 # **LTA history and its significance for current events** J G Vaeth (NOAA, National Environmental Satellite Service, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77 328* 4 p

The concept of the 'hybrid' envisages a vehicle that flies by combining the aerostatic lift of its helium with aerodynamic lift generated by movement through the air A use of hybrids makes it possible to conduct airship operations at considerably higher altitudes and speeds In connection with the possibilities regarding a rebirth of the airship provided by new technological advances, an investigation is conducted concerning the history of the airship, taking into account the lessons which can be learned from the past for the new developments G R

A77-18249 * # **Feasibility of modern airships - Design definition and performance of selected concepts** R R Huston (Goodyear Aerospace Corp , Akron, Ohio) and M D Ardema (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77 331* 13 p 7 refs

Three promising modern airship system concepts and their associated missions were studied (1) a heavy-lift airship, employing a nonrigid hull and a significant amount of rotor lift, used for short-range transporting and positioning of heavy military and civil payloads, (2) a VTOL (vertical take-off and landing), metal-clad, partially buoyant airship used as a short-haul commercial transport, (3) a fully-buoyant airship used for long endurance Navy missions

The heavy-lift airship concept offers a dramatic increase in vertical lift capability over existing systems at significantly lower costs per ton-mile The VTOL airship transport concept appears to be economically competititve with other VTOL aircraft concepts but can attain significantly lower noise levels The fully-buoyant airship concept can provide an airborne platform with long endurance that satisfies many Navy mission requirements (Author)

A77-18260 # **Our amazing air transportation system /AIAA-SAE William Littlewood Memorial Lecture/** R D Kelly (R Dixon Speas Associates, Inc , Manhasset, N Y) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display Incorporating the Forum on the Future of Air Transportation, 13th, Washington, D C , Jan 10-13, 1977, Paper 77-356* 24 p

Early airline experience in the 1930's is discussed along with the achievements of civil air transportation during the 1940's and 1950's Attention is given to the evolution of U S airline aircraft, DC-3 problems, the DC-4 aircraft, the development of an operational cost formula, the stabilized approach system for pilot training, pressur ized cabin aircraft, turbine engine potentials, studies for the development of an aircraft with transcontinental nonstop capabilities and a reasonable payload, the jet competition in the U S , aspects of engineering cooperation, professional societies and committee work, energy requirements, airline fuel specifications, questions of productivity, revenue-cost relations, the importance of timing, and future developments G R

A77-18265 # **Drive mechanisms of flight vehicle control systems Analysis and design Handbook (Mekhanizmy privodov sistem upravleniia letatel'nymi apparatami Raschet i proektirovanie Spravochnik)** M N Sliudikov Moscow, Izdatel'stvo Mashinostroenie, 1975 384 p 101 refs In Russian

Essential data, specifications, and computational formulas for the design of the drive and transmission mechanisms of flight vehicle control systems are given in handbook form The properties of materials used in the production of the components of aircraft servos and control systems are tabulated Methods for calculating the precision of mechanisms and parts are set forth Data on tolerance limits, surface roughness, and form deviations are given Design characteristics and specifications are given for screw joints, hinge-screw mechanisms, cotter joints, tooth and pin joints, gear transmissions, wave gears, worm gears, shafts, and bearing joints P T H

A77-18348 **The determination of collapse load and energy absorbing properties of thin walled beam structures using matrix methods of analysis** J C Miles (Cranfield Institute of Technology, Cranfield, Beds , England) *International Journal of Mechanical Sciences,* vol 18, July Aug 1976, p 399-405 14 refs Research supported by the Science Research Council

Recent interest in occupant safety has given the impetus for much research into the energy absorbing potential of metal structures in the automotive and light aircraft industries Lightweight sheet metal constructions are not, by nature, particularly amenable to simple collapse analysis procedures using the well known limit theorems of plasticity because of the occurrence of local buckling This paper describes a computer analysis particularly designed to deal with this situation Compound beam-spring elements are introduced which are capable of describing the reduction in moment of resistance typical of thin-walled members after bending failure has occurred Geometrical nonlinearities arising from gross distortions are also accounted for A number of laboratory test results are presented to demonstrate the validity of the program (Author)

A77-18467 # **Forecasting the elastic properties of composites reinforced by discrete fibers (Prognozuvannia pruzhnikh vlastivostei kompozitiv, zmitsnenikh diskretnimi voloknami)** L P Khoroshun and B P Maslov *Akademiia Nauk Ukrains'koi RSR, Visnik,* vol 40, Oct 1976, p 21-28 7 refs In Ukrainian

Techniques for forecasting the macroscopic properties of composite materials reinforced with oriented discrete fibers, are described as developed at the Institute of Mechanics of the Ukrainian SSR Academy of Sciences The work is based on stochastic differential and integral equations of elasticity theory Tensors of macroscopic constants and the method of conditional moment functions, fluctuations of displacements and of the strain tensor, tensors of up to fourth rank, and media exhibiting transversal isotropic symmetry are discussed, along with applications of the compatibility equations The importance of the problem for turbine design and aircraft design is pointed out R D V

A77-18472 **Concorde and the climate (Concorde et le climat)** J Bensimon and B DeHove *(Symposium de l'Ozone Atmosphérique, Dresden, East Germany, Aug 9-17, 1976) L'Aeronautique et l'Astronautique,* no 61, 1976, p 17-23 17 refs In French

A one-dimensional thermal model is described for evaluating the climatic effect of various perturbations in stratospheric concentration of ozone, water vapor, and aerosols Calculations show that a fleet of 2,000 Concordes would have only a slight effect on the ground level temperature, and the effect of 200 aircraft would be probably insignificant P T H

A77-18503 # **Synthesis of an automatic aircraft control system (Sintez na sistema za avtomatichno upravlenie na letatelen aparat)** B Danev and A Kukleva (B'lgarska Akademiia na Naukite, Institut po Tekhnicheska Kibernetika, Sofia, Bulgaria) *Problemi na Tekhnicheskata Kibernetika,* no 4, 1976, p 53 61 7 refs In Bulgarian

Four distinct approaches are developed for synthesis of an automatic aircraft control system obeying proportional and proportional integral control laws Control by a state coordinate, synthesis based on assigned poles, optimal synthesis based on models with an optimality criterion, and synthesis of a control system with a proportional control law for the state coordinate and an integral control law for the initial coordinate are considered Standard programs are compiled, with a program pack run on an ICL-4 50 computer, and results are presented in tabular form R D V

A77-18545 **Progress in surface finishing and coatings (Progres en traitements et revêtements de surface)** R Chevalier (SNECMA, Paris, France) *Sciences et Techniques,* Dec 1976, p 55 59 In French

Shotpeening, electrochemical/electrolytic deposition techniques, metallizing, plasma spraying, paints, and thermochemical diffusion techniques for enhancing the resistance of metal surfaces to wear, friction, fatigue, or stress corrosion are reviewed Aerospace applications of programmed shotpeening, plasma spray coating, paints with inorganic binders, diffused Ni-Cd coats and anticorrosion anodizing, and shotpeening combined with hard chromizing or hard nickelizing are mentioned New techniques discussed include multipeening, peening with Ti glass shot, a French technique for hard anodizing of Al alloys using a sinusoidal electrolytic current, electrolytic cadmium plating of Concorde landing gear components, application of coats and plating outside of a bath, new casehardening/nitriding techniques for superalloys, and cyaniding treatments to forestall stress corrosion Advantages and drawbacks of the techniques are weighed R D V

A77-18600 **Deutsche Gesellschaft fur Luft- und Raumfahrt, Yearbook 1975 Volumes 1 & 2 (Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrbuch 1975 Volumes 1 & 2)** Edited by H Blenk and W Schulz Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1976 Vol 1, 345 p , vol 2, 344 p In German

European perspectives in the field of helicopters are considered along with questions concerning the necessity for a cooperation between European and American companies in the future, the program of the government of West Germany for aviation research and technology, the air traffic in the 1980's and its requirements with respect to aircraft and fleet structure, the Alpha Jet program, and the perspectives regarding a military employment of RPV Attention is also given to the perspectives of astronautics, the employment and utilization of manned orbital systems in the space program of the government of West Germany, communication satellites as significant elements of the communication systems of today and tomorrow, the German ground support system for spacecraft, the acceleration tolerance of man as limiting factor in manned aviation, and recent contributions of German aviation research in the area of aircraft aerodynamics

G R

A77-18645 # **Study on film cooling of turbine blades I - Experiments on film cooling with injection through holes near leading edge** M Sasaki, K Takahara, K Sakata, and T Kumagai (National Aerospace Laboratory, Aeroengine Div , Chofu, Tokyo, Japan) *JSME, Bulletin,* vol 19, Nov 1976, p 1344-1352 7 refs

With application to film cooling of turbine blades, experimental investigations are made of the blowing characteristics of a single hole in a circular cylinder in cross flow, and of film cooling with injection from rows of holes located near the leading edge of a flat plate model with a blunt nose, and of the change in the flow pattern of the injected flow around the model by a visualization technique It is concluded that the flow rate coefficient of an ejection hole varies under the influence of the main flow, that the film cooling effectiveness downstream of rows of blowing holes is sometimes lowered by excessive injection, and that the inclination of ejection holes in the spanwise direction shows very high cooling effectiveness

(Author)

A77-18646 # **Emissions from gas turbine combustors I - An experimental study on a model combustor** M Katsuki, Y Mizutani (Osaka University, Suita, Japan), and K -I Shibuya *JSME, Bulletin,* vol 19, Nov 1976, p 1353-1359 7 refs

The distributions of temperatures and species concentrations within a small combustor of can type were measured for the inlet air temperatures of 320 and 430 K and for various swirler vane angles A higher inlet air temperature accelerated the combustion process in the primary zone, the resultant higher temperature level throughout the combustor reducing the emission of carbon monoxide No significant difference in nitric oxide emission, on the other hand, was observed in the range of inlet air temperatures studied The concentration of carbon monoxide decreases more rapidly as a greater part of the combustion process takes place in the upstream part of the combustor The formation process of nitric oxide is also affected by the combustion process but in a more complicated manner

(Author)

A77-18647 # **Emissions from gas turbine combustors. II - Analytical model and numerical analysis.** Y Mizutani and M Katsuki (Osaka University, Suita, Japan) *JSME, Bulletin,* vol 19, Nov 1976, p 1360-1366 16 refs

An axisymmetrical, two-dimensional model of gas turbine combustors of can-type has been developed in which both turbulent diffusion and chemical reactions of finite rate are taken into account simultaneously On the basis of this model, the distribution maps of the velocities, temperatures, equivalence ratios, and the concentrations of oxygen and nitric oxide, as well as the axial profile of combustion efficiency were predicted numerically This suggests the usefulness of the present model in examining the roles of various parameters in the formation process of nitric oxide Its capacity in predicting the blowout behaviors of combustors was also noted

(Author)

A77-18650 **AE monitoring of rapid crack growth in a production size wing fatigue test article** C D Bailey, J M Hamilton, and W M Pless (Lockheed-Georgia Co , Marietta, Ga) *NDT International,* vol 9, Dec 1976, p 298 304 7 refs

Acoustic emission source location techniques were successfully used on a production-size aircraft wing fatigue test article to monitor crack growths in the range from 0 25 mm to 1 6 mm per load cycle The AE data showed good correlation with the crack length data Analyses of these correlations show that AE monitoring has the potential for being used to determine crack length over this range of crack growth rates The fatigue test article was constructed of 7075-T6511 aluminum alloy The test period lasted 14 days and the results demonstrated that AE has application to aircraft structures

(Author)

A77-18724 **Ride control for high speed ground transportation including passenger-seat dynamics and active aerodynamic suspensions** N S Nathoo, R O Stearman, A J Healey (Texas, University, Austin, Tex), and B G Shanahan (Texas, University, Austin, Tex , McDonnell Douglas Corp , Huntington Beach, Calif) *High Speed Ground Transportation Journal,* vol 10, Fall 1976, p 297 315 11 refs Research supported by the University of Texas

The feasibility of controlling high speed ground transportation systems responses through the use of active suspension systems in the form of lifting surfaces is studied Aerodynamically three-dimensional canards are employed to control the pitch and plunge steady state response of the vehicle and passengers to harmonic guideway excitations In addition to the model of an air cushion vehicle, a man seat model is also incorporated into the analysis Vehicle and passenger response has been studied by assuming various control schemes and a parameter optimization technique A second method to suppress acceleration levels of the vehicle via optimal control theory has also been investigated Vehicle response at a speed of 300 miles per hour is compared with railway comfort criteria and the ISO riding comfort standards Except for the actively controlled cases, all results indicate that an uncomfortable ride would result from the vehicle's response The proposed actively controlled suspension provides a safe and comfortable passenger environment

(Author)

A77-18725 **The automatic navigator** M Hirst *Flight International,* vol 111, Jan 8, 1977, p 67 70

A brief didactic review is presented of onboard navigation equipment from NDB (nondirectional beacon) and VOR (VHF omnidirectional range) to the present RNav (area navigation) computerized systems DVOR (Doppler VOR), DME (distance-measuring equipment), Loran (long range navigation), INS (inertial navigation), Omega, and VLF navigation aids systems are characterized briefly Costs and effectiveness are compared for Omega and VLF navaids against triple majority vote INS The MNPS (minimum navigational performance specifications) and supplanting of Loran A are discussed Possible gains in low cost and simplicity for INS, and future advantages of satellite aided navigation, are mentioned R D V

A77-18773 **Hawkeye - A new dimension in tactical warfare** *Air International,* vol 12, Jan 1977, p 7 13, 42 44

The structure and avionics of various Hawkeye system models are presented in detail, along with use of the aircraft in maneuvers and in the Vietnam war theater The history of the present E 2A and E-2C systems is traced from the earlier Guardian and Tracker variants, and ATDS (airborne tactical data system) is traced from the U S Navy AEW (airborne early warning) Detection avionics, data links, various passive detection and radar processing systems, the OL-77/ASQ central radar data processor, features of displays, the CAINS (carrier aircraft inertial navigation system), and other hardware are described A cutaway detail drawing of the E 2C Hawkeye is presented Hawkeye service on station and in loitering in the Vietnam area, and the combined E 2C + F 14A recon/fighter team and its performance, are discussed R D V

A77-18879 „ **Prediction of aerodynamic out-of-plane forces on ogive-nosed circular cylinders** P L Lamont and B L Hunt (Bristol, University, Bristol, England) *Journal of Spacecraft and Rockets,* vol 14, Jan 1977, p 38 44 15 refs

This paper describes an empirical method for predicting the aerodynamic out of plane forces and moments on circular cylindrical bodies with tangent ogive noses The method is derived from experimentally determined distributions of out of plane force over the cylindrical body It is applicable to incompressible flow conditions and is based mainly on experimental results where the boundary layer over the body was laminar at separation An examination of the available experimental data on overall out-of plane forces and moments suggests that some of this data may have been affected by a form of unsteadiness which is determined by the test facility The predictions of the present method show good agreement with the limited amount of experimental data which is considered to have general significance (Author)

A77-18937 **Reliability case history of an airborne air turbine starter** T Murata *IEEE Transactions on Reliability,* vol R-25, Dec 1976, p 302, 303

Field failure data collected over a span of 7 years for airborne air turbine starters (ATS), which are used to start jet engines in aircraft, offer an opportunity for analysis and determination of reliability parameters This paper presents (a) changes in ATS equipment MTBF by year, (b) breakdown of removal causes by year, and (c) Cdf of failure times (Author)

A77-18960 # **Analysis of the climbing characteristics of subsonic jet aircraft (Steigfluganalyse subsonischer Strahlflugzeuge)** W Fohrer Munchen, Technische Universitat, Fachbereich Maschinenwesen, Dr -Ing Dissertation, 1976 35 p 18 refs In German

Calculations are conducted concerning the time of climb of subsonic aircraft The calculations are based on an employment of analytical approximate approaches concerning the relations for the maximum rate of ascent It is the objective of the reported investigation to find a single analytical relation which can be used as a basis for obtaining satisfactory results in the case of aircraft ascent to arbitrary altitudes, taking into account the whole spectrum of subsonic aircraft types The equations of motion are greatly simplified to make an analytical calculation of the rate of climb as a function of aircraft parameter data possible The results obtained with the aid of the described approach are found to be very accurate G R

A77-19012 **The pay-off for advanced technology in commercial aircraft design and operation** D G Brown (Hawker Siddeley Aviation, Ltd , Hatfield, Herts , England) and K S Lawson (British Aircraft Corp , Ltd , Weybridge, Surrey, England) *(Royal Aeronautical Society, Spring Convention on Seeds for Success in Civil Aircraft Design in the Next Two Decades, London, England, May 19, 20, 1976) Aeronautical Journal,* vol 80, Nov 1976, p 461-467

Prospects for introduction of advanced technology and in creased sales of aircraft in the future are discussed, with emphasis on subsonic conventional aircraft World service fleet requirements predictions are put forth, historical trends in the civil aircraft development picture and market are reviewed, along with fares and earnings, payload/weight ratios, fuel prices, and direct operating costs, and their interactions Advances in materials, active control, wing design and reduced wing weight, ATC improvements, fuel efficiency, and their effects on costs and efficiency in airline and airport operation are assessed, along with aircraft and airport noise abatement A substantial market for new aircraft, even if only to replace aircraft retired from service on a time basis, is predicted for the decade ahead R D V

A77-19015 **Engine noise - A look ahead** M Cox and D R Higton (National Gas Turbine Establishment, Farnborough, Hants , England) *(Royal Aeronautical Society, Spring Convention on Seeds for Success in Civil Aircraft Design in the Next Two Decades, London, England, May 19, 20, 1976) Aeronautical Journal,* vol 80, Nov 1976, p 483-486

Exhaust noise, turbine noise, fan noise, and their aeroacoustic interactions, are discussed, with emphasis on noise generated by subsonic engines and its abatement The authors see a trend toward lower specific thrust for engines, with a revival of propeller use for some short-range applications, along with some improvements in aeroacoustic technology and combustion cycles which should enable 10 dB engine noise reduction over the next 15 years Tradeoffs likely in mechanical efficiency, fuel conservation, installation weight, cost, and drag reduction are considered Problems in eliminating ground proximity effects in testing fly-over noise are mentioned Noise absorbing materials and structures are discussed briefly R D V

A77-19016 **The analytical geometry of a simple skew-hinge mechanism** F M Burrows (North Wales, University College, Bangor, Wales) *Aeronautical Journal,* vol 80, Nov 1976, p 487, 488

The kinematics and analytical geometry of the simple skew-hinge mechanism are outlined briefly The device is similar in its kinematics and geometry to the familiar Z-crank Its use is recommended for handling of relatively small loads in control surface actuating systems, and for installation in regions of shallow depth such as aircraft wings Operation is 'approximately linear' over a significant range R D V

A77-19039 # **A modal control technique and its application to stabilization of rotorcraft flight (Metoda sterowania modalnego i jej zastosowanie do ustateczniania lotu smiglowca)** J Pietrucha and Z Szewczyk (Warszawa, Politechnika, Warsaw, Poland) *Mechanika Teoretyczna i Stosowana,* vol 14, no 4, 1976, p 571-584 23 refs In Polish

A modal control approach developed by Porter and Crossley (1968) for lumped-parameter systems with one or several inputs is presented with an application to stabilization of helicopter flight Single-input and multi-input systems are discussed separately Computer algorithms for rotorcraft flight stabilization are worked out, with straightforward algebraic operations so that they are sparing in computer time Extension of the method to all unstable states of

rotorcraft flight presents no great difficulties, and the method can be extended to other applications outside of aviation R D V

A77-19175 **The seat belt light is on** H E Tolle (United Air Lines, Inc , Chicago, Ill) *Exxon Air World,* vol 29, no 1, 1976, p 5-9

Future trends affecting growth and revenues of the airline industry are projected with consideration of factors governing passenger travel demand, the profit picture, competition, political constraints, and fuel costs Success in fuel conservation, the fuel fraction of operating costs, effects of U S (FEA, EPA, FAA, CAB, DOT) government regulations, trends in passenger fares and freight rates, impact of inflation, expected slow and modest technological advances, forecasts of the potential passenger market, demographic trends affecting future passenger travel demand, and the capital investment picture are surveyed, along with European competition Population growth, smaller families, higher incomes, increased leisure time, and increased foreign travel are foreseen as pluses, while higher fares and costs, increased consumer savings, and electronic substitutes for business travel are seen as minuses R D V

A77-19185 # **The determination of the true vertical direction in flight (Die Bestimmung der wahren Lotrichtung im Flug)** V Held Stuttgart, Universitat, Dr Ing Dissertation, 1976 188 p 78 refs In German

An investigation is conducted concerning a number of questions related to the determination of the true vertical in the case of stationary flight operations, taking into account experimental data obtained in flight tests with a uniaxial inertial platform Principal questions regarding the determination of the true vertical in flight with the aid of triaxial, diaxial, and uniaxial platforms are examined An investigation is conducted of the flight and measurement conditions which must be satisfied to obtain with a uniaxial platform the same accuracy as with a triaxial platform Approaches are studied for finding a lower error bound concerning the true vertical determination procedure The various parameters which affect the accuracy of this determination are discussed G R

A77-19238 **Fibers and integrated optics, Proceedings of the Seminar, Reston, Va , March 22, 23, 1976** Seminar sponsored by the Society of Photo Optical Instrumentation Engineers and Society of Photographic Scientists and Engineers Edited by H Hodara (Tetra Tech, Inc) Palos Verdes Estates, Calif , Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings Volume 77), 1976 167 p $34

The papers deal with recent developments in laser semiconductors and low loss optical fibers as well as recent component developments, measurement and analysis techniques, and novel applications in the areas of communications, imaging, and data transmission in general Topics include potential future markets for fiber optics, the status of fiber-optic research in the U S A and abroad, the state of the art of integrated optical devices, the current status of integrated optics based on GaAs, recent developments in fiber-optic manufacturing processes, and distributed-feedback GaAs/GaAlAs diode lasers Other papers discuss methods for measuring the dispersion associated with the propagation of different modes in optical fibers, a technique for calculating bend radiation in an optical fiber, the strength of optical waveguide fibers, and bit-error-rate measurement for evaluating a fiber-optic link Attention is also given to glass fiber-optic dosimetry, uses of fiber optics in medicine, the role of fiber optics in mass spectrometer electrooptical ion detection, fiber laser gyroscopes, and fiber-optics video transmission

Individual items are announced in this issue F G M

A77-19242 **Fiber optics application to A 7 aircraft** J R Ellis and D N Williams (U S Navy, Naval Electronics Laboratory Center, San Diego, Calif) In Fibers and integrated optics, Proceedings of the Seminar, Reston, Va , March 22, 23, 1976 Palos Verdes Estates, Calif , Society of Photo-Optical Instrumentation Engineers, 1976, p 132 150 9 refs

The computer designed Airborne Light Optical Fiber Technology (ALOFT) interface subsystem interconnects the A 7 avionics units Thirteen channels of information are transmitted via 13 fiber-optic cables and are consolidated into one optical connector in the computer interface Attention is given here to the system design and demonstration testing of the ALOFT system Optical connector *design requirements, optical loss and cable requirements,* and light source and detector requirements are discussed System integration design of the LEDs and photodetectors, with their respective transmitter and receiver circuits is examined and an ALOFT system delivered hardware description is given Ground test results via the hot mock-up simulator are presented along with flight test results B J

A77-19246 # **Low cost radar altimeters** K Klippel *Avionics News, Dec 1976,* p 6, 8 10

The paper discusses the details of a general aviation radar altimeter, noting the defects of conventional pulse altimeters (such as averaging the heights of objects instead of measuring them) which can produce up to 50% error, and a low cost effective alternative is proposed The method of leading edge tracking is explained, where by using coherent pulse Doppler system the power drainage is reduced from watts to milliwatts and the error margin to 2-3 feet The problem of ignoring sudden and anomalous changes in altitude is solved by introducing a logic design which keeps the altimeter locked when travelling at sufficiently high speed All the transmitters and the receivers used in the above system are designed to be repairable and replaceable The antennas involved are factory pretuned to 4 5 MHz and are compact and easily installable A Y

A77 19247 , **The dynamics of STOL /The Daniel and Florence Guggenheim Lecture/** R D Hiscocks (National Research Council, Ottawa, Canada) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76 01* 13 p 23 refs

Aspects of the aeronautical history in Canada are examined, taking into account investigations conducted by Turnbull, contributions made by Bell, the significance of air transportation for Canada, developments related to high lift and controllability at low airspeeds, and the employment of small STOL aircraft With STOL aircraft it is feasible to operate between a small community airport and special assigned runways at a major center without conflict with heavy traffic Handicaps for short range STOL related to aerial navigation problems are pointed out and approaches for overcoming these handicaps are considered Attention is given to the development of new materials for aircraft construction, the economic justification for STOL, and the characteristics of the next generation of STOL G R

STAR ENTRIES

N77-13979# Boeing Aerospace Co , Seattle Wash
AERODYNAMIC DESIGN
Ian H Rettie *In* Md Univ Air Transportation for the 1980's, Jun 1976 p 115-152 Presented at College Park Md 14 Oct 1975
Avail NTIS HC A17/MF A01

The aerodynamic design of the wide-body type aircraft is discussed with a view toward better performance and more efficient commercial services L S

N77-13980# Pratt and Whitney Aircraft, East Hartford, Conn Engineering Dept
AIR TRANSPORT PROPULSION FOR THE 1980'S
J W Witherspoon *In* Md Univ Air Transportation for the 1980 s Jun 1976 p 153-225 Presented at College Park Md 11 Nov 1975
Avail NTIS HC A17/MF A01

Turbofan engine technology is discussed for use in present and future wide-body aircraft L S

N77-13981# Douglas Aircraft Co Inc , Santa Monica, Calif
STRUCTURES AND MATERIALS
Melvin Stone *In* Md Univ Air Transportation for the 1980 s, Jun 1976 p 227-264 Presented at College Park Md 2 Dec 1975
Avail NTIS HC A17/MF A01

Aircraft design is discussed with emphasis on structural improvements of advanced composites A state of the art is given for aircraft structures and materials L S

N77-13982# Lockheed-Georgia Co Marietta
EFFECTS OF ARTIFICIAL STABILITY ON CONFIGURATION DESIGN
Roy H Lange *In* Md Univ Air Transportation for the 1980 s Jun 1976 p 265-315 refs Presented at College Park Md 23 Mar , 1976
Avail NTIS HC A17/MF A01

Applications of advanced technology to the design of future transport aircraft show the potential to provide significant improvements in performance and economics of such aircraft A presentation is given to identify current activities in active controls describe the preliminary design integration process and discuss applications of active controls technology in design including a specific redesign study conducted on the Lockheed JetStar airplane Author

N77-13983# United Aircraft Corp East Hartford Conn
ADVANCED HELICOPTER DESIGNS
Raymond F Donovan *In* Md Univ Air Transportation for the 1980's, Jun 1976 p 317-352 Presented at College Park, Md 6 Apr 1976 (For primary document see N77-13975 05-01)
Avail NTIS HC A17/MF A01

Techniques are discussed as solutions to problems pertaining to helicopter design A 'state of the art is given on helicopter design L S

N77-13985*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
SCANNING LASER-VELOCIMETER SURVEYS AND ANALYSIS OF MULTIPLE VORTEX WAKES OF AN AIRCRAFT
Victor R Corsiglia and Kenneth L Orloff Aug 1976 33 p refs
(NASA-TM-X-73169 A-6750) Avail NTIS HC A03/MF A01 CSCL 01A

A laser velocimeter capable of rapidly scanning a flow field while simultaneously sensing two components of the velocity was used to measure the vertical and streamwise velocity structure 1 5 spans downstream in the wake of a model typical of a large subsonic transport (Boeing 747) This flow field was modeled by a superposition of axisymmetric vortices with finite cores This theoretical model was found to agree with the measured velocities everywhere except where two vortices were in close proximity Vortex strengths derived from the span loading on the wing as predicted by vortex-lattice theory also agree with the present measurements The axisymmetric vortex model used herein is a useful tool for analytically investigating the vortex wakes of aircraft Author

N77-13988*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
PRELIMINARY STUDY OF EFFECTS OF WINGLETS ON WING FLUTTER
Robert V Doggett, Jr and Moses G Farmer Washington Dec 1976 25 p refs
(NASA-TM-X-3433 L-10963) Avail NTIS HC A02/MF A01 CSCL 01A

Some experimental flutter results are presented over a Mach number range from about 0 70 to 0 95 for a simple, swept tapered, flat-plate wing model having a planform representative of subsonic transport airplanes and for the same wing model equipped with two different upper surface winglets Both winglets had the same planform and area (about 2 percent of the basic-wing area) however, one weighed about 0 3 percent of the basic-wing weight and the other weighed about 1 8 percent of the wing weight The addition of the lighter winglet reduced the wing-flutter dynamic pressure by about 3 percent the heavier winglet reduced the wing-flutter dynamic pressure by about 12 percent The experimental flutter results are compared at a Mach number of 0 80 with analytical flutter results obtained by using doublet-lattice and lifting-surface (kernel-function) unsteady aerodynamic theories Author

N77-13989*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
WING SURFACE-JET INTERACTION CHARACTERISTICS OF AN UPPER-SURFACE BLOWN MODEL WITH RECTANGULAR EXHAUST NOZZLES AND A RADIUS FLAP
Alvin M Bloom (George Washington Univ), William C Hohlweg (George Washington Univ), and William C Sleeman, Jr Washington Dec 1976 82 p
(NASA-TN-D-8187, L-10410) Avail NTIS HC A05/MF A01 CSCL 01A

The wing surface jet interaction characteristics of an upper surface blown transport configuration were investigated in the Langley V/STOL tunnel Velocity profiles at the inboard engine center line were measured for several chordwise locations and chordwise pressure distributions on the flap were obtained The model represented a four engine arrangement having relatively high aspect ratio rectangular spread, exhaust nozzles and a simple trailing edge radius flap Author

N77-13990*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF 45 DEG SWEPT WINGS AT MACH APPROXIMATELY 0
John E Lamar Sep 1976 46 p
(NASA-TM-X-73942) Avail NTIS HC A03/MF A01 CSCL 01A

Wind tunnel tests were conducted in the Langley 7 x 10 foot wind tunnel at Mach numbers less than 0 20 and at Reynolds numbers less than 3 74 million The effect of the aft area on the 45 deg swept wing longitudinal aerodynamic characteristics at low subsonic speeds and at an angle of attack range from approximately -2 deg to 28 deg was studied The data are presented without analysis Author

N77-13991# Systems Research Labs Inc Newport News, Va Rasa Div
AN EXPERIMENTAL INVESTIGATION OF VORTEX FLOW CONTROL FOR HIGH LIFT GENERATION Interim Report, 1 Jan - 31 Dec 1975
Richard P White Jr and John C Balcerak Dec 1975 210 p refs
(Contract N00014-74-C-0091 NR Proj 212-223)
(AD-A027524 RASA/SRL-14-76-2 ONR-CR212-223-2) Avail NTIS HC A10/MF A01 CSCL 20/4

An experimental research program was conducted to investigate methods of improving the performance characteristics of low-aspect ratio swept-wing surfaces in the post-stall region Wind tunnel tests were conducted with an unmodified wing panel and with snags strakes and combinations thereof affixed to the panel The prediction of changes in the performance characteristics by simplified theoretical analyses is discussed with regard to the observed complexity of the flow field produced by the vortex generators GRA

N77-13994# Naval Surface Weapons Center Dahlgren, Va
SIMPLIFIED SOLUTION OF THE COMPRESSIBLE SUBSONIC LIFTING SURFACE PROBLEM
J W Purvis May 1976 36 p refs
(AD-A027514 NSWC/DL-TR-3487) Avail NTIS HC A03/MF A01 CSCL 01/3

A new technique for determining the spanwise and chordwise distribution of load on thin finite wings in compressible subsonic flow is presented The method is based on the application of planar lifting surface theory Classical theoretical results are used to define functions for the pressure coefficient distribution and a new technique is presented for evaluating the kernel function integral Analytical results are compared with experimental data and with solutions from a standard numerical integration method of applying lifting surface theory Excellent correlation with experimental results is obtained for Mach numbers up to 0 80 to 0 85 for thin wings Advantages of the new technique as opposed to other methods are also presented GRA

N77-13995# Nielsen Engineering and Research, Inc , Mountain View, Calif
INVESTIGATION OF AERODYNAMIC LOADS AT SPIN ENTRY Annual Report, 1 Apr 1975 - 1 May 1976
Selden B Spangler and Marnix F E Dillenius 28 May 1976 37 p refs
(Contract N00014-74-C-0344 NR Proj 212-225, RF41411801)
(AD-A026989, NEAR-TR-117, ONR-CR212-225-2) Avail NTIS HC A03/MF A01 CSCL 01/1

The second year s work is summarized on an investigation of the aerodynamic load distribution on fighter-bomber type aircraft at incipient spin entry flight conditions The principal tasks were development of an asymmetric vortex-lattice computer program for a wing-body in combined pitch and sideslip and water tunnel tests on realistic aircraft nose models The technical approach on the vortex-lattice program is described, and typical calculative results are shown The tunnel test program is described A cooperative test program between ONR and Langley Research Center, NASA, to obtain simultaneous force and moment and flow field measurements on a generalized figher model at high angles of attack is described Computer methods have been developed for vortex shedding from circular noses, for the wing-body loads induced by an arbitrary distribution of nose vortices, and for afterbody and tail loads The principal missing features are noncircular nose effects and detailed experimental data to check the methods Author (GRA)

N77-13997# Aeronautical Research Associates of Princeton Inc N J
INTERACTIONS AND MERGING OF LINE VORTICES Final Report, 1 Jan - 31 Dec 1975
Alan J Bilanin Richard S Snedeker, and Milton E Teske Feb 1976 47 p refs
(Contract F44620-75-C-0051 AF Proj 9781)
(AD-A027717 ARAP-276 AFOSR-76-0873TR) Avail NTIS HC A03/MF A01 CSCL 20/4

The results of a theoretical and experimental study of the interactions between adjacent line vortices are presented Particular emphasis is given to the process of merging or pairing in which two vortices of like sign coalesce to form a single vortex Merging is discussed in terms of its importance to the growth and aging of turbulent shear layers and aircraft wakes Flow visualization experiments are described in which merging was observed by means of smoke injected into a wind tunnel flow Vortex pairs of like sign and equal strength, varying sign and strength and opposite sign and equal strength were studied Good qualitative agreement is found between the observed flow patterns and those calculated by means of a computer code GRA

N77-13998# Frankford Arsenal, Philadelphia, Pa
WAKE REGION PERTURBATION FOR BASE DRAG REDUCTION
Walter J Puchalski and James F Kowalick 1976 6 p refs
(AD-A026147) Avail NTIS HC A02/MF A01 CSCL 19/4

Fumer technology promises beneficial results in terms of imparting terminal effects characteristics to selected ammunition Fumers should not be employed, however, strictly to reduce time of flight Fumer projectiles at a selected range have considerably higher striking energy, and should therefore be considered for use where marginal penetration performances are expected An optimized fumer round would ideally have some degree of programmed burning of the pyrotechnic composition inherent in its design A good fumer must produce low molecular weight gases at very high temperatures Generally speaking, the use of fumers makes sense if the projectile in question is optimized with respect to its contour (low drag shape) A practical compromise would appear to be a ballistically sound projectile having an optimized contour (low drag shape) and a tracer element which serves both as a fire control aid (bright tracer) and as a fumer GRA

N77-14000# Lincoln Lab Mass Inst of Tech Lexington
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, No 18, 1 Apr - 30 Jun 1976
1 Jul 1976 40 p
(Contracts DOT-FA72WAI-261 F19628-76-C-0002)
(AD-A030368/5 FAA-RD-76-126) Avail NTIS HC A03/MF A01 CSCL 17/7

This is the eighteenth Discrete Address Beacon System Quarterly Technical Summary covering the period 1 April through 30 June 1976 Included are the results to date of analytical studies, laboratory and flight experiments and software developments supporting the concept feasibility and performance definition phase of the FAA DABS Program Author

N77-14002# Federal Aviation Administration Washington D C
A COMPARISON OF AIR RADIONAVIGATION SYSTEMS (FOR HELICOPTERS IN OFF-SHORE AREAS) Final Report
George H Quinn Aug 1976 20 p
(AD-A030337/0 FAA-RD-76-146) Avail NTIS HC A02/MF A01 CSCL 17/7

The technical potential of ten navigation systems that may meet specific IFR en route navigation requirements for helicopters operating in off-shore areas is examined Technical factors considered essential for navigation are (1) operational range (2) *operational altitude* (3) *accuracy and* (4) *reliability* Estimated user equipment cost was included because of its importance in system selection Author

N77-14003# Facility Checking Squadron (1866th) (AFCS) Richards-Gebaur AFB, Mo
TRACALS EVALUATION REPORT GROUND/AIR/GROUND COMMUNICATIONS SPECIAL EVALUATION REPORT, SHEPPARD AFB, TEXAS Final Report
Bruce E Wallachy 24 May 1976 100 p ref
(AD-A026823, Rept-76/66S/59) Avail NTIS HC A05/MF A01 CSCL 17/7

The purpose of the evaluation was to determine the reasons for and resolve complaints against the ATC communications system This report summarizes and recommends solutions to problems concerning airfield blind spots frequency accuracy of receiver equipment RSU receiver frequency drift, intermittent communications in T-37 training areas signal generator test equipment noise interference in VHF frequency spectrum and AN/GRR-25 versus AN/GRR-24 performance Other information included specifies coverage data, and equipment performance The results and tests presented in this report can be used with similar equipment and systems GRA

N77-14004# Federal Aviation Administration Washington D C Air Traffic Service
PERFORMANCE MEASUREMENT SYSTEM FOR MAJOR AIRPORTS Final Report
Bobby J Woods and Allan R Tobiason Nov 1975 263 p refs
(AD-A026224) Avail NTIS HC A12/MF A01 CSCL 17/7

This document summarizes the findings and implemented version of the Air Traffic Control Performance Measurement System (PMS) for major airports Airports covered are Atlanta Hartsfield, Boston Logan Cleveland Hopkins Washington National, Denver Stapleton, Dallas Fort Worth Regional Newark International John F Kennedy International Los Angeles International LaGuardia Miami International, O Hare International Philadelphia International Pittsburgh Greater San Francisco International and St Louis Lambert PMS uses as its standard of measure a quantitatively derived version of airport capacity termed an Engineered Performance Standard (EPS)
Author (GRA)

N77-14006# Mitre Corp McLean, Va
MULTI-SITE INTERMITTENT POSITIVE CONTROL ALGORITHMS FOR THE DISCRETE ADDRESS BEACON SYSTEM, REVISION 2
A L *McFarland, K R Patel and D L Roberts* May 1976 241 p refs Revised
(Contract DOT-FA70WA-2448)
(AD-A026515, MTR-6742-CH-2, FAA-EM-74-4-Ch-2) Avail NTIS HC A11/MF A01

This document presents complete detailed computer algorithms for implementing Intermittent Positive Control (IPC) within a multi-site Discrete Address Beacon System (DABS) network This document is to be used by the Federal Aviation Administration to specify the IPC system which is to be provided as an integral part of the DABS Phase 2 system by the DABS System Development Contractor Author (GRA)

N77-14007*# McDonnell Aircraft Co St Louis Mo
SIMULATION TEST RESULTS FOR LIFT/CRUISE FAN RESEARCH AND TECHNOLOGY AIRCRAFT
Michael P Bland and Roman K Konsewicz 6 Dec 1976 132 p refs
(Contract NAS2-9144)
(NASA-CR-137979 MDC-A4439) Avail NTIS HC A07/MF A01 CSCL 01C

A flight simulation program was conducted on the flight simulator for advanced aircraft (FSAA) The flight simulation was a part of a contracted effort to provide a lift/cruise fan V/STOL aircraft mathematical model for flight simulation The simulated aircraft is a configuration of the Lift/Cruise Fan V/STOL research technology aircraft (RTA) The aircraft was powered by three gas generators driving three fans One lift fan was installed in the nose of the aircraft, and two lift/cruise fans at the wing root The thrust of these fans was modulated to provide pitch and roll control, and vectored to provide yaw, side force control and longitudinal translation Two versions of the RTA were defined One was powered by the GE J97/LF460 propulsion system which was gas-coupled for power transfer between fans for control The other version was powered by DDA XT701 gas generators driving 62 inch variable pitch fans The flight control system in both versions of the RTA was the same Author

N77-14008# Dayton Univ Ohio School of Engineering
LANDING GEAR/SOIL INTERACTION DEVELOPMENT OF CRITERIA FOR AIRCRAFT OPERATION ON SOIL DURING TURNING AND MULTIPASS OPERATIONS Final Report, 1 Jan 1974 - 15 May 1975
David C Kraft and Norman S Phillips Wright-Patterson AFB, Ohio AFFDL Oct 1975 175 p refs
(Contract F33615-73-C-3023, AF Proj 1369)
(AD-A027422 AFFDL-TR-75-78) Avail NTIS HC A08/MF A01 CSCL 08/13

The continuing design and operational requirements for military aircraft to operate on unimproved runways has led to the need to investigate those landing gear/soil runway parameters which most significantly influence performance This report summarized those activities accomplished during the second year *of a two-year research effort concerned with the development* of criteria for turning operation at high speed, and multipass operation The work reported was conducted in several areas The turned tire test data was completely analyzed and predictive equations incorporated into the turning program A limited parametric study was conducted for three classes of vehicles to calculate wheel force ratios as functions of runway width required A multipass test program was conducted at the Army Engineers Waterways Experiment Station to measure the response of rolling and braked tires in alternating paths The data was reduced and predictive equations evolved from rut depths as a function of first pass response and subsequent path and braking Limited start-up force data were examined to determine a preliminary estimate of start-up drag ratios A soft tire/soil computer program was developed to study roughness effects GRA

N77-14011# Sikorsky Aircraft, Stratford Conn
INVESTIGATION OF ADVANCED HELICOPTER STRUCTURAL DESIGNS VOLUME 1 ADVANCED STRUCTURAL COMPONENT DESIGN CONCEPTS STUDY Final Report
Melvin J Rich May 1976 193 p refs
(Contract DAAJ02-74-C-0061 DA Proj 1F2-62208-AH-90)
(AD-A026246 SER-50929-Vol-1,
USAAMRDL-TR-75-59A-Vol-1) Avail NTIS HC A09/MF A01

Design studies have shown that weight and cost of a medium-size utility helicopter can be reduced through application of advanced concepts and materials A baseline helicopter of conventional design was compared with designs employing advanced concepts and materials for the same gross weight Results showed that weight empty (less engines avionics contingency) was reduced 12% cost was reduced 3%, and payload was increased 70% (960 to 1 634 pounds) By incorporating the advanced concepts and materials into the initial design for the same payload, even greater reductions were found in weight and cost Gross weight was reduced 14% weight empty (less engines avionics contingency) 21%, and weight empty costs 14% A risk and feasibility assessment was made for the airframe and landing gear rotor and control system and transmission structures The airframe and landing gear were found to be of medium risk and feasibility Rotor and control system risk is low and feasibility is high The transmission structures have medium risk and high feasibility GRA

N77-14012# Sikorsky Aircraft Stratford Conn
INVESTIGATION OF ADVANCED HELICOPTER STRUCTURAL DESIGNS VOLUME 2 FREE PLANETARY TRANSMISSION DRIVE Final Report, 20 Jan - 20 Jul 1975
A Korzun May 1976 100 p refs
(Contract DAAJ02-74-C-0061 DA Proj 1F2-62208-AH-90)
(AD-A026247 SER-50932-Vol-2
USAAMRDL-TR-75-59B-Vol-2) Avail NTIS HC A05/MF A01 CSCL 01/3

This volume investigates the free planetary transmission as applied to a utility transport helicopter High-power rotary speed reduction gearing in helicopter transmissions usually takes the form of conventional epicyclic planetary reduction units Research and development has led to development of the free planet transmission concept This type of drive compared with conventional two-stage planetary transmissions, promises several advantages including 10% lighter weight 16 5% lower cost in 500-unit quantities, 1/2 percent greater efficiency almost twice the reliability and greater tolerance to loss of lubrication GRA

N77-14013# Naval Ship Research and Development Center, Bethesda Md Aviation and Surface Effects Dept
A CONTROL SYSTEM FOR THE WIND TUNNEL MODEL OF A REVERSE-BLOWING CIRCULATION CONTROL ROTOR (RB-CCR)
Kenneth R Reader May 1976 39 p refs
(AD-A026548, DTNSRDC/ASED-1215) Avail NTIS HC A03/MF A01 CSCL 01/3

A pneumatic valving system has been developed to provide cyclic and collective control inputs for a circulation control type rotor over an advance ratio range of 0 to 2 0 The design method and experimental techniques utilized in developing the control system for a wind tunnel model of the reverse-blowing circulation control rotor (RB-CCR) are discussed and a tradeoff is presented between two control systems which have potential for the necessary requirements A cam-collector nozzle system is considered a better choice for the model rotor configuration than a cam-collector ring control system It was concluded that a system to control the RB-CCR wind tunnel model can be designed by employing the proper area relationships and adhering to a simple design procedure Author (GRA)

N77-14014# Army Missile Research Development and Engineering Lab Redstone Arsenal, Ala Guidance and Control Directorate
AH-1 HELICOPTER VIBRATION LEVELS FOR STUB WING MOUNTED EQUIPMENT
Gordon D Welford and Joseph S Boland III Sep 1975 148 p
(AD-A026825 RG-76-30) Avail NTIS HC A07/MF A01 CSCL 01/3

This report presents measured translational and angular acceleration inputs to stub wing mounted equipment on the AH-1 helicopter In this case the wing mounted electro-optical systems were the stabilized platform airborne laser system and the stabilized mirror airborne laser system The data are presented in the form of power spectral density, amplitude versus frequency, and oscillograph charts GRA

N77-14015# Naval Intelligence Support Center Washington D C Translation Div
AB 212 ASW NEW MULTIPURPOSE HELICOPTER FOR ITALIAN NAVY
22 Jun 1976 9 p Transl into ENGLISH from Riv Marittima (Italy) Mar 1976 p 140-144
(AD-A026861 NISC-Trans-3815) Avail NTIS HC A02/MF A01 CSCL 01/3

The AB 212 ASW is a four-seat, all-weather single-rotor and twin-turbine naval aircraft entirely made of metal Specifications are as follows length-17 39 m, width-2 85 m rotor diameter-14 63 m, height (with rotor stopped)-4 01 m, and empty weight-3,420 kg GRA

N77-14016# Naval Postgraduate School, Monterey, Calif
A STUDY OF THE FAILURE OF JOINTS IN COMPOSITE MATERIAL FUEL CELLS DUE TO HYDRAULIC RAM LOADING M S Thesis
Henry Speer Ezzard, Jr Jun 1976 81 p refs
(AD-A027258) HC A05/MF A01 CSCL 01/3

The objectives of this research were to show the relative importance of the transverse shearing forces, the bending moments and the tensile forces produced by hydraulic ram loading on military aircraft fuel tank joint designs for composite materials, and to present fuel tank test section designs With the use of a finite element analysis, it was shown that the transverse shearing force may be major cause of attachment failure of composites, primarily by an unzipping or pull out mode of failure It was also shown that failure criteria for transverse shearing stresses in composites are lacking By comparing several specific aircraft design concepts, designs for a wing fuel test tank and a fuselage fuel test tank were selected Simplicity, similarity to actual aircraft fuel tanks, and uniformity between experiments were primary considerations in the selection Author (GRA)

N77-14017# Army Material Systems Analysis Activity, Aberdeen Proving Ground, Md
DESIGN COMPARISON BETWEEN HELICOPTER AND TILT ROTOR AIRCRAFT
R R Oehrli Feb 1976 43 p refs
(DA Proj 1R7-65706-M-541)
(AD-A027559 AMSAA-TR-153) Avail NTIS HC A03/MF A01 CSCL 01/3

A version of the AMSAA helicopter design program has been modified to include a tilt rotor analysis This modification includes addition of a rotor strip theory performance analysis in the rigid mode A series of studies have recently been completed with this analysis and this note has been prepared as a record of the procedures used A discussion of the analysis and some example problems are shown These indicate the size trade offs that are required to obtain the high speed advantage of a typical tilt rotor compared to a helicopter Author (GRA)

N77-14018# Applied Physics Lab , Johns Hopkins Univ , Laurel, Md

STRUCTURAL STUDIES OF OBLIQUE FOLDING WINGS

R M Rivello Apr 1976 65 p refs
(Contract N00017-72-C-4401)
(AD-A025712 APL/JHU/TG-1296) Avail NTIS HC A04/MF A01 CSCL 16/4

Design studies on an oblique folding wing for a 34-in -diameter, subsonic, cruise-type missile are described Aeroelastic divergence and load amplification are investigated It is found that divergence is not a problem but load buildup on the forward-swept wing and load reduction on the aft-swept wing result in large rolling moments Design studies of the wing pivot indicate that a Conrad four-point bearing and a torsion-spring actuator should result in a lightweight, reliable and inexpensive fold mechanism Weights and volumes of the oblique wing design are computed and compared with results of previous studies of swing-wing and wraparound wing configurations The wraparound wing is found to be the lightest and provides the greatest fuel volume Author (GRA)

N77-14019*# Sperry Flight Systems, Phoenix, Ariz

STOLAND Final Report

John Grgurich and Peter Bradbury Nov 1976 157 p refs
(Contract NAS2-6567)
(NASA-CR-137972) Avail NTIS HC A04/MF A01 CSCL 01C

The STOLAND system includes air data navigation, guidance flight director (including a throttle flight director on the Augmentor Wing) 3-axis autopilot and autothrottle functions The 3-axis autopilot and autothrottle control through parallel electric servos on both aircraft and on the augmentor wing the system also interfaces with three electrohydraulic series actuators which drive the roll control surfaces, elevator and rudder The system incorporates automatic configuration control of the flaps and nozzles on the augmentor wing and of the flaps on the Twin Otter Interfaces are also provided to control the wing flap chokes on the Augmentor Wing and the spoilers on the Twin Otter The STOLAND system has all the capabilities of a conventional integrated avionics system Aircraft stabilization is provided in pitch roll and yaw including control wheel steering in pitch and roll The basic modes include altitude hold and select, indicated airspeed hold and select flight path angle hold and select, and heading hold and select The system can couple to TACAN and VOR/DME na aids for conventional radial flying Author

N77-14021# Naval Air Engineering Center Lakehurst, N J Ground Support Equipment Dept

DATA ITEM DESCRIPTION FOR ACQUISITION OF DETAILED PERFORMANCE CHARACTERISTICS AND SIGNAL TRACING DIAGRAMS FOR ELECTRONICS Final Report

T McGrath 30 Apr 1976 84 p refs
(AD-A026953, NAEC-GSED-Misc-0183-Rev-1-A) Avail NTIS HC A05/MF A01 CSCL 14/2

The report describes how to record performance characteristics for Avionic UUTs (Units Under Test) in such a fashion that these characteristics can be computer manipulated It also describes additional documentation required for the proper testing and fault isolation of UUT's GRA

N77-14023# Defense Systems Management School Fort Belvoir, Va

ADVANCED AVIONICS FOR THE A-10 A DECISION ANALYSIS MODEL

Jackson A Thomas May 1975 49 p refs
(AD-A027678) Avail NTIS HC A03/MF A01 CSCL 09/3

Using decision analysis techniques a generic decision model for potential avionics enhancements to the A-10 aircraft is developed Five generic avionics additions and the baseline single seat aircraft are considered in the decision model Aspects of systems acquisition and the impact of war are also incorporated The model developed provides the basis for a flexible management tool that can assist the program manager in reaching a decision, if one should be required concerning avionics additions to the A-10 aircraft The model demonstrates how the decision analysis techniques can be applied to an unstructured decision problem encountered in program management Author (GRA)

N77-14024# Illinois Univ Urbana-Champaign Aviation Research Lab

A VERSATILE COMPUTER-GENERATED DYNAMIC FLIGHT DISPLAY

Bruce Arthur Artwick May 1976 78 p refs
(Contract N00014-76-C-0081 NR Proj 196-133)
(AD-A027419 ARL-76-5/ONR-76-1) Avail NTIS HC A05/MF A01 CSCL 01/4

This report describes a real-time, dynamic, computer-driven visual display program which is written in the FORTRAN programming language Versatility efficiency and ease of use are stressed in the development, resulting in an easy to interface to dynamic display which can be implemented economically with a bare minimum of graphics hardware and a sixteen bit mini-computer which has FORTRAN capabilities Modular structure is stressed and speedup methods are discussed including the use of a matrix multiplier A unique frame synthesizing feature is described in detail Sample data base structures and display images conclude the report Author (GRA)

N77-14025* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

DUAL OUTPUT VARIABLE PITCH TURBOFAN ACTUATION SYSTEM Patent

Robert H Griswold, Jr (GE, Cincinnati) and Carl L Broman, inventors (to NASA) (GE Cincinnati) Issued 30 Nov 1976 10 p Filed 21 May 1975 Sponsored by NASA
(NASA-Case-LEW-12419-1 US-Patent-3 994,128 US-Patent-Appl-SN-579375, US-Patent-Class-60-226R, US-Patent-Class-416-160 US-Patent-Class-416-162, US-Patent-Class-416-165 US-Patent-Class-416-167, US-Patent-Class-416-153) Avail US Patent Office CSCL 21E

An improved actuating mechanism was provided for a gas turbine engine incorporating fan blades of the variable pitch variety, the actuator adapted to rotate the individual fan blades within apertures in an associated fan disc The actuator included means such as a pair of synchronizing ring gears, one on each side of the blade shanks and adapted to engage pinions disposed thereon Means were provided to impart rotation to the ring gears in opposite directions to effect rotation of the blade shanks in response to a predetermined input signal In the event of system failure, a run-away actuator was prevented by an improved braking device which arrests the mechanism

Official Gazette of the U S Patent Office

N77-14026*# United Technologies Corp , East Hartford, Conn

COST/BENEFIT ANALYSIS OF ADVANCED MATERIALS TECHNOLOGIES FOR FUTURE AIRCRAFT TURBINE ENGINES

J W Bisset Nov 1976 38 p refs
(Contract NAS3-20072 et al)
(NASA-CR-135107 PWA-5453) Avail NTIS HC A03/MF A01 CSCL 21E

The cost/benefits of advance commercial gas turbine materials are described Development costs estimated payoffs and probabilities of success are discussed The materials technologies investigated are (1) single crystal turbine blades, (2) high strength hot isostatic pressed turbine disk (3) advanced oxide dispersion strengthened burner liner (4) bore entry cooled hot isostatic pressed turbine disk, (5) turbine blade tip - outer airseal system, and (6) advance turbine blade alloys M C F

N77-14027*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

FURTHER STUDIES OF STATIC TO FLIGHT EFFECTS ON FAN TONE NOISE USING INLET DISTORTION CONTROL FOR SOURCE IDENTIFICATION

Brent K Hodder Dec 1976 42 p refs Prepared in cooperation with Army Air Mobility R and D Lab Moffett Field, Calif
(NASA-TM-X-73183, A-6821) Avail NTIS HC A03/MF A01 CSCL 20A

Current experimental investigations have linked static inflow distortion phenomena such as the ground vortex, atmospheric turbulence, and teststand structure interference to the generation of fan tone noise at the blade passing frequency Since such distortions do not exist in flight it is important to remove them from the static test environment and thereby improve the static-to-flight tone-noise correlation In the course of providing evidence for this position, a recent investigation used a distortion control inlet with a modern day turbofan engine to assess atmospheric turbulence effects Although the initial results were encouraging, they were incomplete The present investigation continues this work and shows more completely the effect of atmospheric turbulence on tone-noise generation Further use is made of the distortion control inlet to identify other competing tone-noise sources in the test engine such as a rotor-core stator interaction which was confirmed by engine modifications Author

N77-14029*# Boeing Commercial Airplane Co , Seattle Wash Dept of Preliminary Design

ENERGY CONSUMPTION CHARACTERISTICS OF TRANSPORTS USING THE PROP-FAN CONCEPT Final Report

Oct 1976 147 p refs
(Contract NAS2-9104)
(NASA-CR-137937, D6-75780) Avail NTIS HC A07/MF A01 CSCL 01C

The fuel saving and economic potentials of the prop-fan high-speed propeller concept were evaluated for twin-engine commercial transport airplanes designed for 3333 6 km range 180 passengers, and Mach 0 8 cruise A fuel saving of 9 7% at the design range was estimated for a prop-fan airplane having wing-mounted engines, while a 5 8% saving was estimated for a design having the engines mounted on the aft body The fuel savings and cost were found to be sensitive to the propeller noise level and to aerodynamic drag effects due to wing-slipstream interaction Uncertainties in these effects could change the fuel savings as much as + or - 50% A modest improvement in direct operating cost (DOC) was estimated for the wing-mounted prop-fan at current fuel prices This improvement could become substantial in the event of further relative increases in the price of oil The improvement in DOC requires the achievement of the nominal fuel saving and reductions in propeller and gearbox maintenance costs relative to current experience Author

N77-14030*# Boeing Commercial Airplane Co Seattle, Wash Dept of Preliminary Design

ENERGY CONSUMPTION CHARACTERISTICS OF TRANSPORTS USING THE PROP-FAN CONCEPT SUMMARY REPORT Final Report

Nov 1976 50 p refs
(Contract NAS2-9104)
(NASA-CR-137938, D6-75780) Avail NTIS HC A03/MF A01 CSCL 01C

For abstract, see N77-14029

N77-14031*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

SMALL, LOW COST, EXPENDABLE TURBOJET ENGINE 2 PERFORMANCE CHARACTERISTICS

Robert P Dengler and Lawrence E Macioce Washington Dec 1976 31 p refs
(NASA-TM-X-3463, E-8775) Avail NTIS HC A03/MF A01 CSCL 21E

A small experimental axial-flow turbojet engine was tested at sea level static conditions and over a range of simulated flight conditions to evaluate its performance as well as to demonstrate the feasibility of low-cost concepts utilized in its design Testing was conducted at engine speeds as high as 37,000 rpm and at turbine inlet temperatures as high as 1,272 K For maximum speed the engine produced a net thrust of 3 118 newtons at sea level static operation and 2 318 newtons at its cruise condition of M0 = 0 8 and 6 096 meters Data obtained over a range of inlet Reynolds number indexes for nominal M0 of 0 38 revealed similar effects or trends on compressor characteristics of those previously established for much larger engines Author

N77-14035# Air Force Flight Dynamics Lab Wright-Patterson AFB, Ohio

ANALYSIS OF INHERENT ERRORS IN ASYNCHRONOUS REDUNDANT DIGITAL FLIGHT CONTROL SYSTEMS Final Report, 9 Jun - 31 Oct 1975

Vincent J Darcy and Charles R Slivinsky Apr 1976 154 p refs
(AF Proj 2049)
(AD-A026954 AFFDL-TR-76-16) Avail NTIS HC A08/MF A01 CSCL 01/4

The concept of skewed sampling is developed and a single-rate closed-loop state variable model for realistic aircraft control loops is developed Using this model a covariance analysis of the channel differences is given This statistical treatment is based on filtered white noise external inputs, but it is shown how such inputs can be used to generate signals which approximate the true system external inputs The model and the analysis are general and applicable to a variety of systems A user-oriented software package using FORTRAN is developed to facilitate the required computations and to allow parametric studies of the effect on inherent errors of control system gains, time constants, sample time and other parameters The analysis is applied to several examples including time and other parameters The analysis is applied to several examples, including a study of inherent errors in an asynchronous dual-redundant digital version of the A-7D pitch-axis control augmentation system GRA

N77-14037*# McDonnell Aircraft Co , St Louis, Mo

MATHEMATICAL MODEL FOR LIFT/CRUISE FAN V/STOL AIRCRAFT SIMULATOR PROGRAMMING DATA

M P Bland B Fajfar, and R K Konsewicz 6 Dec 1976 263 p
(Contract NAS2-9144)
(NASA-CR-151916 MDC-A4571) Avail NTIS HC A12/MF A01 CSCL 14B

Simulation data are reported for the purpose of programming the flight simulator for advanced aircraft for tests of the lift/cruise fan V/STOL Research Technology Aircraft These simulation tests are to provide insight into problem areas which are encountered in operational use of the aircraft A mathematical model is defined in sufficient detail to represent all the necessary pertinent aircraft and system characteristics The model includes the capability to simulate two basic versions of an aircraft propulsion system (1) the gas coupled configuration which uses insulated air ducts to transmit power between gas generators and fans in the form of high energy engine exhaust and (2) the mechanically coupled power system which uses shafts clutches, and gearboxes for power transmittal Both configurations are modeled such that the simulation can include vertical as well as rolling takeoff and landing, hover powered lift flight, aerodynamic flight and the transition between powered lift and aerodynamic flight Author

N77-14205*# Lockheed-California Co Burbank
DEVELOPMENT OF FIRE RESISTANT, NONTOXIC AIRCRAFT INTERIOR MATERIALS Technical Report, 21 Jun 1975 - 30 Sep 1976
G Haley B Silverman, and Y Tajima Sep 1976 91 p refs (Contract NAS2-8835)
(NASA-CR-137920) Avail NTIS HC A05/MF A01 CSCL 11D

All available newly developed nonmetallic polymers were examined for possible usage in developing fire resistant nontoxic nonmetallic parts or assemblies for aircraft interiors Specifically, feasibility for the development of clear films for new decorative laminates compression moldings, injection molded parts, thermoformed plastic parts and flexible foams were given primary considerations Preliminary data on the flame resistant characteristics of the materials were obtained Preliminary toxicity data were generated from samples of materials submitted from the contractor Author

N77-14206*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
THERMOPLASTIC POLYMERS FOR IMPROVED FIRE SAFETY
Demetrius A Kourtides John A Parker and C J Hilado Nov 1976 56 p refs
(NASA-TM-X-73185, A-6832) Avail NTIS HC A04/MF A01 CSCL 11D

The thermochemical and flammability characteristics of some typical thermoplastic materials currently in use and others being considered for use in aircraft interiors are described The properties studied included (1) thermomechanical properties such as glass transition and melt temperature (2) changes in polymer enthalpy by differential scanning calorimetry, (3) thermogravimetric analysis in anaerobic and oxidative environments, (4) oxygen index, (5) smoke evolution (6) relative toxicity of the volatile products of pyrolysis and (7) selected physical properties Author

N77-14213# Goodyear Aerospace Corp , Litchfield Park, Ariz
ENVIRONMENTAL RESISTANCE OF COATED AND LAMINATED POLYCARBONATE TRANSPARENCIES Final Technical Report, Nov 1973 - Jul 1975
Richard A Huyett and Glenn E Wintermute Mar 1976 150 p
(Contract F33615-74-C-5005 AF Proj 7381)
(AD-A026412, GERA-2119 AFML-TR-76-24) Avail NTIS HC A07/MF A01 CSCL 01/3

This report covers a program conducted to assess the environmental resistance characteristics of selected coated polycarbonate and acrylic/interlayer/polycarbonate composite aircraft windshield materials when exposed to aggressive laboratory accelerated and outdoor environmental testing Author (GRA)

N77-14272# RAND Corp Washington D C
THE POTENTIAL OF LIQUID HYDROGEN AS A MILITARY AIRCRAFT FUEL
William T Mikolowsky and Larry W Noggle Feb 1976 15 p refs
(AD-A026666, P-5577) Avail NTIS HC A02/MF A01 CSCL 21/4

Liquid hydrogen does not appear to be attractive as a military aircraft fuel for the immediate future In a wide variety of mission applications, liquid hydrogen is less cost-effective and less energy-effective than the available alternative Indications are that synthetic jet-fuel is the most attractive alternative fuel for very large airplanes At the least, this conclusion appears valid until coal reserves are substantially depleted (Even for relatively high growth rates in coal consumption domestic coal production is not likely to peak much before the second quarter of the 21st century) This conclusion is substantially strengthened when one realizes that airplanes using a conventional jet-fuel have the potential for a much greater payoff from advances in fuel-conserving aircraft technology Furthermore, these conclusions prevailed despite our favorable assumptions toward liquid hydrogen in several important instances (e g , aerial refueling) In summary there is little if any potential for liquid hydrogen as a fuel for aircraft entering the Air Force inventory between now and the end of the century GRA

N77-14319# Naval Electronics Lab Center San Diego Calif
FW-CW RANGING MULTIPATH INVESTIGATION FOR NAVY VTOL AIRCRAFT Research Report, May 1975 - Apr 1976
F E Morris S K Miyashiro and B H Humpherys 1 May 1976 45 p refs
(AD-A027190 NELC-TR-1986) Avail NTIS HC A03/MF A01 CSCL 01/5

Evaluation of the range error caused by multipath in a FM-CW range measuring system has been accomplished analytically and experimentally Tests show that the modulation index-frequency product will have to be significantly increased and the multipath signal levels suppressed by narrow-beam tracking antennas or by use of circularly polarized antennas to achieve 1-foot ranging accuracy in a severe multipath environment Circular polarization provides a significant improvement against single reflection multipath signals from metal surfaces Multipath tests show that the FM-CW equipment range accuracy is severely degraded in a strong multipath signal environment but that increasing the modulation index can provide an improvement Author (GRA)

N77-14491# Mechanical Technology, Inc , Latham N Y
ADVANCED COMPRESSOR SEAL FOR TURBINE ENGINES Final Technical Report
Anthony J Smalley and Peter R Albrecht 10 Feb 1976 103 p refs
(Contract F33615-73-C-2043 AF Proj 3066)
(AD-A026916, MTI-75-TR59 AFAPL-TR-75-66) Avail NTIS HC A06/MF A01 CSCL 21/5

This report describes a resilient seal concept entitled the J-Seal This concept uses a pressure loaded membrane and hydrostatic bearing principles to maintain a minimum rotor stator clearance over a range of axial rotor displacement Methods of analyzing this concept have been developed A design study is presented and hardware has been fabricated Manufacturing inadequacies in a key component caused proof of concept testing to be inconclusive but an adequate test rig for high-temperature testing has been constructed Author (GRA)

N77-14615*# Utah Univ , Salt Lake City Dept of Mechanical and Industrial Engineering
THE SUBJECTIVE EVALUATION OF NOISE FROM LIGHT AIRCRAFT Final Report
Kevin P Shepherd Washington NASA Dec 1976 39 p refs
(Grant NsG-1160)
(NASA-CR-2773, UTEC-ME-75-159) Avail NTIS HC A03/MF A01 CSCL 13B

A study was conducted in which subjects evaluated the sounds of a light aircraft and a motorcycle Particular emphasis was placed on examining the duration of the sounds Thirty subjects gave annoyance ratings to a total of 50 sounds, with peak levels between 65 and 85dB(A) It was found that aircraft and motorcycles have differing optimum duration corrections The conventional duration correction used in the calculation of EPNL is far from being the optimum for light aircraft Author

N77-14621# Naval Air Propulsion Test Center, Trenton, N J Propulsion Technology and Project Engineering Dept
DISCUSSION OF AIRCRAFT AIR POLLUTION LEGISLATION AND NAVAL AIRCRAFT OPERATIONS Final Report
A F Klarman and Richard J Skeba Jun 1976 26 p refs
(AD-A026176, NAPTC-PE-83) Avail NTIS HC A03/MF A01 CSCL 13/2

Information on Laws Executive Orders and Environmental Protection Agency (EPA) Regulations which could have an effect on naval air operations was surveyed and summarized Specific analysis of Naval air operations was performed in conformance with the EPA Standards for aircraft and aircraft engines and also taking into consideration differences between commercial and Naval air operations The establishment of engine emission goals to be incorporated into new engine development programs was recommended Author (GRA)

N77-14639# Bolt Beranek, and Newman Inc , Canoga Park, Calif
TEST PLAN FOR AIRCRAFT RUNUP NOISE PENALTY EVALUATION Final Report
Sanford Fidell Mar 1976 39 p refs
(Contract F33615-75-C-5044, AF Proj 7231)
(AD-A026209 BBN-2941, AMRL-TR-75-110) Avail NTIS HC A03/MF A01 CSCL 01/5

This report outlines a test plan for conducting a social survey to determine whether community response to noise from military aircraft operations differs significantly between noise from flight operations and noise from ground runup (maintenance) operations The report includes discussion of the methodology and rationale for the survey as well as sample telephone and mail questionnaires Author (GRA)

N77-14814# Boeing Computer Services, Inc , Seattle, Wash
AIRCRAFT CONFIGURATION NOISE REDUCTION VOLUME 1 ENGINEERING ANALYSIS Final Report, Aug 1974 - Jun 1976
D G Dunn, L M Butzel, A DiBlasi, L Filler, and L D Jacobs Jun 1976 411 p refs
(Contract DOT-FA74WA-3497)
(AD-A030655/5 D6-42849-1 FAA-RD-76-76-Vol-1) Avail NTIS HC A18/MF A01 CSCL 20/1

Use of wing and fuselage structures as noise barriers for shielding aircraft engine noise from the community is discussed Favorable aircraft configurations for community noise reduction of turbojet and turbofan powered aircraft are used Significant noise reduction potential is illustrated on a hypothetical engine-over-wing (EOW) configuration using high bypass ratio, turbofan engines Noise shielding estimation procedures are developed for two types of configuration noise reduction concepts i e the EOW and the engine-over-fuselage Results are described for a theoretical analysis, a major Boeing/Aeritalia test program, and an empirical analysis of test data As a result, analytical prediction procedures are defined computerized and added to software The shielding prediction procedures consider individual noise components inlet fan, compressor, exit fan core, turbine, and jet noise A new source, jet/edge interaction noise, can also be predicted using the procedures The collective software incorporating the shielding package, can be used to estimate community noise levels of wing and fuselage shielded turbofan or turbojet noise Author

N77-14815# Boeing Commercial Airplane Co , Seattle Wash
AIRCRAFT CONFIGURATION NOISE REDUCTION VOLUME 2 COMPUTER PROGRAM USER'S GUIDE AND OTHER APPENDICES Final Report, Aug 1974 - Jun 1976
D G Dunn D J Cecil L M Butzel J M Campbell H U Lu C N Berman and L Filler Jun 1976 135 p
(Contract DOT-FA74WA-3497)
(AD-A030656/3, D6-42849-2 FAA-RD-76-76-Vol-2) Avail NTIS HC A07/MF A01 CSCL 20/1

N77-14816# Boeing Commercial Airplane Co , Seattle Wash
AIRCRAFT CONFIGURATION NOISE REDUCTION VOLUME 3 COMPUTER PROGRAM SOURCE LISTING Final Report, Aug 1974 - Jun 1976
D G Dunn and D J Cecil Jun 1976 295 p 3 Vol
(Contract DOT-FA74WA-3497)
(AD-A030657/1, D6-42849-3 FAA-RD-76-76-Vol-3) Avail NTIS HC A13/MF A01 CSCL 20/1

N77-14817*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
NOISE RESPONSE OF CAVITIES OF VARYING DIMENSIONS AT SUBSONIC SPEEDS
Patricia J W Block Washington Dec 1976 36 p refs
(NASA-TN-D-8351, L-11045) Avail NTIS HC A03/MF A01 CSCL 20A

An expression for the Strouhal number of lengthwise cavity oscillations is obtained which includes the effect of length-to-depth ratio This expression which agrees well with the experimental 1975 through 6 October 1975 on a research and development program entitled, Electronically Programmable PSK SAW Devices Research under this program is directed toward the development of a state-of-the-art Surface Acoustic Wave (SAW) module for use in electronically programmable long code PSK signal correlation and encoding The program is based on the UTRC PSK Diode-Correlator a unique SAW device that utilizes nonlinear mixing phenomena in a hybrid semiconductor delay line configuration When fully developed in 64 and 128 tap modular form, the PSK Diode-Correlator module will provide advantages in maximum chip rate minimum tap dissipation, and electronic flexibility Work during this quarter has been directed toward the fabrication and testing of a programmable 64 tap PSK Diode-Correlator This prototype design has incorporated several significant modifying improvements to previous diode correlator configurations in order to minimize device insertion loss and spurious signal level The following report details the design improvements operational characteristics and experimental encoding and correlation performance of the 64 tap prototype PSK module Author (GRA)

N77-14984# Department of National Defence Ottawa (Ontario)
RESEARCH AND DEVELOPMENT IN SUPPORT OF CANADIAN MILITARY AIR REQUIREMENTS

E J Bobyn *In* AGARD 11th AGARD Ann Meeting Feb 1976 p 15-18 (For primary document see N77-14982 06-01) Avail NTIS HC A04/MF A01

The Department of National Defense in cooperation with other government departments and industry initiated V/STOL aircraft research and development The bulk of the research and development activity was directed towards sub-systems acquisition of technical knowledge human factors in man/machine interface avionics systems analysis surveillance propulsion devices, landing gear detection devices navigation aids, data processors materials, power supplies weapon modifications and other associated components Author

N77-14986# De Havilland Aircraft Co of Canada Ltd Ottawa (Ontario)
STOL DEVELOPMENTS
J P Uffen *In* AGARD 11th AGARD Ann Meeting Feb 1976 p 22-41 refs

Avail NTIS HC A04/MF A01

The characteristics of STOL aircraft which distinguish them from conventional CTOL aircraft are described Examples of the way in which STOL has evolved are given with discussion of the features of the de Havilland Dash 7 Looking to the future developments which retain the short takeoff and landing capability while extending the speed payload and range of STOL aircraft are described These have differing characteristics which permit selection of optional configurations for particular roles Author

N77-14992 Engineering Sciences Data Unit London (England)
AERODYNAMIC CENTRE OF WING-FUSELAGE COMBINATIONS
Sep 1976 17 p
(ESDU-76015, ISBN-0-85679-151-2) For information on availability of series, sub-series and other individual data items, write NTIS, Attn ESDU Springfield Va 22161 HC $242 50

Data for estimating the aerodynamic center of wing fuselage combinations to aid in aircraft stability calculations are presented ESDU

N77-14996*# Boeing Co Renton, Wash
TEST DATA REPORT LOW SPEED WIND TUNNEL TESTS OF A FULL SCALE, FIXED GEOMETRY INLET, WITH ENGINE, AT HIGH ANGLES OF ATTACK
W M Shain Nov 1976 119 p refs
(Contract NAS2-9215)
(NASA-CR-151927 T6-6094) Avail NTIS HC A06/MF A01 CSCL 01A

A full scale inlet test was to be done in the NASA-ARC 40' X 80 WT to demonstrate satisfactory inlet performance at high angles of attack The inlet was designed to match a Hamilton-Standard 55 inch, variable pitch fan driven by a Lycoming T55-L-11A gas generator The test was installed in the wind tunnel on two separate occasions but mechanical failures in the fan drive gear box early in each period terminated testing

A detailed description is included of the Model installation, instrumentation and data reduction procedures Author

N77-14999*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
TWO-DIMENSIONAL AERODYNAMIC CHARACTERISTICS OF SEVERAL ROTORCRAFT AIRFOILS AT MACH NUMBERS FROM 0 35 TO 0 90

Kevin W Noonan (Army Air Mobility Res and Develop Lab Hampton Va) and Gene J Bingham (Army Air Mobility Res and Develop Lab Hampton, Va) Jan 1977 52 p refs
(NASA-TM-X-73990) Avail NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted in the Langley 6- by 28-inch transonic tunnel and the 6- by 19-inch transonic tunnel to determine the two-dimensional aerodynamic characteristics of several rotorcraft airfoils at Mach numbers from 0 35 to 0 90

The airfoils differed in thickness, thickness distribution and camber The FX69-H-098 the BHC-540, and the NACA 0012 airfoils were investigated in the 6- by 28-inch tunnel at Reynolds numbers (based on chord) from about 4 7 to 9 3 million at the lowest and highest test Mach numbers respectively The FX69-H-098 the NLR-1 the BHC-540, and the NACA 23012 airfoils were investigated in the 6- by 19-inch tunnel at Reynolds numbers from about 0 9 to 2 2 million at the lowest and highest test Mach numbers respectively Author

N77-15004# ARO Inc Arnold Air Force Station Tenn
EXPERIMENTAL ROLL-DAMPING, MAGNUS, AND STATIC-STABILITY CHARACTERISTICS OF TWO SLENDER MISSILE CONFIGURATIONS AT HIGH ANGLES OF ATTACK (0 TO 90 DEGREES) AND MACH NUMBERS 0 2 THROUGH 2 5 Final Report, 16 Jun - 18 Sep 1975
Leroy M Jenke AEDC Jul 1976 116 p refs
(AF Proj 8219 ARO Proj V41A-A8A)
(AD-A027027 ARO-VKF-TR-76-13 AEDC-TR-76-58) Avail NTIS HC A06/MF A01 CSCL 16/4

An experimental investigation was conducted to verify that the recently developed high-alpha missile roll-damping test mechanism could be used to obtain the roll-damping characteristics of slender missile configurations and to obtain roll-damping Magnus static-stability and axial-force characteristics of a typical missile configuration The verification tests were conducted with the Basic Finner Model at Mach 0 22 and 2 50 Additional test results were obtained with a Modified Basic Finner Model for Mach number 0 6 through 2 5 GRA

N77-15005# Naval Ship Research and Development Center, Bethesda Md Aviation and Surface Effects Dept
TWO-DIMENSIONAL SUBSONIC WIND TUNNEL EVALUATION OF A 20-PERCENT-THICK CIRCULATION CONTROL AIRFOIL Final Report
Jane Abramson Jun 1975 33 p refs
(AD-A027164 DTNSRDC-ASED-331) Avail NTIS HC A03/MF A01 CSCL 20/4

A circulation control uncambered elliptic airfoil section with a thickness-to-chord ratio of 0 20 was tested subsonically to determine its aerodynamic characteristics Lift coefficients up to 5 were produced at momentum coefficients of 0 24 The initially high unblown drag coefficients, characteristic of bluff trailing edge airfoils were greatly reduced at low values of momentum coefficient It was therefore possible to produce equivalent lift-to-drag ratios in excess of 30 when Cl = 1 0 The ability to produce high lift coefficients essentially independent of angle of attack is indicated by the results of this investigation Author (GRA)

N77-15010# Stanford Research Inst Menlo Park Calif
DSTAR DIRECT SEA-TO-AIR REFUELING (INFLIGHT REFUELING OF MILITARY CARGO AIRCRAFT FROM SHIPS AT SEA)
Richard L Garwin Jun 1976 19 p refs
(Contract DAHC15-73-C-0370 ARPA Order 2504 SRI Proj 3000)

(AD-A026750, SRI-JSR-75-9) Avail NTIS HC A02/MF A01 CSCL 15/5

Preliminary analysis shows that military cargo and combat aircraft can refuel in five minutes directly from a tanker in the ocean (or a depot on land) by flying in a tight circle while connected to a refueling mast by means of a hose through which fuel is pumped The aircraft need not carry a hose cable or winch A bank angle of 45 deg a circle of radius 400 m pump pressure of 1500 psi and aircraft altitude of 120 m allow DSTAR of aircraft from 25 to 350 tons gross For a C-5A at 350 tons weight the hose tension is 20 tons for a 25-ton fighter a lighter hose is used For the smaller aircraft the hose should be faired to reduce drag GRA

N77-15015# Federal Aviation Administration Washington D C
TECHNICAL PROGRESS IN THE US DEVELOPMENT OF A MICROWAVE LANDING SYSTEM Progress Report, Jul 1971 - Jun 1974
Sep 1976 227 p
(AD-A031150/6, FAA-RD-74-187) Avail NTIS HC A11/MF A01 CSCL 17/7

Abbreviated background information on the microwave landing system development program is presented Technical progress made between July 1971 and July 1974 is reported The selection of the better technique scanning beam or Doppler and of associated signal format for prototype development is discussed Author

N77-15025 North Carolina State Univ Raleigh
PREDICTIONS OF LIGHT AIRCRAFT HORIZONTAL TAIL ONSET FLOWS A REVIEW AND ANALYSIS Ph D Thesis
Delbert Clyde Summey 1976 116 p
Avail Univ Microfilms Order No 76-28524

Analytical methods presented in the literature for the determination of onset flow in the vicinity of the horizontal tail of light aircraft are reviewed The theoretical basis of the two computer programs (WASH and WAKE) is then developed in detail WASH calculates the location of wake sheet streamlines behind the wing and upwash and downwash angles ahead of and behind the wing respectively WAKE computes two-dimensional velocity profiles along the wake streamlines given the upper and lower surface velocity profiles at the wing trailing edge Comparisons with experiment indicate good agreement for wake location downwash angles and two dimensional velocity profiles at low to moderate angles of attack Included is a discussion on the adaptation of the results of the two programs to predict the total onset flow at the tail Dissert Abstr

N77-15026*# Rockwell International Corp Los Angeles Calif Aircraft Div
INVESTIGATION OF NORMAL SHOCK INLETS FOR HIGHLY MANEUVERABLE AIRCRAFT
Arnold W Martin [1977] 321 p refs
(Contract NAS2-8955)
(NASA-CR-137970) Avail NTIS HC A14/MF A01 CSCL 01C

Concepts are investigated for obtaining both low cowl drag and good inlet performance at high angles of attack The effect of a canard on inlet performance for a kidney shaped inlet in each of two vertical locations is discussed along with a sharp lip two dimensional inlet on a canardless forebody M C F

N77-15027*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
AIRCRAFT DESIGN CONCEPT Patent Application
Frank D Neuman (Boeing Co Seattle), Gottfried O Friebel (Boeing Co, Seattle), and Armand Sigalla inventors (to NASA) (Boeing Co, Seattle) Filed 15 Nov 1976 10 p Sponsored by NASA

(NASA-Case-LAR-11852-1 US-Patent-Appl-SN-742035) Avail NTIS HC A02/MF A01 CSCL 01C

The passenger cabin in commercial aircraft is divided into forward and aft compartments allowing the wing carry-through structure to occupy space ordinarily reserved for passengers Benefits are a stronger smaller, more weight-efficient wing structure larger fuselage fineness ratio reduced weight and drag and increased fuel economy NASA

N77-15029*# General Dynamics/Convair San Diego Calif
LOW-FREQUENCY NOISE REDUCTION OF LIGHTWEIGHT AIRFRAME STRUCTURES Technical Report, Jun 1975 - Aug 1976
G L Getline Aug 1976 68 p refs
(Contract NAS1-13910)
(NASA-CR-145104 CASD-NAS-76-032) Avail NTIS HC A04/MF A01 CSCL 01C

The results of an experimental study to determine the noise attenuation characteristics of aircraft type fuselage structural panels were presented Of particular interest was noise attenuation at low frequencies below the fundamental resonances of the panels All panels were flightweight structures for transport type aircraft in the 34 050 to 45 400 kg (75 000 to 100 000 pounds) gross weight range Test data include the results of vibration and acoustic transmission loss tests on seven types of isotropic and orthotropically stiffened flat and curved panels The results show that stiffness controlled acoustically integrated structures can provide very high noise reductions at low frequencies without significantly affecting their high frequency noise reduction capabilities Author

N77-15032# Sikorsky Aircraft Stratford Conn
BONDED FIELD-REPLACEABLE ROTOR BLADE POCKET FOR THE CH-54B VOLUME 1 DESIGN STUDY Final Report
John A Longobardi Jun 1976 158 p refs 2 Vol
(Contract DAAJ02-73-C-0076
DA Proj 1F1-63204-DB-38-Vol-1)
(AD-A027206 UTRC/S64385-Vol-1 USAAMRDL-TR-75-25A)
Avail NTIS HC A08/MF A01 CSCL 01/3

The present CH-54B main rotor blade consists of 28 nonstructural trailing-edge fairings called pockets Fourteen of these pockets are different in dimension because of the taper on the blade spar The adhesive retaining the pockets to the blade is a high-temperature and -pressure system For these reasons, damaged pockets are repaired at the factory because of high inventory of pockets and sophisticated tooling for the best-curing adhesive would be needed to make a field repair possible Consequently under previous contract with the Army (Contract DAAJ02-71-C-0022) the feasibility of developing a pocket and adhesive suitable for field application was investigated The study resulted in a universal pocket design which could be utilized to replace any pocket on the CH-54B blade and an adhesive system which would cure at room temperature GRA

N77-15033# Sikorsky Aircraft Stratford Conn
BONDED FIELD-REPLACEABLE ROTOR BLADE POCKET FOR THE CH-54B VOLUME 2 INSTRUCTION MANUAL Final Report, 5 Jun 1973 - 5 May 1974
John A Longobardi Jun 1976 24 p 2 Vol
(Contract DAAJ02-73-C-0076 DA Proj 1F1-63204-DB-38)
(AD-A027280 SER-64385-Vol-2

USAAMRDL-TR-75-25B-Vol-2) Avail NTIS HC A02/MF A01 CSCL 01/3

Volume II presents the instructions for installing field-replaceable pockets on CH-54B main rotor blades It is the end result of experience gained from in-house activity and army personnel installing pockets at Sikorsky s Stratford Conn plant and in the field at fort Wainwright Alaska and Fort Eustis Va The instruction manual is part of a self-contained kit which has all the necessary components to make a field repair Volume I contains the results of pocket and adhesive development and evaluation the final pocket design and adhesive were successfully proof load fatigue whirl and flight tested Author (GRA)

N77-15034# Advisory Group for Aerospace Research and Development Paris (France)

NONLINEAR EFFECTS IN AIRCRAFT GROUND AND FLIGHT VIBRATION TESTS

G Haidl (Messerschmitt-Boelkow-Blohm G m b H Munich) Dec 1976 21 p refs Presented at 43d Struct and Mater Panel Meeting London Sep 1976

(AGARD-R-652 ISBN-92-835-1231-7) Avail NTIS HC A02/MF A01

Examples of non-linear vibration behavior in ground resonance tests of an aircraft are shown Model tests for a simplified system with non-linear properties have been performed to study the effects of friction and backlash with respect to ground resonance test and flight flutter test With symmetric and asymmetric non-linear stiffness characteristics effects of amplitude dependent frequencies mode coupling, mode asymmetries and the consequences in parameter identification in vibration tests are pointed out and discussed In case of flutter critical modes the problems of apparent damping caused by non-linear system properties are shown and recommendations are given to reach a representative flutter clearance with respect to this non-linear system behavior Author

N77-15036*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

APPARATUS AND METHOD FOR JET NOISE SUPPRESSION Patent Application

Lucio Mestrello inventor (to NASA) Filed 23 Dec 1976 17 p

(NASA-Case-LAR-11903-1 US-Patent-Appl-SN-753971) Avail NTIS HC A02/MF A01 CSCL 20A

A method and apparatus are described for jet noise suppression through control of the static pressure of the jet and control of the rate of entrainment of ambient fluid into the jet downstream of the exhaust nozzle The momentum flux is regulated over an extended region of the jet affecting Reynolds stresses in the jet and the spreading angle of the jet Static pressure is controlled through a long hollow porous nozzle plug centerbody which may be selectively vented to ambient conditions connected to a vacuum source or supplied with fluids of various densities for injection into the stream Additionally sound in the jet may be channeled along the nozzle plug centerbody by injecting coolant such as a cryogenic fluid through the centerbody into the jet NASA

N77-15037*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECT OF CERAMIC COATING OF JT8D COMBUSTOR LINER ON MAXIMUM LINER TEMPERATURES AND OTHER COMBUSTOR PERFORMANCE PARAMETERS

Helmut F Butze and Curt H Liebert Dec 1976 24 p refs (NASA-TM-X-73581 E-9043) Avail NTIS HC A02/MF A01 CSCL 21E

The effect of ceramic coating of a JT8D combustor liner was investigated at simulated cruise and takeoff conditions with two fuels of widely different aromatic contents Substantial decreases in maximum liner temperatures and flame radiation values were obtained with the ceramic-coated liner Small reductions in exhaust gas smoke concentrations were observed with the ceramic-coated liner Other performance parameters such as combustion efficiency and emissions of unburned hydrocarbons CO and NOx were not affected significantly No deterioration of the ceramic coating was observed after about 6 hours of cyclic operation including several startups and shutdowns Author

N77-15038*# Teledyne Continental Motors Mobile Ala Aircraft Products Div

SCREENING ANALYSIS AND SELECTION OF EMISSION REDUCTION CONCEPTS FOR INTERMITTENT COMBUSTION AIRCRAFT ENGINES

B J Rezy J E Meyers J R Tucker and S J Stuckas Nov 1976 202 p refs

(Contract NAS3-19755)

(NASA-CR-135074 TCM-5206) Avail NTIS HC A10/MF A01 CSCL 21A

An analysis was conducted to screen evaluate and select three engine exhaust emission reduction concepts from a group of 14 candidate alternatives A comprehensive literature search was conducted to survey the emission reduction technology state-of-the-art and establish contact with firms working on intermittent combustion engine development and pollution reduction problems Concept development advantages disadvantages and expected emission reduction responses are stated A set of cost effectiveness criteria was developed appraised for relative importance and traded off against each concept so that its merit could be determined A decision model was used to aid the evaluators in managing the criteria making consistent judgements calculating merit scores and ranking the concepts An Improved Fuel Injection System Improved Cooling Combustion Chamber and a Variable Timing Ignition System were recommended to NASA for approval and further concept development An alternate concept Air Injection was also recommended Author

N77-15039*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

A REVIEW OF SEVERAL PROPULSION INTEGRATION FEATURES APPLICABLE TO SUPERSONIC-CRUISE FIGHTER AIRCRAFT

Bobby L Berrier Dec 1976 58 p refs

(NASA-TM-X-73991) Avail NTIS HC A04/MF A01 CSCL 21E

A brief review has been made of the propulsion integration features which may impact the design of a supersonic cruise fighter type aircraft The data used for this study were obtained from several investigations conducted in the Langley 16-foot transonic and 4 by 4 foot supersonic pressure wind tunnels Results of this study show (1) that for conventional nozzle installations contradictory design guidelines exist between subsonic and supersonic flight condition (2) that substantial drag penalties can be incurred by use of dry power nozzles during supersonic cruise and (3) that a new and unique concept the subsonic transport turbofans is described herein A number of unconventional engine concepts were identified and parametrically studied to determine their relative fuel-saving potential Based on results from these studies, regenerative geared and variable-boost turbofans and combinations thereof were selected along with advanced turboprop cycles for further evaluation and refinement Preliminary aerodynamic and mechanical designs of these unconventional engine configurations were conducted and mission performance was compared to a conventional direct-drive turofan reference engine Consideration is given to the unconventional concepts and their state of readiness for application Areas of needed technology advancement are identified Author

N77-15040# Bolt Beranek and Newman Inc Canoga Park Calif
NOISE REDUCTION FOR BUSINESS AIRCRAFT Final Report
William J Galloway John F Wilby Colin G Gordon and John F Mills Oct 1976 228 p refs
(Contract DOT-FA75WA-3668)
(AD-A031149/8 BBN-3284 FAA-RD-76-125) Avail NTIS HC A11/MF A01 CSCL 01/3

The noise reduction potential is analyzed for the business jet aircraft fleet registered in the United States as of 1975 Noise characteristics of each aircraft are defined at various thrust levels and noise reductions achievable for different design options are determined Costs and performance penalties are assessed for each option in order to evaluate the consequences of lowering present FAR 36 Appendix C noise levels The exhaust noise of all engines can be reduced significantly with multi-element nozzles The addition of a lined ejector provides little additional noise reduction at greatly increased weight and performance penalties Acoustic liners in exhaust ducts reduce fan or core noise for some engines but inlet liners have little value To assess noise reductions a single number criterion is proposed based on the effective perceived noise level contour that circumscribes a two square-mile area It is recommended that takeoff noise be measured at 2 5 nautical miles from brake release Author

N77-15041*# Pratt and Whitney Aircraft East Hartford Conn Commercial Products Div
ADVANCED SUPERSONIC PROPULSION STUDY, PHASE 3 Final Report
R A Howlett J Johnson J Sabatella and T Sewall Dec 1976 158 p refs
(Contract NAS3-19540)
(NASA-CR-135148 PWA-5461) Avail NTIS HC A08/MF A01 CSCL 21E

The variable stream control engine is determined to be the most promising propulsion system concept for advanced supersonic cruise aircraft This concept uses variable geometry components and a unique throttle schedule for independent control of two flow streams to provide low jet noise at takeoff and high performance at both subsonic and supersonic cruise The advanced technology offers a 25% improvement in airplane range and an 8 decible reduction in takeoff noise relative to first generation supersonic turbojet engines Author

N77-15043*# General Electric Co Cincinnati Ohio Aircraft Engine Group
STUDY OF UNCONVENTIONAL AIRCRAFT ENGINES DESIGNED FOR LOW ENERGY CONSUMPTION
R E Neitzel R Hirschkron, and R P Johnston Dec 1976 165 p refs
(Contract NAS3-19519)
(NASA-CR-135136 R76AEG597) Avail NTIS HC A08/MF A01 CSCL 21E

A study of unconventional engine cycle concepts which may offer significantly lower energy consumption than conventional subsonic transport turbofans, is described herein A number of unconventional engine concepts were identified and parametrically studied to determine their relative fuel-saving potential Based on results from these studies regenerative geared and variable-boost turbofans, and combinations thereof were selected along with advanced turboprop cycles for further evaluation and refinement Preliminary aerodynamic and mechanical designs of these unconventional engine configurations were conducted and mission performance was compared to a conventional direct-drive turofan reference engine Consideration is given to the unconventional concepts and their state of readiness for application Areas of needed technology advancement are identified Author

N77-15044*# Pratt and Whitney Aircraft East Hartford Conn
ANALYSIS AND DESIGN OF DIGITAL OUTPUT INTERFACE DEVICES FOR GAS TURBINE ELECTRONIC CONTROLS Final Report
D M Newirth and E W Koenig Dec 1976 66 p
(Contract NAS3-19898)
(NASA-CR-135135 PWA-5471) Avail NTIS HC A04/MF A01 CSCL 21E

A trade study was performed on twenty-one digital output interface schemes for gas turbine electronic controls to select the most promising scheme based on criteria of reliability performance cost and sampling requirements The most promising scheme a digital effector with optical feedback of the fuel metering valve position was designed Author

N77-15045*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THERMAL DESIGN AND ANALYSIS OF A HYDROGEN-BURNING WIND TUNNEL MODEL OF AN AIRFRAME-INTEGRATED SCRAMJET
Robert W Guy J N Mueller S Z Pinckney and L P Lee [1976] 83 p refs
(NASA-TM-X-73931) Avail NTIS HC A05/MF A01 CSCL 21A

An aerodynamic model of a hydrogen burning airframe integrated scramjet engine has been designed fabricated and instrumented This model is to be tested in an electric arc heated wind tunnel at an altitude of 35 39 km (116 094 ft) but with an inlet Mach number of 6 simulating precompression on an aircraft undersurface The scramjet model is constructed from oxygen free high conductivity copper and is a heat sink design except for water cooling in some critical locations The model is instrumented for pressure surface temperature, heat transfer rate and thrust measurements Calculated flow properties heat transfer rates and surface temperature distributions along the various engine components are included for the conditions stated above For some components estimates of thermal strain are presented which indicate significant reductions in plastic strain by selective cooling of the model These results show that the 100 thermal cycle life of the engine was met with minimum distortion while staying within the 2669 N (600 lbf) engine weight limitation and while cooling the engine only in critical locations Author

N77-15046# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
MINI RPV ENGINE NOISE REDUCTION Final Report, May 1974 - Aug 1975
Ralph M Shimovetz and Davey L Smith Mar 1976 97 p refs
(ARPA Order 2707 AF Proj 2707)
(AD-A027638 AFFDL-TR-76-28) Avail NTIS HC A05/MF A01 CSCL 20/1

The purpose of this effort was to investigate the reduction in radiated acoustic noise associated with two types of engines considered for power plants in small (75-100 lb) remotely piloted vehicles (Mini RPV) in the class of the Praeire and Calere Aircraft The two engines considered are approximately 5 HP the first a rotary combustion (RC) the second a two stroke cycle reciprocating (P) The sound pressure levels were recorded using a semicircle arrangement of microphones in a free field and with various engine noise reduction devices installed The engines were rotated such that a spherical definition of the acoustic pressures were made From these data the sound power levels and directional characteristics were determined Aural detection analyses are performed for the most desirable noise reduction cases The computed aural detection altitudes and the most significant sources of noise were defined Author (GRA)

N77-15048 Cincinnati Univ Ohio
OPTIMAL INPUT DESIGN FOR PARAMETER IDENTIFICATION OF DYNAMIC SYSTEMS Ph D Thesis
Subrahmanyam Ramachandran 1976 124 p
Avail Univ Microfilms Order No 76-27422

Nonlinear multi-input multi-output multi-parameter systems are considered The design criterion is that the optimal input should minimize statistical correlations between parameters The performance index for the control design is taken as a linear weighted sum of the squares of the correlation coefficients of the aerodynamic stability and control derivatives as computed from the Cramer-Rao lower bound matrix The optimal control is bang-bang when the system is linear in control and amplitude constraint is imposed on the input Optimal aileron and rudder inputs are designed for an F-8 aircraft with super-critical wing Reducing the correlation results in improved estimates and confidence levels Flight tests for parameter identification are designed for a light aircraft using optimal inputs Simulations are carried out using the optimal inputs and lateral derivatives are extracted from flight data Dissert Abstr

N77-15049*# Stanford Univ Calif Dept of Aeronautics and Astronautics
CONTROL METHODS FOR AIDING A PILOT DURING STOL ENGINE FAILURE TRANSIENTS
Ernest R Nelson and Daniel B DeBra Dec 1976 177 p refs
(Grant NsG-2100)
(NASA-CR-149280) Avail NTIS HC A09/MF A01 CSCL 01C

Candidate autopilot control laws that control the engine failure transient sink rates by demonstrating the engineering application of modern state variable control theory were defined The results of approximate modal analysis were compared to those derived from full state analyses provided from computer design solutions The aircraft was described and a state variable model of its longitudinal dynamic motion due to engine and control variations was defined The classical fast and slow modes were assumed to be sufficiently different to define reduced order approximations of the aircraft motion amendable to hand analysis control definition methods The original state equations of motion were also applied to a large scale state variable control design program in particular OPTSYS The resulting control laws were compared with respect to their relative responses ease of application and meeting the desired performance objectives Author

N77-15083*# Chrysler Corp New Orleans La Space Div
MATED AERODYNAMIC CHARACTERISTICS INVESTIGATION FOR THE 0 04 SCALE MODEL TE 1065 (BOEING 747-100) OF THE 747 CAM AND THE 0 0405 SCALE MODEL (43-0) OF THE SPACE SHUTTLE ORBITER IN THE NASA LANGLEY V/STOL TRANSITION RESEARCH WIND TUNNEL (CA8), VOLUME 3
Oct 1976 782 p refs 3 Vol
(Contract NAS9-13247)
(NASA-CR-147643, DMS-DR-2290-Vol-3) Avail NTIS HC A99/MF A01 CSCL 01A

Aerodynamic force data are presented in tables and graphs for the NASA Langley V/STOL Transition Research Wind Tunnel tests on a 0 04 scale model of the 747 with a 0 0405 scale Orbiter space shuttle The investigation included the effects of flap setting stabilizer angle, elevator angle ground proximity and Orbiter tailcone fairing Data were obtained in the pitch plane only The test was run at M = 0 15, with a dynamic pressure of 35 psf Six static pressures were measured on each side of the 747 CAM nose to determine the effects of the Orbiter on the 747 airspeed and altitude indicators Author

N77-15101*# TRW Inc Cleveland Ohio
PMR POLYIMIDE/GRAPHITE FIBER COMPOSITE FAN BLADES
P J Cavano and W E Winters 15 Dec 1976 98 p refs
(Contract NAS3-18939)
(NASA-CR-135113 ER-7821F) Avail NTIS HC A05/MF A01 CSCL 11D

Ultrahigh speed fan blades designed in accordance with the requirements of an ultrahigh tip speed blade axial flow compressor were fabricated from a high strength graphite fiber tow and a PMR polyimide resin The PMR matrix was prepared by combining three monomeric reactants in methyl alcohol and the solution was applied directly to the reinforcing fiber for subsequent in situ polymerization Some of the molded blades were completely finished by secondary bonding of root pressure pads and an electroformed nickel leading edge sheath prior to final machining The results of the spin testing of nine PMR fan blades are given Prior to blade fabrication, heat resin tensile properties of the PMR resin were examined at four formulated molecular weight levels Additionally three formulated molecular weight levels were investigated in composite form with both a high modulus and a high strength fiber both as-molded and postcured in room temperature and 232 C transverse tensile flexure and short beam shear Mixed fiber orientation panels simulating potential blade constructions were also evaluated Flexure tests short beam shear tests and tensile tests were conducted on these angle-plied laminates Author

N77-15153# Air Force Materials Lab Wright-Patterson AFB Ohio
TRENDS IN THE APPLICATION OF ADVANCED POWDER METALLURGY IN THE AEROSPACE INDUSTRY
G P Peterson *In* AGARD Advan Fabric Tech in Powder Met and Their Econ Implications Nov 1976 9 p

Avail NTIS HC A11/MF A01

A variety of jet propulsion and airframe components were examined in terms of cost factors It is shown that the dominant factor in increasing costs is metal removal or machining Powder metallurgy is proposed as a means of reducing the costs of machining engine and aircraft components Hot isostatic pressing rotating electrode process, press and sinter, and extrusion are among the processes discussed J M S

N77-15176# Grumman Aerospace Corp Bethpage N Y Advanced Materials and Processes Development
NEAR-NET POWDER METALLURGY AIRFRAME STRUCTURES
R H Witt *In* AGARD Advan Fabric Tech in Powder Met and Their Econ Implications Nov 1976 8 p refs

Avail NTIS HC A11/MF A01

The use of powder metallurgy for the reduction or minimization of the acquisition cost of titanium alloy airframe parts is discussed

The results of studies regarding the following processes are presented (1) cold isostatic pressing and sintering to produce high density preforms for subsequent hot forging to full-density near-net shapes (2) hot pressing of shapes and (3) hot isostatic pressing to full-density near-net shapes in a one-step operation The primary titanium alloys investigated were Ti-6Al-4V and Ti-6Al-6V-2Sn Advantages disadvantages technological and economic considerations are summarized for each approach and potential future airframe applications are presented Author

N77-15202# Monsanto Research Corp St Louis Mo
DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F, PART 2 Final Report, 1 Oct 1974 - 22 Sep 1975
F S Clark J F Herber and S L Reid Dec 1975 46 p refs
(Contract F33615-73-C-5079 AF Proj 7343)
(AD-A027068 MRC-SL-538-Pt-2 AFML-TR-74-247-Pt-2) Avail NTIS HC A03/MF A01 CSCL 11/8

This contract involved advanced characterization of three MIL-L-27502 lubricants These were ester blends designated MCS 1710 MCS 1709 and Fluid 12 Oxidation-corrosion and storage life tests were run on all fluids Mil-L-27502 bearing tests were run on MCS 1710 and MCS 1709, each gave very good results Moreover, both of these blends have satisfactory Ryder loads Two hundred gallons of MCS 1710 plus a metal deactivator were blended and sent to AFML for further evaluation The deactivator was added to reduce magnesium corrosion of MCS 1710 Author (GRA)

N77-15212# Committee on Aeronautical and Space Sciences (U S Senate)
ALTERNATIVE FUELS FOR AVIATION
Washington GPO 1976 187 p refs Hearings before Subcomm on Aerospace Technol and Natl Needs of Comm on Aeronaut and Space Sci , 94th Congr , 2d Sess , 27-28 Sep 1976
(GPO-78-544) Avail SOD HC $1 90

Research and progress in the development of alternative fuels for aviation are discussed The impact of using nonoptimum synthetic hydrocarbon based fuels on aeronautical structures and the cost of commercial airfares is explored A H

N77-15214# Monsanto Research Corp Dayton, Ohio Dayton Lab
ENVIRONMENTAL DEGRADATION OF FUELS, FLUIDS AND RELATED MATERIALS FOR AIRCRAFT Final Report, 1 Dec 1973 - 31 Jan 1976
F Neil Hodgson and A M Kemmer Mar 1976 123 p refs
(Contract F33615-74-C-2002 AF Proj 3048)
(AD-A026908 MRC-DA-539 AFAPL-TR-76-26) Avail NTIS HC A06/MF A01 CSCL 21/4

Investigations of the composition and properties of a number of hydrocarbon fuels are described Fuel analyses for hydrocarbon types, trace metals content, trace organic contaminants and elemental composition are presented Studies of the fluorescence spectral properties of aircraft exhaust emissions are described as is an investigation of the feasibility of using fluorometric measurements on fuels to supplement coker thermal stability data An investigation of the experimental parameters of the hot manifold flammability test is discussed along with test results for various hydraulic fluids Components recovered from aircraft crash sites have been examined to determine factors contributing to aircraft failure Studies supporting Air Force programs for the formulation and specification development of high density fuels are presented Author (GRA)

N77-15223 Ohio Univ , Athens
A STUDY OF DIFFRACTION OF ELECTROMAGNETIC WAVES AROUND LARGE STATIONARY AIRCRAFT AND ITS EFFECTS ON INSTRUMENT LANDING SYSTEM GUIDANCE SIGNALS Ph D Thesis
Robert Adrian Rondini 1976 208 p
Avail Univ Microfilms Order No 76-27257

The basic scattering theory upon which the theoretical model was based is the vector extension of Kirchoff s diffraction integral for scalar fields As applied to the problem of scattering of electromagnetic waves by a large aircraft, the solution of the resultant diffraction integral required that a number of simplifying assumptions be made in order to arrive at a numerical result Mathematical justifications for using the simplifying assumptions were also presented Dissert Abstr

N77-15241# Facility Checking Squadron (1868th) (AFCS) APO New York 09332
RADAR SPECIAL EVALUATION REPORT DEGRADATION OF AN/UPX-6 INTERROGATOR SET IDENTIFICATION FRIEND OR FOE/SELECTIVE IDENTIFICATION FEATURE IFF/SIF RETURNS FROM F-4 AND RF-4 AIRCRAFT
Roy A Parker 13 May 1976 51 p
(AD-A027417 Rept-75/68S-17) Avail NTIS HC A04/MF A01 CSCL 17/9

This report concerns the degraded identification friend or foe/selective identification feature (IFF/SIF) returns received from F-4 and RF-4 aircraft by radar facilities using the AN/UPX-6 interrogator set The specific system investigated was an AN/MPN-13 mobile ground control approach facility The primary cause of the degradation was that the alignment of the KY-532B/ASQ airborne transponders in the subject aircraft was not compatible with the interrogation pulses transmitted by the AN/UPX-6 Author (GRA)

N77-15247# Ohio State Univ Columbus ElectroScience Lab
MEASUREMENT OF THE POWER HANDLING CAPABILITIES OF A BIPLANAR SLOT ARRAY Technical Report, Mar 1973 - Dec 1975
C J Larson Jun 1976 14 p refs
(Contract F33615-73-C-1173 AF Proj 7633)
(AD-A027500, ESL-3622-9 AFAL-TR-76-58) Avail NTIS HC A02/MF A01 CSCL 17/9

The subject of this report is the measurement of the power handling capability of a biplanar metallic radome The radome which is a double layer of slot arrays is simulated by placing a small piece of the radome in a waveguide and using the images t9 simulate an infinite array The power handling capability is determined by raising the incident power in the waveguide until the piece of radome breaks down The incident breakdown power can be simply related to the breakdown power density of the array in free space Biplanar radome surfaces able to handle power densities in excess of 4 megawatt sq m are demonstrated The knowledge of the breakdown power density of the radome will aid the Air Force in designing airborne radar systems Author (GRA)

N77-15250# Science Applications Inc Berkeley, Calif
INTERNAL INTERACTION ANALYSIS TOPOLOGICAL CONCEPTS AND NEEDED MODEL IMPROVEMENTS Final Report
F M Tesche M A Morgan, B H Fishbine and E R Parkinson Kirtland AFB N Mex AFWL May 1976 35 p refs
(Contract F29601-75-C-0012 AF Proj 1209)
(AD-A027047, AFWL-TR-75-282) Avail NTIS HC A03/MF A01 CSCL 18/6

This report introduces and formalizes various topological concepts for defining internal interaction problems A preliminary examination of presently-used internal interaction models is made, and indications of possible improvements are given Finally a brief discussion of possible statistical approaches to the internal interaction problem is presented Author (GRA)

N77-15253# Ohio State Univ Columbus
CURRENTS INDUCED ON METAL/DIELECTRIC STRUCTURES FOR TRANSVERSE MAGNETIC PLANE WAVE INCIDENCE Final Report
Yeongming Hwang and W D Burnside Apr 1976 34 p refs
(Contract F29601-74-C-0010, AF Proj 3763)
(AD-A026896, AFWL-TR-75-116) Avail NTIS HC A03/MF A01 CSCL 20/3

The induced surface current density on a two-dimensional air foil type wing by a Transverse Magnetic wave is studied in this report The reaction concept is employed to formulate an integral equation for the structure The surface current density is expanded with subsectional bases The dielectric body is modeled with polarization current which is then expanded in terms of subarea bases By enforcing reaction tests with an array of electric test sources which are the same as the expansion bases (Galerkin s method) the moment method is employed to reduce the integral equation to a system of simultaneous linear equations Inversion of the matrix equation yields the current distribution GRA

N77-15274# Army Communications Command Fort Huachuca Ariz
STANDARD ENGINEERING INSTALLATION PACKAGE US ARMY AIRFIELD/HELIPORT AIR/GROUND COMMUNICATIONS
28 May 1976 394 p
(AD-A026913 ACC-SEIP-010-C-1) Avail NTIS HC A17/MF A01 CSCL 17/2

The U S Army Communications-Electronics Engineering Installation Agency (USACEEIA) is responsible for engineering

and installing Communications-Electronics (C-E) equipment for the upgrade of Air Traffic Control (ATC) and Navigational and Landing Aids (NAVAIDS) at existing U S Army Airfields and Heliports (AAF/AHP) worldwide The purpose of this Standard Engineering Installation Package (SEIP) is to guide all activities in the selection acquisition and installation of air/ground communications equipment for AAF/AHP GRA

N77-15299# General Electric Co Binghamton N Y Aerospace Controls and Electrical Systems Dept

THE 150 KVA SAMARIUM COBALT VSCF STARTER GENERATOR ELECTRICAL SYSTEM, PHASE 1 Final Report, 1 Jun 1974 - 29 Mar 1976

Lee J Bailey Lawrence W Messenger David L Lafuze and Charles F Triebel Mar 1976 227 p

(Contract F33615-74-C-2037 AF Proj 3145)

(AD-A026518 ACS-1109 AFAPL-TR-76-8) Avail NTIS HC A05/MF A01 CSCL 10/2

Development and construction of a solid rotor using rare earth samarium cobalt magnets for a 150 KVA Variable Speed Constant Frequency Starter/Generator electrical system is described The system consists of the solid rotor 14-pole starter/generator which, in the generate mode is driven at 12,000 to 21 000 RPM and a cycloconverter which converts the 9-phase variable frequency power from the generator to a high quality 3-phase 400 Hz 150 KVA power source In the start mode, the cycloconverter converts 3-phase 400 Hz power to a 9-phase variable frequency variable voltage which is used to power the starter/generator as a synchronous motor GRA

N77-15410# Southwest Research Inst San Antonio, Tex

LUBRICANT/METALLURGY INTERACTION EFFECTS ON TURBINE ENGINE LUBRICANT LOAD RATING Final Report, 1 Mar 1973 - 1 Mar 1976

P M Ku, H E Staph H J Carper and E L Anderson 1 Mar 1976 229 p refs

(Contract F33615-73-C-2027 AF Proj 3048)

(AD-A026208 SwRI-RS-638 AFAPL-TR-76-27) Avail NTIS HC A11/MF A01 CSCL 21/5

This investigation has as its objective the development of an improved methodology for aircraft power spur gear design, with primary emphasis on gear-tooth scuffing (scoring) and secondary emphasis on gear-tooth pitting (surface fatigue) Toward this end mathematical models are proposed for scuffing and pitting as well as for another relevant but less important failure mode rubbing wear Basic data for the scuffing and pitting models were derived from sliding-rolling disk tests using the AFAPL disk tester Gear scuffing and pitting tests were also performed, using two WADD gear machines to evaluate the validity of the two models The scuffing model was found to yield scuff-limited gear power-transmitting capacities to about five percent of the actual However the several correlating factors employed in the model require independent confirmation and rationalization The pitting model was found to yield gear pitting lives about ten times the actual due principally to the weak statistical base of the quantitative data available and also a lack of basic understanding of the pitting process in gears The wear model which is not within the scope of this investigation was not tested The investigation has revealed many areas where basic understanding or quantitative data are still inadequate Recommendations for additional research are presented Author (GRA)

N77-15579# Federal Aviation Administration, Washington D C

COLLOCATED FLIGHT SERVICE STATION/AIR ROUTE TRAFFIC CONTROL CENTER AVIATION WEATHER UNIT, TASK 1 Final Report

L J Wuebker E Spring E Mandel J Langston (Kansas City Flight Service Station) and F Blake (Mitre Corp , Washington, D C) Jul 1976 74 p

(AD-A031099/5) Avail NTIS HC A04/MF A01 CSCL 04/2

A comprehensive study and analysis was performed to determine optimum weather and aeronautical data collection, forecasting and dissemination methodologies for a collocated Flight Service Station and Air Route Traffic Control Center environment Special emphasis was placed on a centralized weather unit that would improve weather services to all facets of the aviation community as a result of collocating a Flight Service Station with an Air Route Traffic Control Center Author

N77-15790*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

OPTIMAL ONE-SECTION AND TWO-SECTION CIRCULAR SOUND-ABSORBING DUCT LINERS FOR PLANE-WAVE AND MONOPOLE SOURCES WITHOUT FLOW

Harold C Lester and Joe W Posey Washington Dec 1976 53 p refs

(NASA-TN-D-8348 L-11039) Avail NTIS HC A04/MF A01 CSCL 20A

A discrete frequency study is made of the influence of source characteristics on the optimal properties of acoustically lined uniform and two section ducts Two simplified sources a plane wave and a monopole are considered in some detail and over a greater frequency range than has been previously studied Source and termination impedance effects are given limited examination An example of a turbomachinery source and three associated source variants is also presented Optimal liner designs based on modal theory approach the Cremer criterion at low frequencies and the geometric acoustics limit at high frequencies Over an intermediate frequency range optimal two section liners produced higher transmission losses than did the uniform configurations Source distribution effects were found to have a significant effect on optimal liner design but source and termination impedance effects appear to be relatively unimportant Author

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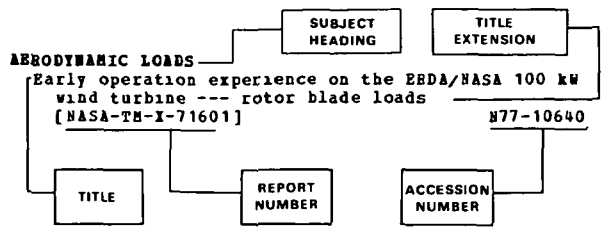

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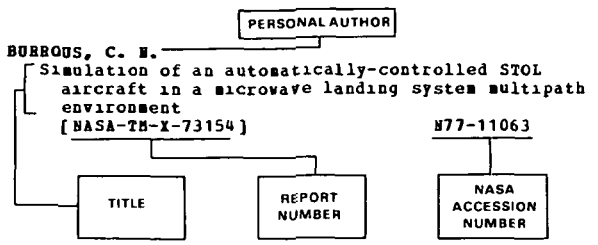

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